



**DIRECTORATE FOR ROADS OF VIETNAM (DRVN)  
MINISTRY OF TRANSPORT (MOT)  
THE SOCIALIST REPUBLIC OF VIETNAM  
JAPAN INTERNATIONAL COOPERATION AGENCY**



# **THE PROJECT FOR CAPACITY ENHANCEMENT IN ROAD MAINTENANCE PHASE II**

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## ABBREVIATION

AADT	: Annual Average Daily Traffic
ADB	: Asian Development Bank
C/P	: Counterpart
CS	: Conversion Software
CV	: Curriculum Vitae (Bridge)
DAS	: Data Analysis System
DB	: Database
DOT	: Department of Transport
DRVN	: Directorate for Roads of Vietnam
FWD	: Falling Weight Deflectometer
HDM-4	: Highway Development & Management Module 4
IRI	: International Roughness Index
ISDP	: Implementation of Sector Development Policy
ITST	: Institute of Transport Science and Technology
JCC	: Joint Coordination Committee
JCTC	: Japan Construction Training Centre
JICA	: Japan International Cooperation Agency (Japan)
JRA	: Japan Road Association
LCC	: Life Cycle Cost
MH	: Maintenance History
MLIT	: Ministry of Land, Infrastructure, Transportation and Tourism (Japan)
MOC	: Ministry of Construction
MOET	: Ministry of Education and Training
MOF	: Ministry of Finance
MOT	: Ministry of Transport
MPI	: Ministry of Planning and Investment
MS	: Microsoft
NEXCO	: Nippon Expressway Company Limited (Japan)
NILIM	: National Institute for Land and Infrastructure Management
NTSS	: Northern Transport Secondary School
ODA	: Official Development Assistance
OJT	: On the Job Training
PBC	: Performance Based Contract
PC	: Pavement Condition
PDM	: Project Design Matrix
PDOT	: Provincial Level Department of Transport
PMS	: Pavement Management System
PMoS	: Pavement Monitoring System
PMU	: Project Management Unit
PMU TA	: Project Management Unit Technical Assistance
PPC	: Provincial People's Committees
PRRMC	: Provincial Road Repair and Maintenance Company
PTISRS	: Project on Transportation Information System for Road Sector
PWRI	: Public Works Research Institute (JAPAN)
QL	: National Road (Vietnam)
RA	: Road Asset
RB	: Road Bureau
RCMC	: Road Construction/ Maintenance Company
R & D	: Research and Development
RDB	: Road Development Bureau
REC	: Road Engineering Center
RI	: Road Inventory
RIMS	: Road Infrastructure Management System

RMU	:	Road Management Unit
RNIP	:	Road Network Improvement Project
RoSy BASE	:	Database program, part of the RoSy PMS RIMS program suite
ROW	:	Right of Way
RMB	:	Regional Management Bureau
RRMC	:	Road Repair and Maintenance Company
RRMU	:	Regional Road Management Unit
RTC	:	Road Technical Centre
SB	:	Sub Bureau
SAPI	:	Special Assistance for Project Implementation for Transport Sector Loan for National Road Network Improvement
SCIC	:	State Capital Investment Corporation
SOE	:	State Owned Enterprises
ST	:	Station
TV	:	Traffic Volume
TWG	:	Technical Working Group
UTC	:	University of Transport and Communication
UTT	:	University of Transport Technology
VBA	:	Visual Basic Application
VBMS	:	Vietnam Bridge Management System
VEC	:	Vietnam Expressway Company
VFCEA	:	Vietnam Federation of Civil Engineer's Association
VIBRA	:	Vietnam Bridge and Road Association
VPMS	:	Vietnam Pavement Management System
VRA	:	Vietnam Road Administration
VRAMP	:	Vietnam Road Asset Management Project
VTRANSS	:	Vietnam Transport Sector Study
WB	:	World Bank
WG	:	Working Group

## **CHAPTER 1 OUTLINE OF PROJECT**

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### **1.1 BACKGROUND**

Road Asset Management is a systematic process of effectively maintaining, upgrading and operating assets, combining engineering principles with sound business practice and economic rationale, and providing the tools to facilitate a more organized and flexible approach to making decisions necessary to achieve the public's expectations.

Japan International Cooperation Agency (hereinafter referred to as JICA) conducted a technical assistance project on capacity enhancement in road maintenance (hereinafter referred to as JICA Phase I Project), from July 2011 to March 2014 in Directorate for Roads of Viet Nam (hereinafter referred to as DRVN) with RMB I as a pilot area, aiming to improve management capacity of Plan-Do-Check-Action (PDCA) cycle for road maintenance including road information management system (i.e. development of road database), pavement maintenance budget planning (i.e. development of PMS and pavement maintenance budget planning), road facility inspection and repair technology, road maintenance administrative procedure and intuition and training programs. In order to upgrade output of JICA Phase I Project to make them applicable to nationwide national road network, support legalization of outputs as DRVN institution, and implement some pilot repair works on new road maintenance technology, JICA and DRVN is now implementing a technical cooperation for “the Project for Capacity Enhancement in Road Maintenance Phase II” (hereinafter referred to as the Project) since February 2015.

### **1.2 POLICY OF JICA TECHNICAL COOPERATION PROJECT**

This JICA Project is a collaboration project where both parties, JICA and DRVN, work together to develop project outputs, focusing more on the processes of the development and technology transfer during project implementation rather than simply producing project outputs. With this nature, DRVN is kindly requested to take an initiative for the implementation of this project and actively participate in the Project.

### **1.3 PROJECT PURPOSE**

The Project aims to enhance capacity of national road maintenance for DRVN and its subsidiary organizations through applying the JICA Phase I Project outputs, which was implemented under the RMB I jurisdiction as a pilot area, into the rest of the country (RMB II, III and IV jurisdiction), transferring technology at the same time.

### **1.4 PROJECT TERM**

February 2015 – April 2018 (39 months)

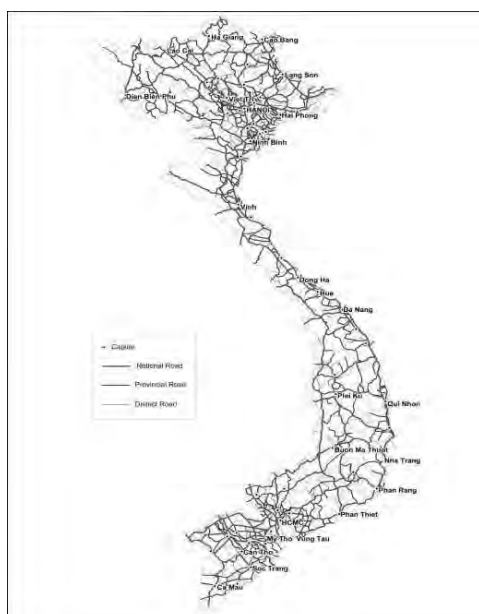


## 1.5 PROJECT TARGET AREA

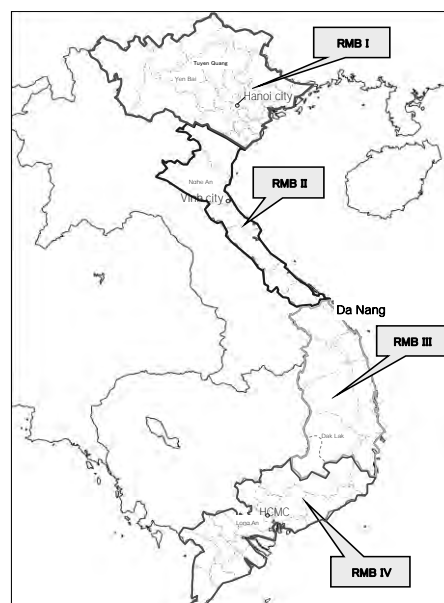
Target areas of the Project are the jurisdiction of RMB I, II, III and IV which manage national roads (9,767 km, as of December, 2014<sup>1</sup>). **Figure 1.6.1** and **Figure 1.6.2** show the national road network and jurisdiction of RMBs respectively.

## 1.6 COUNTERPARTS OF THE PROJECT

Project implementing agencies of Vietnamese side are relevant departments of DRVN, RMBs (I, II, III and IV), and Sub bureaus. Counterparts are relevant officials and staff of the above mentioned agencies.



**Figure 1.6.1 National Road Network**



**Figure 1.6.2 RMB Jurisdiction**

Source: Project for Capacity Enhancement in Road Maintenance, Project Completion report, 2014, JICA

## 1.7 SCOPE OF WORK AND EXPECTED OUTPUTS

Logical Framework (Project Design Matrix, hereinafter referred to as PDM) is shown in **Table 1.7.1**. PDM included in Record of Discussions (hereinafter referred to as R/D) signed in September 2014 is set as version 0 and keep updated in consultation with DRVN since the first JCC. The approved PDM at the first JCC is set as PDM version 1, and adopted to manage the progress of the Project. PDM will also be updated flexibly as required, based on consultation with JICA and JCC.

<sup>1</sup> Based on information provided by DRVN on 15<sup>th</sup> December, 2014.

**Table 1.7.1 Logical Framework (Project Design Matrix: PDM)**

Project Name: The Project for Capacity Enhancement in Road Maintenance Phase II

Project Period: February 2015 to March 2018 (3 years)

Implementation Organization: DRVN under MOT

Target Group: DRVN, Road Management Bureau (RMB) I, II, III, IV

Target Area: Designated area of RMB I, II, III, IV

Prepared : 29th March, 2017

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
<p><b>Overall Goal</b> Road maintenance is conducted properly based on the mid-term plan, following PDCA cycle.</p>	<p>(By 3 years from the project end) The indicators for pavement damage (IRI, cracks, rutting, etc.) will be improved X %.</p>	<p>1. Result of data comparison of regular pavement condition survey by DRVN 2. Trial 3 year and annual plan for pavement maintenance 3. Annual Report 4. Interview to DRVN</p>	
<p><b>Project Purpose</b> Implementation capacity for road maintenance is strengthened in Viet Nam</p>	<p>1. Trial pavement repair work plan using PMS is formulated in RMB I, II, III and IV 2. Primary rules for road facility inspection, maintenance and repair work are formulated (*1) 3. Implementation structure for road maintenance is established.</p>	<p>1. Trial pavement repair work plan of RMB I, II, III and IV 2. Regulation 3-1. Regulation 3-2. Interview to DRVN</p>	<p><b>I.A to achieve Overall goal</b> 1. Budget is allocated stably for maintenance activities in accordance with <i>five</i> year plan 2. Training is conducted by DRVN continuously to maintain technical skills</p>
<p><b>Outputs</b> 1. PMS data development technology is improved 2. PMS is upgraded and applied to the planning of trial pavement repair work plans 3. Technical specifications for inspecting road facility and selecting repair work are developed 4. Responsibility assignment and administration procedure are clarified for road maintenance 5. <i>Training implementation and public relations are reinforced</i></p>	<p><u>1. System development of PMS data input is completed.</u> 2. Road asset database, maintenance history database and pavement condition database are completed for PMS 3. Trial pavement repair work plan (annual, <i>five</i> year) using PMS is formulated by DRVN. 4. Final draft of Road Facility Inspection Guideline, Road Routine Maintenance Manual, and <u>Expressway Maintenance Manual are formulated.</u> 5. Amendment plans to realize output 1-3 are developed <i>6-1. DRVN conduct regular trainings on project outputs</i> <i>6-2. DRVN conduct PR.</i></p>	<p><u>1. PMS data input system (Offline system and Web-based online system)</u> 2. Road asset DB, maintenance history DB, pavement condition DB, Traffic DB 3. Trial pavement repair plans (annual, <i>five</i> year plan) 4. Final Draft of Road Facility Inspection Guideline, Road Routine Maintenance Manual and <u>Expressway Maintenance Manual</u> 5. Amendment plans (draft) <i>6-1. Training record</i> <i>6-2. PR outputs</i></p>	<p><b>I.A. to achieve Project Purpose</b> 1 Engineers who received training are assigned continuously  2. Legalization procedure for Final draft of Road Facility Inspection Guideline and Road Routine Maintenance Manual proceeds</p>
<b>Activities</b>	<b>Inputs</b>		<b>I.A. to achieve Outputs</b>

	Japanese side	Vietnamese side	
<p>1-1. Formulate PMS Database</p> <p>1-2. Implement Pavement Condition Surveys for RMB II, III and IV selected roads</p> <p>1-3. Develop Web-based PMS Data Input System</p>	<p>1. Dispatch of Experts</p> <p>(1) Long term Expert</p> <ul style="list-style-type: none"> <li>• Road maintenance policy/regulations</li> </ul> <p>(2) Short-term experts</p> <ul style="list-style-type: none"> <li>• Team Leader/Road Maintenance Planning</li> <li>• Deputy Team Leader/PMS System Operation Technology</li> <li>• Pavement Condition Survey (Planning and Management)</li> <li>• Pavement Condition Survey (Calibration)</li> <li>• PMS System Technology (Budget Plan)</li> <li>• PMS System Technology (Repair Plan)</li> <li>• Web-based System for Pavement Condition Data Web System</li> <li>• Road Facility Inspection Technology</li> <li>• Road Maintenance Technology</li> <li>• Pilot Repair Work Management</li> <li>• Pavement Technology</li> <li>• Road Maintenance Administrative Procedure</li> <li>• Capacity Development/Project Coordination</li> </ul> <p>2. Training in Japan</p> <ul style="list-style-type: none"> <li>• Three times (once/year) on Road maintenance policy and repair technology</li> </ul> <p>3. Equipment, Machinery and Materials</p> <p>(1) Special equipment and materials for pilot repair works (Crack seal technology, Pothole repair technology (Shallow pothole/Deep pothole, Waterproofing technology)</p> <p>(2) Computers for planning system</p> <p>(3) Others needed for project implementation</p> <p>4. Others (Sub Contract)</p> <ul style="list-style-type: none"> <li>• Local service for Pilot Pavement Condition Survey</li> <li>• Local Service for development of web-based operation system</li> </ul>	<p>1. Human resources</p> <p>(1) Chairperson of JCC</p> <p>(2) Chairperson of TWG</p> <p>(3) Counterparts (DRVN and RMBs)</p> <p>(4) Coordinator</p> <p>2. Facilities</p> <p>Communal office space for JP Team and local support team with electricity, air-condition, internet, telephone line.</p> <p>3. Cost</p> <p>(1) Cost for pilot repair works on maintenance and repair work (including cost for general materials)</p> <p>(2) Small running expenses necessary for the implementation of the Project. (e.g. daily allowance, accommodation and domestic travel expenses of DRVN's staff for participating in training in Vietnam)</p> <p>4. Others</p> <p>(1) Implementation of the pilot repair works for maintenance and repair Work with JICA experts' advisory.</p> <p>(2) Implementation of pilot Pavement Condition Survey for the selected roads under RMB II, III and IV jurisdictions, with JICA's local service.</p>	<p>1. VRAMP Project (WB) is implemented as planned</p> <p>2. IT policy of DRVN on organization and operation of database and system is maintained</p>
<p>2-1. Upgrade PMS software</p> <p>2-2. Convert input data and make PMS dataset</p> <p>2-3. Formulate trial Pavement Repair Work Plan (annual and five year plan) for RMB I, II, III and IV road networks by PMS system and examine system operability.</p> <p>2-4. Develop web-based system for displaying pavement condition data on the DRVN mapping system</p> <p>2-5. Develop Web-based system which enables PMS Operation on website and formulates trial annual and five year pavement repair work plans</p> <p>2-6. Develop Web-based Analysis System for Pavement Condition Survey Data</p> <p>2-7. Develop Web-based Pavement Monitoring System (PMoS)</p>			
<p>3-1. Implement, Monitor and Evaluate Pilot Repair Works on Pavement Repair Technology which incorporates new technology and materials</p> <p>3-2. Upgrade Road Facility Inspection Guideline</p> <p>3-3. Upgrade Road Routine Maintenance Manual for standardization</p> <p>3-4. Develop Expressway Maintenance Manual</p>			<p><b>Preconditions</b></p> <p>Support and priority of DRVN on outputs generated through the phase I project including system database, technical standards, and recommendation on institution are maintained</p>
<p>4-1. Prepare Amendment Plan for Road Maintenance Responsibility Assignment</p> <p>4-2. Prepare Amendment Plan for Road Maintenance Administrative Procedure</p>			
<p>5.1. Prepare Draft Training Plan</p> <p>5.2. Support Training Implementation</p> <p>5.3. Conduct Public Relations</p>			

Note :(\*1): target facilities, frequency, methods, diagnosis, selection method for repair works, repair work, construction management

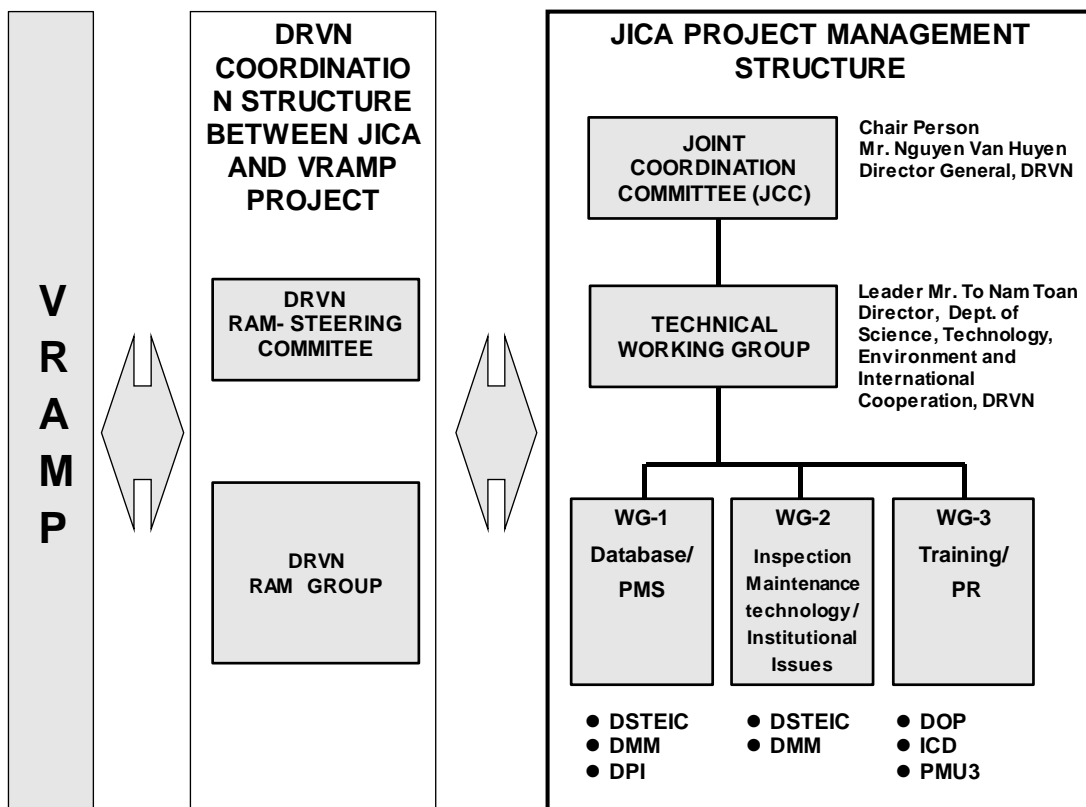
**1.8 PROJECT MANAGEMENT**

**1.8.1 Joint Coordination Committee (JCC) and Technical Working Group (TWG)**

Outline of Joint Coordination Committee (hereinafter referred to be referred as JCC<sup>2</sup>) and Technical Working Group<sup>2</sup> (hereinafter referred to as TWG) is shown in **Figure 1.8.1** and **Table 1.8.1**. In addition, Road Asset Management Steering Committee and Road Asset Management Working Group (hereinafter referred to as RAM-WG) have been established for efficient coordination between the World Bank Vietnam Road Asset Management Project (hereinafter referred to as VRAMP) and this JICA project. Members of the Committee and RAM-WG are mostly assigned as the members of JCC and TWG, therefore, this RAM-WG will take a role as coordination mechanism for the Project at the practical level.

Also a tentative schedule of JCC and TWG is indicated in **Figure 1.10.1**.

, which is continuously keep updating during project implementation in consultation with DRVN and Chairperson of JCC.



**Figure 1.8.1 Project Management**

<sup>2</sup> RAM-SC is established under Decision No.1267/QD-TCDBVN, 24<sup>th</sup> June, 2014 and RAM-TWG is established under Decision No.1777/QD\TCDBVN, 7<sup>th</sup> August, 2014.

**Table 1.8.1 Functions and Participants of JCC and TWG**

		JCC	TWG
Chairperson		Director General of DRVN	Director of Science, Technology, Environment and International Cooperation Dept. of DRVN
Frequency of meeting		Once a year (to discuss and report Work Plan, Progress Report, and Completion Report, and Monitoring Sheet)	Every 3 months, except when JCC is hold
Function		<ul style="list-style-type: none"> <li>• Discuss and approve Work Plan based on R/D</li> <li>• Review the progress of the Project based on annual Work Plans/ Progress Report and Monitoring Sheet.</li> <li>• Promote dissemination procedure of project outputs</li> <li>• Exchange views on main issues arising from the project in progress</li> </ul>	<ul style="list-style-type: none"> <li>• Discuss and Coordinate project progress based on annual Work Plans/ Progress Report and Monitoring Sheet</li> <li>• Review and coordinate a progress of the project</li> <li>• Discuss and coordinate issues related to Project implementation</li> <li>• Select speakers, trainers and trainees for seminars, workshops and OJTs.</li> </ul>
Members	Vietnamese side	<ul style="list-style-type: none"> <li>• Director General of DRVN (Chairperson)</li> <li>• Vice Director General of DRVN</li> <li>• MOT: DPI, DOST, Infrastructure Dept., TCQM Bureau, ITST</li> <li>• DRVN Department Members</li> <li>• PMU3</li> </ul>	<ul style="list-style-type: none"> <li>• Director of STE-ICD of DRVN (Group leader)</li> <li>• DRVN Department Members</li> </ul>
	Japanese side	<ul style="list-style-type: none"> <li>• Embassy of Japan in Vietnam</li> <li>• Representative of JICA Vietnam Office</li> <li>• JICA Long-term Expert</li> <li>• JICA Project Team</li> </ul>	<ul style="list-style-type: none"> <li>• JICA Long-term Expert</li> <li>• JICA Project Team</li> </ul>

Note: Prepared based on Record of Discussions signed 5th of November 2014

STE-ICD: Science, Technology and Environment, and International Cooperation Department

**Table 1.8.2 Functions and Participants of Working Group**

		WG-1	WG-2	WG-3
Targeted Field		<ul style="list-style-type: none"> <li>• PMS data collection and processing technology (Measure 1)</li> <li>• PMS upgrade/ formulation of pavement budget/repair plans (Measure 2).</li> </ul>	<ul style="list-style-type: none"> <li>• Technical standards for road inspection and maintenance (Measure 3)</li> <li>• Maintenance procedures and responsibility assignment (Measure 4)</li> </ul>	<ul style="list-style-type: none"> <li>• Training Programs and Public Relations (Measure 5)</li> </ul>
Function		<ul style="list-style-type: none"> <li>• Support data collection</li> <li>• Support base-line survey</li> <li>• Participate in the discussion</li> <li>• Support OJTs</li> </ul>	<ul style="list-style-type: none"> <li>• Support data collection</li> <li>• Support base-line survey</li> <li>• Participate in the discussion</li> <li>• Support OJTs</li> </ul>	<ul style="list-style-type: none"> <li>• Support data collection</li> <li>• Support base-line survey</li> <li>• Participate in the discussion</li> <li>• Support coordination and implementation of seminars, workshops and OJTs</li> <li>• Support Public Relation activities</li> </ul>
Frequency of meeting		Whenever necessary	Whenever necessary	Whenever necessary
Vietnamese side (DRVN)		Director, STE-ICD (Group Leader)	Deputy Director of STE-ICD of DRVN (Group leader)	Personnel Dept. (Group Leader)
		<ul style="list-style-type: none"> <li>• Dept. of Planning and Investment</li> <li>• Maintenance and Management Dept.</li> <li>• Road IT Center</li> </ul>	<ul style="list-style-type: none"> <li>• Maintenance and Management Dept.</li> <li>• Road Construction Management Bureau</li> </ul>	<ul style="list-style-type: none"> <li>• STE-ICD</li> <li>• PMU3</li> </ul>
Japanese side		<ul style="list-style-type: none"> <li>• JICA Long-term Expert</li> <li>• JICA Project Team</li> </ul>	<ul style="list-style-type: none"> <li>• JICA Long-term Expert</li> <li>• JICA Project Team</li> </ul>	<ul style="list-style-type: none"> <li>• JICA Long-term Expert</li> <li>• JICA Project Team</li> </ul>

### **1.8.2 Coordination with VRAMP**

VRAMP funded by the World Bank plans to succeed the Road Asset Database System developed under the JICA Phase I Project. Therefore, in the case of a large scale modification applied to Road Asset Database Structure by VRAMP which might take significant time in completing, it will impact significantly to the Project on the formulation of the PMS Dataset for a pavement repair work plan using the PMS dataset formulation module. Thus, RAM-WG set by DRVN as above, is expected to coordinate regularly with VRAMP on issues including the target route and extent of work for pavement condition surveys.

### **1.8.3 Administrative Operation of the Project**

#### **1) Preparation and Consultation of Monitoring Sheet**

At the beginning of the Project, JICA Project Team has drafted Monitoring Sheet I & II Ver.1 (draft) based on R/D signed and confirm with counterparts for any changes required on PDM and Project Operation (PO). Every 6 month, the progress of the Project is being monitored and evaluated, and upon mutual agreements at JCC or TWG, the version of monitoring sheet is also being updated.

#### **2) Promote Understanding on PDCA Cycle**

Establishing PDCA cycle is the utmost important factor to enhance capacity in road maintenance. Thus, the Project implements four activities efficiently which are 1) Survey, inspection and evaluation of defects and deterioration (road facility inspection and road condition survey), 2) Planning (PMS development, formulation of pavement repair work plan), 3) Selection of repair work, and 4) Monitoring and evaluation (Pilot repairing projects). The Project will also promotes understanding of Counterparts (hereinafter to be referred as C/P) on these objectives.

#### **3) Safety Measures for Pavement Condition Survey and Pilot Repair Projects**

Securing health and safety is prioritized during the implementation of pavement condition surveys and pilot repair works. During the surveys and construction works on road, traffic should be sufficiently controlled, and adequate health and safety measures are provided for C/P and local workers as well as third parties such as vehicles and pedestrians. To enhance this capacity at planning stage, the Project introduced the Japanese health and safety measures to promote awareness of C/P, and at the implementation stage, provides instructions at sites as required.

#### **4) Planning of Seminar, Workshop and OJT**

In order to disseminate project outputs, trainings are structured in a combination of seminar, workshop and OJT according to target groups and project outputs. Seminar is hold in Ha Noi, whereas workshop and OJTs are hold at four regions of RMBs. Number of trainings are being implemented in collaboration with DRVN. Basically, workshop and OJT are implemented

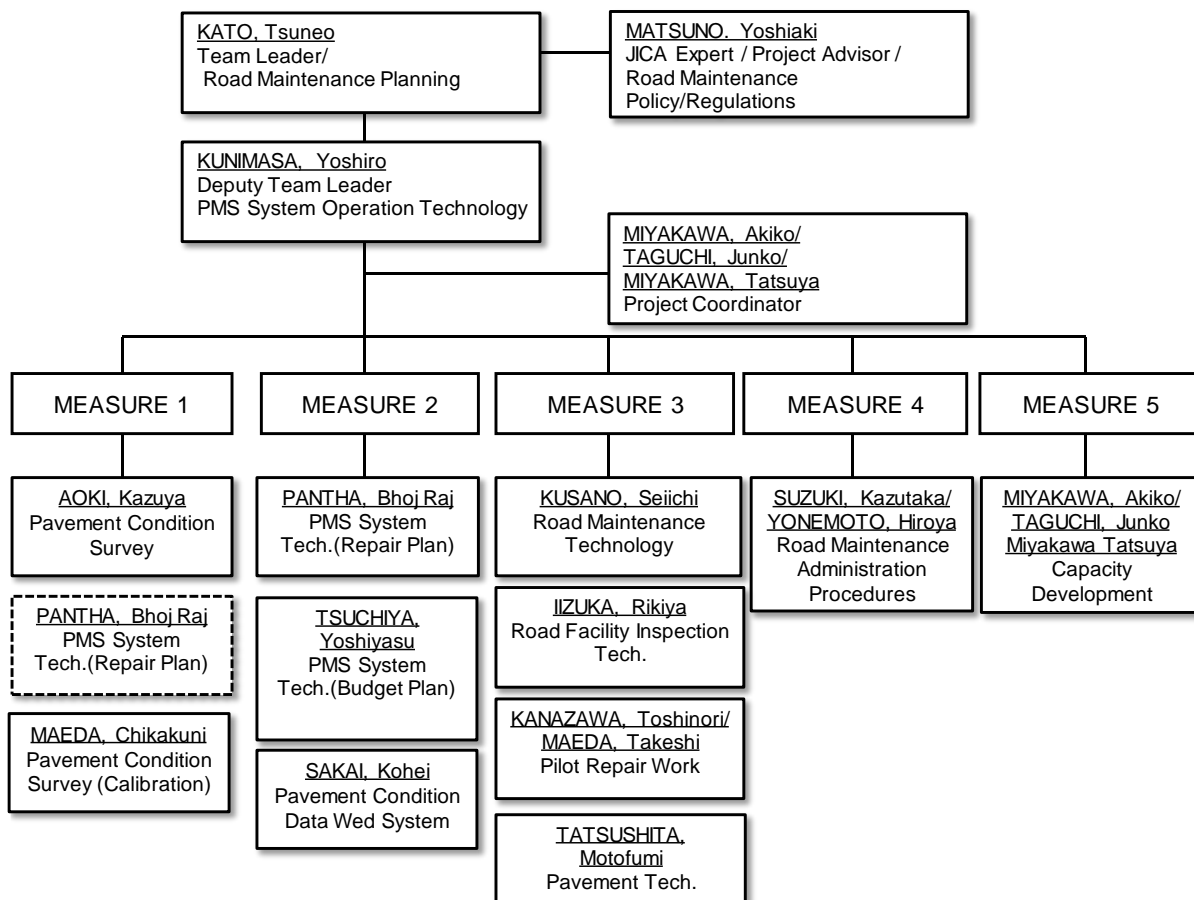
together in combination to ease load of DRVN and the JICA Project Team. **Table 1.10.1** shows a tentative training plan for the Project.

**5) Planning of Training in Japan**

Training in Japan aims to promote the understanding of road maintenance institution, regulation and policy in Japan and to introduce Japanese technology, through lectures and site visits by Japanese road maintenance agencies such as MLIT, Expressway Company, and private companies. Total participants are planned about 15 people (5 per year). However, during implementation of the training, the number of participants is revised based on mutual understanding.

**1.9 PROJECT TEAM STRUCTURE**

The Project promotes a strengthening of cooperation and information sharing between C/P, between a JICA long-term expert and the JICA Project Team experts, and also within the JICA Project Team, through forming Groups of experts according to Outputs as shown in **Figure 1.9.1**.



**Figure 1.9.1 Project Team Structure**

## **1.10 ASSIGNMENT SCHEDULE**

Assignment schedule is shown on **Figure 1.10.1**.



**Table 1.10.1 Outline of Seminar, Workshop and OJT**

Training Style	Target Group	Trainer / Speaker	Venue	Frequency	Contents
Seminar	Agencies involved in legislation of road maintenance regulation and institution including leaders of DRVN, MOT, (PDOTs), ITST and UTC, and ASEAN countries. (Attendant total 100)	<ul style="list-style-type: none"> <li>• DRVN</li> <li>• Experts from Japan</li> <li>• JICA Project Team experts</li> </ul>	Hanoi	2 times/ Full day  1 <sup>st</sup> : 2015 OCT 2 <sup>nd</sup> :2017 NOV	<p><b><u>Focus on Knowledge based Technical Transfer related to Project Outputs</u></b></p> <ul style="list-style-type: none"> <li>• Progress and result of the project</li> <li>• Methods for road asset management</li> <li>• PDCA cycle on road maintenance</li> <li>• Road facility inspection and road maintenance technology</li> <li>• Case study on road maintenance in Japan</li> <li>• Request for support on legislation and standardization</li> </ul>
Workshop	Management level Officials and Engineers of RMBs, SBs and RTCs (Attendant total 30-50)	<ul style="list-style-type: none"> <li>• DRVN</li> <li>• JICA Project Team experts</li> </ul>	RMB I, II, III, IV	15 times / Half day  1 <sup>st</sup> : 2015 JUL(4 cities) 2 <sup>nd</sup> :2016 MAY(4 cities) 3 <sup>rd</sup> : 2016 OCT (4 cities) 4 <sup>th</sup> : :2017 MAY(4 cities) 5 <sup>th</sup> :2017 OCT (4 cities)	<p><b><u>Focus on Knowledge based Technical Transfer related to Project Outputs</u></b></p> <ul style="list-style-type: none"> <li>• Progress and result of the project</li> <li>• Methods for road asset management</li> <li>• PDCA cycle on road maintenance</li> <li>• Significance and principle components of road facility inspection and road maintenance technology (MEASURE 3)</li> <li>• Case study on road maintenance in Japan (MEASURE 4)</li> </ul>
OJT	Field Engineer of RMBs, SBs and RTCs (Attendant total 15-20)	<ul style="list-style-type: none"> <li>• DRVN</li> <li>• JICA Project Team experts</li> </ul>	RMB I, II, III, IV	15 times  1 <sup>st</sup> : 2015 JUL(3 cities) 2 <sup>nd</sup> :2016 OCT(4 cities) 3 <sup>rd</sup> :2017 MAY(4 cities) 4 <sup>th</sup> :2017 OCT (4 cities)	<p><b><u>Focus on Technical Transfer of Project Outputs</u></b></p> <ul style="list-style-type: none"> <li>• Data Input for PMS Database (MEASURE 1)</li> <li>• Survey and Analysis of Pavement Condition Survey (MEASURE 2)</li> <li>• Operation of PMS (MEASURE 2)</li> <li>• Operation of web based system (MEASURE 2)</li> <li>• Formulation of PMS Dataset (MEASURE 2)</li> <li>• Formulation of pavement repair work plan (MEASURE 2)</li> <li>• Operation of Budget Simulation software (MEASURE 2)</li> <li>• Operation of Road Facility Inspection Guideline (MEASURE 3)</li> <li>• Operation of Road Routine Maintenance Manual (MEASURE 3)</li> <li>• Opinion exchange on guideline and manuals (MEASURE 3)</li> </ul>

Note: Schedule and number of training by training style is shown on "Figure 2-9. Flow Chart".



## CHAPTER 2 PROJECT FRAMEWORK

### 2.1 PROJECT FRAMEWORK

The Framework including Measures and Activities to achieve Project Purpose stated on the PDM is summarized in **Table 2.1.1**, and basic approaches of each activity are explained in the following sections according to “Expected Output”, “Information Dissemination and Technology Transfer”, and “Remarks”.

**Table 2.1.1 Measures and Activities to Achieve Project Purpose**

Project Purpose	Measures	Activities	
Enhance Implementation Capacity for National Road Maintenance in Viet Nam	MEASURE 1; Improve PMS Data Collection and Processing Technology	1-1	Formulate PMS Database
		1-2	Implement Pavement Condition Survey
		1-3	Develop Web-based PMS Data Input System
	MEASURE 2; Upgrade PMS to Apply Road Network of RMB I, II, III, and IV, and Formulate Draft Repair Work Plan	2-1	Upgrade PMS
		2-2	Formulate PMS Dataset
		2-3	Formulate Pavement Repair Work Draft Plan
		2-4	Develop Web-based System for Displaying Pavement Condition Survey Data
		2-5	Develop Web-based PMS Operation System
		2-6	Develop Web-based Analysis System for Pavement Condition Survey Data
		2-7	Develop Web based Pavement Monitoring System
	MEASURE 3; Improve Inspection and Repair Work Selection Technology on Road Facility and Develop Technical Standards	3-1	Implement, Monitor and Evaluate Pilot Repair Works on Pavement Repair Technology
		3-2	Upgrade Road Facility Inspection Guideline
		3-3	Upgrade Road Routine Maintenance Manual
		3-4	Develop Expressway Maintenance Manual
	MEASURE 4; Enhance Responsibility Assignment and Administration Procedures for Road Maintenance	4-1	Prepare Amendment Plan for Road Maintenance Responsibility Assignment
		4-2	Prepare Amendment Plan for Road Maintenance Administrative Procedure
	MEASURE 5; Plan and Support Implementation of Training Programs and Conduct Public Relations	5-1	Prepare Draft Training Plan
5-2		Support Training Implementation	
5-3		Conduct Public Relations	

#### 2.1.1 Improve PMS Data Collection and Processing Technology (MEASURE 1)

MEASURE 1 aims to improve PMS data collection and processing technology in all RMBs. In order to achieve this aim, following approach are taken.

### **1) Activity 1-1 Formulate PMS Database**

#### **a) Expected Output**

PMS Data (57 data items) which includes data from Road Asset DB, Pavement Condition DB, Maintenance History DB, and Traffic Volume DB. During development of web-based PMS system, PMS data items have been increased (71 data items). However, the increased data items are basically derived from the original data items.

#### **b) Information Dissemination and Technology Transfer**

- Information dissemination by seminar and workshop  
Case studies on database management; practices of database management of national road and expressway in Japan
- Technical Transfer to Field Engineers (RMBs and Subordinate agencies)  
Data input of Road Asset DB and Maintenance History DB using Microsoft Excel

#### **c) Remarks**

- Formulation of draft amendment plans on administration procedure, responsibility assignment and related legislation, which are required for PMS data input, has drafted under MEASURE 4.

### **2) Activity 1-2 Implement Pavement Condition Survey**

#### **a) Expected Output**

Pavement condition Database for RMB II, III and IV roads

#### **b) Information Dissemination and Technology Transfer**

- Provide information in the Seminar or Workshop  
Introduce cases of the management and activity in Japanese national road or expressway.
- Technical transfer for worker
  - Operation of the survey vehicle and equipment on board
  - Operation methods of survey, data analysis, data processing and pavement condition database management

#### **c) Remarks**

- Formulation of a draft amendment plan on administration procedure, responsibility assignment and related legislation, which are required for the standardization of pavement condition survey, has drafted under MEASURE 4.

### **3) Activity 1-3 Develop Web-based PMS Data Input System**

#### **a) Expected Output**

Web-based PMS Data Input System and Operation Manual

**b) Information Dissemination and Technology Transfer**

- Information dissemination by seminar and workshop  
Case studies on web-based data input system; practices of web-based data input system of national road and expressway in Japan
- Technical Transfer to Field Engineer (RMBs and Subordinate agencies)  
Operation of the Web-based PMS Data Input System

**c) Remarks**

- Formulation of draft amendment plans on administration procedure, responsibility assignment and related legislation, which are required for management of Web-based PMS Data Input System, has drafted under MEASURE 4.

**2.1.2 Upgrade PMS to Apply Road Network of RMB I, II, III, and IV, and Formulate Draft Repair Work Plan (MEASURE 2)**

**1) Activity 2-1 Upgrade PMS**

**a) Expected Output**

- PMS Software (Budget Simulation Model) and Operation Manual
- PMS Software (Pavement repair work planning Model) and Operation Manual
- Annual and 5 Year Pavement Repair Plan for RMB I, II, III and IV Jurisdiction

**b) Information Dissemination and Technology Transfer**

- Information dissemination by seminar and workshop  
Case studies related to Road Asset Management in Japan
- Technical Transfer to Field Engineer (RMBs and Subordinate agencies)
  - Theory and algorithm of the PMS Software
  - Operation method of the PMS Software

**c) Remarks**

- Formulation of draft amendment plans on administration procedure, responsibility assignment and related legislation, which are required for PMS, has drafted under MEASURE 4.

**2) Activity 2-1 Formulate PMS Dataset**

**a) Expected Output**

- Data Conversion System/PMS dataset module (with 2 functions) and Operation Manual
- PMS Dataset

**b) Information Dissemination and Technology Transfer**

- Information dissemination by seminar and workshop

Case studies on Database management and application of national road and expressway in Japan

- Technical Transfer to the field Engineers in RMBs and Subordinate agencies
- Operation of the Data Conversion System
- Development of PMS Dataset

**c) Remarks**

- Formulation of draft amendment plans on administration procedure, responsibility assignment and related legislation, which are required for PMS dataset formulation, has drafted under MEASURE 4.

**3) Activity 2-3 Formulate Pavement Repair Work Draft Plan**

**a) Expected Output**

Annual and 5 year pavement repair work plans for the targeted national roads under RMB I, II, III and IV jurisdiction.

**b) Information Dissemination and Technology Transfer**

- Information dissemination by seminar and workshop
- Case studies on road asset management in Japan
- Technical Transfer to Field Engineer (RMBs and Subordinate agencies)
  - Design theory of the PMS (Budget planning simulation model and repair work planning model) and Operation of the Web Based System
  - Operational procedure for the pavement budget simulation and pavement repair work planning.

**c) Remarks**

- Formulation of the draft amendment plans on administration procedure, responsibility assignment and related legislation, which are required for pavement repair work planning, has drafted under MEASURE 4.
- The Project has made every effort in raising DRVN trainers in cooperation with JCC and TWG so that DRVN can implement training on its own in the near future. Detail information regarding training such as training style, content, target group, venue and frequency is summarized under Measure 5.

**4) Activity 2-4 Develop Web-based System for Displaying Pavement Condition Survey Data**

**a) Expected Output**

Web-based System for Displaying Pavement Condition Data and Operation Manual

**b) Information Dissemination and Technology Transfer**

- Information dissemination by seminar and workshop

Case introduction of systematization of asset management in Japan.

- Technical Transfer to Field Engineer (RMBs and Subordinate agencies)

Operation of the Web-based System for Displaying Pavement Condition Data.

**c) Remarks**

- Responsibility assignment for managing pavement condition data display system has recommended under MEASURE 4.

**5) Develop Web-based PMS Operation System**

**a) Expected Output**

Web-based PMS Operation System and Operation Manual

**b) Information Dissemination and Technology Transfer**

- Information dissemination by seminar and workshop  
Case studies on the road asset management system development and implementation of national road and expressway in Japan
- Technical Transfer to Field Engineer  
Operation method of the Web-based PMS Operation System

**c) Remarks**

- Responsibility for managing PMS has recommended under MEASURE 4.

**6) Activity 2-6 Develop Web-based Analysis System for Pavement Condition Survey Data**

**a) Expected Output**

Pavement Condition Data Analysis System and Operation Manual

**b) Information Dissemination and Technology Transfer**

- Information dissemination by seminar and workshop  
Case studies related to formulation of road asset management system in Japan
- Technical Transfer to Field Engineer (RMBs and Subordinate agencies)  
Operation method of the Pavement Condition Data Analysis System

**c) Remarks**

- Responsibility assignment for managing pavement condition data analysis system has recommended under MEASURE 4.

**7) Activity 2-7 Develop Web-based Pavement Monitoring System**

**a) Expected Output**

Web-based Pavement Monitoring System and Operation Manual

**b) Information Dissemination and Technology Transfer**

- Information dissemination by seminar and workshop  
Case studies related to formulation of road asset management system in Japan
- Technical Transfer to Field Engineer (RMBs and Subordinate agencies)  
Operation method of the Web-based Pavement Condition Data Analysis System

**c) Remarks**

- Responsibility assignment for managing pavement monitoring system has recommended under MEASURE 4.

**2.1.3 Improve Inspection and Repair Work Selection Technology on Road Facility and Develop Technical Standard (MEASURE 3)**

**1) Activity 3-1 Implement, monitor and evaluate pilot repair works on pavement repair technology**

**a) Expected Output**

- Evaluation report of pilot repair works

**b) Information Dissemination and Technology Transfer**

- Information dissemination by seminar and workshop  
Case studies on development of standard of road facility inspection
- Technical Transfer to Field Engineer
  - Implementation method of pilot repair works required for technical standardization
  - Evaluation results of pilot technology

**c) Remarks**

- DRVN has taken an initiative in implementing the pilot repair works and to take responsibilities for budget allocation, selection of project areas, selection of contractors, procurement of domestic equipment and materials, implementation of repair works, work quality and safety management, and monitoring and evaluation of work performance. On the other hand, the Project has provided technical assistance to the selection of repair work technologies, construction technologies, work quality and safety management, and monitoring and evaluation methods. The Project has supported for procurement of equipment or materials from Japan, while DRVN cooperated with the acceleration of importation procedures.
- Specification of pilot repair works has been prepared for future use.



## **2) Activity 3-2 Upgrade the Road Facility Inspection Guideline**

### **a) Expected output**

- Road Facility Inspection Guideline (Final version for authorization procedure)

### **b) Information Dissemination and Technology Transfer**

- Information dissemination at Seminars and Work Shops  
Introduction of Japanese case on enactment of the Road Facility Inspection Guideline
- Technical Transfer to Field Engineer
  - Outline and contents of the Road Facility Inspection Guideline
  - Application method of the Road Facility Inspection Guideline

### **c) Remarks**

- Formulation of the draft amendment plans on administration procedure, responsibility assignment and related legislation, which are required for the legalization of Road Facility Inspection Guideline, has drafted under MEASURE 4.

## **3) Activity 3-3 Upgrade Road Routine Maintenance Manual (draft)**

### **a) Expected Output**

Road Routine Maintenance Manual (Draft)

### **b) Information dissemination and technology transfer**

- Information dissemination by seminar and workshop  
Introduction of Japanese practice on arrangement of road routine maintenance standard
- Technology transfer to Field engineer
  - Summary and structure of the Road Routine Maintenance Manual (draft)
  - Application method of the Road Routine Maintenance Manual (draft)

### **c) Remark**

- DRVN was requested to enhance communication with professional organizations in standardization including the Department of Science and Technology of MOT, ITST and UTC in order to ensure smooth implementation of legalization procedures for Road Routine Maintenance Manual.
- Formulation of the draft amendment plans on administration procedure, responsibility assignment and related legislation, which are required for the legalization of the Road Routine Maintenance Manual, has drafted under MEASURE 4.

## **4) Activity 3-4 Develop Expressway Maintenance Manual (draft)**

### **a) Expected Output**

Expressway Maintenance Manual (Draft)

**b) Information dissemination and technology transfer**

- Information dissemination by seminar and workshop  
Introduction of Japanese practice on arrangement of Expressway Maintenance Manual

**c) Remark**

DRVN was requested to give feedback on draft manual timely.

**2.1.4 Enhance Responsibility Assignment and Administration Procedures for Road Maintenance (MEASURE 4)**

**1) Activity 4-1 Prepare Amendment Plan for Road Maintenance Responsibility Assignment**

**a) Expected Output**

- Draft plan for maintenance responsibility assignment
- Draft amendment plan of regulations for responsibility assignment

**b) Information Dissemination and Technology Transfer**

- Information dissemination by seminar and workshop  
Case studies on responsibility assignment of road asset management in Japan

**c) Remarks**

- DRVN is requested to implement recommendations of this Project by incorporating them into the DRVN Comprehensive Renovation Plan in Management and Maintenance of National Road Network System.
- DRVN is also requested to take an initiative for drafting an amendment plan for legalization relevant to road stakeholder responsibility assignment.

**2) Prepare Improvement Plan for Road Maintenance Administrative Procedure**

**a) Expected Output**

- Recommendation on the improvement of road maintenance procedures
- Revision plan of relevant regulations

**b) Dissemination and Technology Transfer**

- Information dissemination by seminar and workshop  
Introduction of Road Asset Management in Japan

**c) Remarks**

- DRVN is requested to implement recommendations of this Project by incorporating them into DRVN Comprehensive Renovation Plan in Management and Maintenance of National Road Network System.

- DRVN is also requested to take the initiative for drafting an amendment plan for legalization relevant to road stakeholder responsibility assignment.

## **2.1.5 Plan and Support Implementation of Training Programs and Conduct Public Relations (MEASURE 5)**

### **1) Activity 5-1 Prepare Draft Training Program**

#### **a) Expected Output**

- Draft training program for during the Project
- Draft training program for after the Project
- Recommendation on road administration training for the future

#### **b) Information Dissemination and Technology Transfer**

- Information dissemination by seminar and workshop  
Case studies on trainings of national road and expressway maintenance in Japan under Ministry of Land, Infrastructure, Transport and Tourism (hereinafter referred as MLIT) and Nippon Expressway Company Limited (hereinafter referred as NEXCO) respectively.

#### **c) Remarks**

- Formulation of draft amendment plan on administration procedure, responsibility assignment and related legislation, which require for implementation of training plan, has drafted under MEASURE 4.

### **2) Activity 5- Support Training Implementation**

#### **a) Expected Output**

- Training materials
- Trained trainers

#### **b) Information Dissemination and Technology Transfer**

- Administrative operation method of training
- Fostering of trainers

#### **c) Remarks**

- DRVN was requested to take a part in a proactive manner including training planning, operation, and provision of trainer on seminars, workshops and OJTs under the Project.

### **3) Activity 5-3 Conduct Public Relations**

#### **a) Expected Output**

- DRVN Annual Report
- DRVN promotional video

- Web based Information System for Road Maintenance Technology and Operation Manual

## **2.2 WORK FLOW**

Work flow is shown in **Figure 2.2.1**.



## CHAPTER 3 CURRENT STATUS OF NATIONAL ROAD MAINTENANCE

### 3.1 OVERVIEW OF ROAD SECTOR

#### 3.1.1 Road Classification

According to Decree No.11/2010/ND-CP on February 24, 2010 which was enacted pursuant to Law on Road Traffic (No.23/2008/QH12 enforced on July 1, 2009), and amended by Decree No.100/2013/ND-CP dated 03/09/2013. the road system in Viet Nam falls in 7 categories; (1) National Road, (2) Provincial Road, (3) District Road, (4) Urban Road, (5) Commune Road, (6) Exclusive Road, and (7) Expressway. Exclusive roads are special roads that connect to industrial zones, military zones, forests, etc. The Decree also prescribes agencies responsible for the construction and maintenance of the road. The outline of road classification is described in **Table 3.1.1**.

**Table 3.1.1 Administrative Road Classification (as of 2014)**

Classification	Definition	Agency Responsible	Total Length (km)
National Road	The main axial roads of the nationwide land road network, which are of particularly important effect in service of national or regional socio-economic development, defense and security, including: <ul style="list-style-type: none"> <li>• Roads linking Hanoi capital with the centrally-run cities; and with administrative centers of the provinces;</li> <li>• Roads linking administrative centers of three or more provinces or centrally-run cities (hereinafter called provinces);</li> <li>• Roads linking international seaports with international border gates and main land border gates.</li> </ul>	Ministry of Transportation	21,109
Provincial Road	Axial roads within one province or two provinces, including roads linking a province's administrative center with districts' administrative centers or with adjacent provinces' administrative centers; roads linking national roads with districts' administrative centers.	Provincial People's Committee (DOT)	26,218
District Road	Roads link districts' administrative centers with the administrative centers of communes or commune clusters or with adjacent districts' administrative centers; roads linking provincial roads with administrative centers of communes or centers of commune clusters.	District People's Committee	53,299
Commune Road	Roads linking the communes' administrative centers with hamlets and villages, or roads linking communes together.	Commune People's Committee	178,294
Urban Road	Roads lying within the administrative boundaries of inner cities or urban centers.	Provincial People's Committee	20,076
Exclusive Road	Roads used exclusively for transport and communication by one or a number of agencies, enterprises and/or individuals linking to industrial area, military sites, forestry	(Investor)	10,836
Total			309,832

Source: Decree No.11/2010/ ND-CP, Prescribing the management and Protection of Road Traffic Infrastructures.

Data as of 2014

### 3.1.2 Road Network

Viet Nam’s road network, shown in **Table 3.1.2** has a length of 309.832km (excluding expressway routes), of which 178,294 (57.5%) are commune roads and 26,218km (8.5%) are provincial roads, both consisting of 66% of all road network. On the other hand, the national roads, shown in **Figure 3.1.1** whose total length is 21.109 km (6.8%) play a role as primary arterials of the road network. Overall road network has grown at a rate of 8,500 km, by 2.8%, per year, and the national road network 355 km and 1.68% per a year over the past seventeen years since 1997. The national road network forms two north–south corridors, coastal and upland, with east–west roads along the central part of Viet Nam. In the north, the national roads form a radial circumferential pattern. In the south, the national road network forms a grid pattern. The coverage of the national roads seems adequate. However, due to the topographic conditions of Viet Nam, 39% of the national road network is in mountainous terrain. Therefore, the design standards of nearly half of the national roads are constrained. It also creates problems for road maintenance and is vulnerable to natural disasters, such as landslides.

**Table 3.1.2 Road Length for the Road Network in Viet Nam (Unit: km)**

Year	Total length	National Road	Provincial Road	District Road	Commune Road	Urban Road	Exclusive Road
1997	164,620	15,071	1,653	32,907	89,372	5,213	5,524
1998	171,071	15,286	17,097	34,519	92,558	5,534	6,077
1999	150,950	15,392	17,653	35,509	69,913	5,755	6,728
2000	183,177	15,436	18,344	36,840	99,670	5,919	6,968
2001	201,558	15,613	18,997	37,013	117,017	5,921	6,997
2002	221,295	15,824	19,916	37,947	134,643	5,944	7,021
2003	216,790	16,118	21,417	46,508	118,589	8,264	5,894
2004	223,287	17,295	21,762	45,013	124,942	6,654	7,621
2005	230,502	17,295	23,990	47,109	126,869	7,808	7,432
2006	268,778	16,125	24,822	50,844	155,968	15,182	5,836
2007	251,535	17,339	23,905	54,181	138,965	10,075	7,070
2008	277,560	16,913	24,750	43,520	175,329	9,558	7,490
2009	279,928	16,758	25,449	51,721	161,136	17,025	7,838
2010	295,972	16,747	25,594	54,609	170,606	20,461	7,955
2011	294,635	16,700	25,434	50,603	173,752	18,868	9,278
2012	309,182	17,091	26,807	52,656	183,593	18,687	10,348
2013	306,591	17,868	26,218	53,299	178,294	20,076	10,836
2014	309,832	21,109	26,218	53,299	178,294	20,076	10,836

Source: Road Maintenance Management Department, DRVN, Data as of December 2014



Source: DRVN

**Figure 3.1.1 National Road Network**

### **3.1.3 Road Administration**

The principal governing law for road transportation is Law on Road Traffic, which was initially enacted by the National Assembly on June 29, 2001 (No. 26/2001/QH10). The Law was recently revised and come to effect on July 1, 2009 (No.23/2008/QH12). The Law prescribes roads traffic rules, road infrastructure facilities, vehicles in traffic and road users, road transportation and state management of road traffic. The six (6) administrative classifications of roads containing National Road, Provincial Road, District Road, Commune Road, Urban Road and Exclusive Road are set out in this document. The Law also prescribes provisions pertinent to road administration and maintenance.

Following the law enactment, the Government issued Decree No.11/2010/ND-CP February 24, 2010, and assigns MOT to be the state management of all road networks in Viet Nam, which also delegated the management of national roads to DRVN, and the management of Provincial Road, District Road and Commune Road to their managing Provincial People’s Committees (PPCs).

The following explains further.

#### **(1) Ministry of Transport (MOT)**

According to Decree No.107/2012/ ND-CP, December 20, 2012, MOT has the roles and positions in carrying out the state administrating functions over roadway, railway, waterway transport nationwide and also provides the administration of the public services as regulated by the law. MOT shall perform the uniform state management over roads nationwide and be responsible for organizing the management of construction and maintenance of the national highway system.



**(2) Directorate for Roads of Viet Nam (DRVN)**

DRVN is an agency under Ministry of Transport performing functions as an assistant for Transport minister in state management on road transport and carries out tasks of managing, maintaining and exploiting the national road system, providing the localities (PPCs) throughout the countries with professional engineering guidance on road management, maintenance and exploitation. The responsibility assignment of DRVN is stipulated in Prime Minister Decision No.60/2013/QD-TTg.

**(3) Provincial People’s Committees (PPCs)**

PPCs manage the systems of provincial roads and urban roads within their respective localities and assign Provincial Transport Services (Provincial Department of Transportation: PDOTs) and Provincial Traffic/Public Work Services for the tasks of directly managing and maintaining provincial roads and provincial urban roads respectively.

**(4) District and Commune People’s Committees (DPCs and CPCs)**

DPCs and CPCs manage, maintain and exploit district and commune roads upon receiving regulations issued by PPC.

**3.1.4 Pavement Conditions**

**Table 3.1.3** shows a road classification by pavement type. Looking at an entire road network, the pavement ration of cement concrete, asphalt concrete and asphalt pavement constitutes 28% of all road networks, 309,832km. This clearly shows a more economical pavement structure has been selected and applied in accordance with road classification.

**Table 3.1.3 Road Classification by Pavement Type (2014)**

<b>1. Road Classification</b>			
No	Categories	Total length (Km)	(%)
1	National road	21,109	6.8
2	Provincial road	26,218	8.5
3	District road	53,299	17.2
4	Communal road	178,294	57.5
5	Urban road	20,076	6.5
6	Exclusive road	10,836	3.5
	Total	309,832	100
<b>2. Pavement Classification</b>			
No	Pavement structure	Total length (Km)	(%)
1	Asphalt Concrete	41,212	13.3
2	Bituminous Surface treatment	67,774	22
3	Cement concrete	47,483	15.3
4	Aggregated pavement	50,302	16.2
5	Earth	96,799	31.2
6	Other	6,262	2
7	Total	309,832	100

Source; Road Maintenance Management Department, DRVN, Data as of 2014

### 3.2 CURRENT STATUS OF NATIONAL ROAD MAINTENANCE

#### 3.2.1 Road Administration

There are three administrators involved in the national road maintenance and management, which are 1) MOT, 2) DRVN and 3) PDOT as shown in **Table 3.2.1**. Organization structure and roles and responsibilities of these organizations are outlined under the table.

**Table 3.2.1 Road Administration**

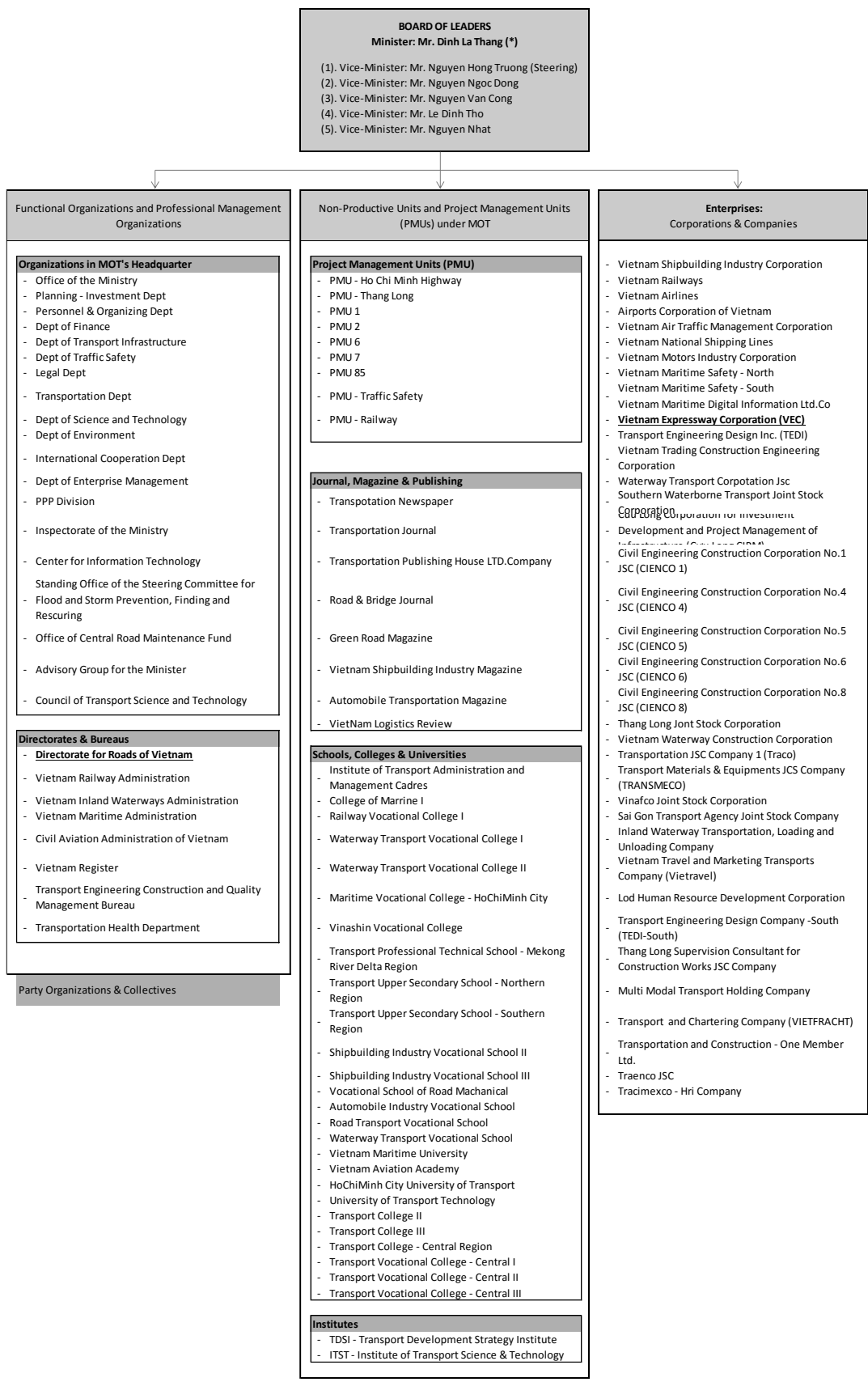
	Organization	Organization status	Job position	Role and Responsibility
Central Government in Road Sector	MOT	Ministry	Management/ Professionals/ Admin	State Authority of National road management
	DRVN	Government agency		State management on National road under MOT
	RMBs	Government agency	Management/ Professionals/ Admin	Regional Management on maintenance and emergency work for National Road
	Sub-bureaus	Government agency	Management/Professionals/ Technicians/ Admin	Management and maintenance of national roads on field.
Provincial Government	PPCs	Government agency	Management/ Professionals	Local Authority of Provincial road management
	PDOTs	Government agency	Management /Professionals /Technicians	Conduct and manage maintenance and emergency work for Provincial road & delegated National road

Source: JICA Project Team, 2015

#### (1) MOT

##### 1) Organization Structure

Government Decree, No.107/2012/ND-CP issued on December 20, 2012, stipulates new functions, tasks, powers and organization structures for MOT. **Figure 3.2.1** shows the organization structure of MOT.



Note. (\*) Vice Minister Nguyen Hong Truong is currently in charge of MOT on behalf of the Minister who is just tasked to the Party Secretary of Ho Chi Minh City

Source: JICA Project Team 2016

**Figure 3.2.1 MOT Organization Structure**

## **2) Roles and Responsibilities**

Main responsibilities stipulated in Decree No.107 are outlined as follows;

- To direct the implementation, planning and the development of the transportation infrastructure that is approved by the Prime Minister.
- To enact building standards (standards for infrastructure construction) and regulates the management of infrastructure according to the traffic authority. The functions carried out by the MOT with this respect are regulating the use of management, maintenance and exploitation of transport infrastructure within the country and directing and inspecting the maintenance organization, standards, technical regulation of communication networks.
- To organize the tasks and powers of the agency for investment decisions, gathering and selecting investors for investment in construction of transport infrastructure and announcing the list of projects calling for capital investment form the infrastructure in accordance with the law.
- To publish documents and guidelines for opening air ports, airport and aviation settings on the Prime Ministers assent.
- To decide the temporary closing of airports, reopening of airports, the East Coast, open ports, port waters, maritime flow, ports, inland waterway the water means that on foreign, inland waterways, railway station, and railway under the law.
- To hold the certificate of registration of airports, in accordance with the law.
- To classify the process of Government regulation, name or model number and specifications of the road level, decided to classify, modify the highway system, the number of the road.

### **(2) DRVN**

#### **1) Organization Structure**

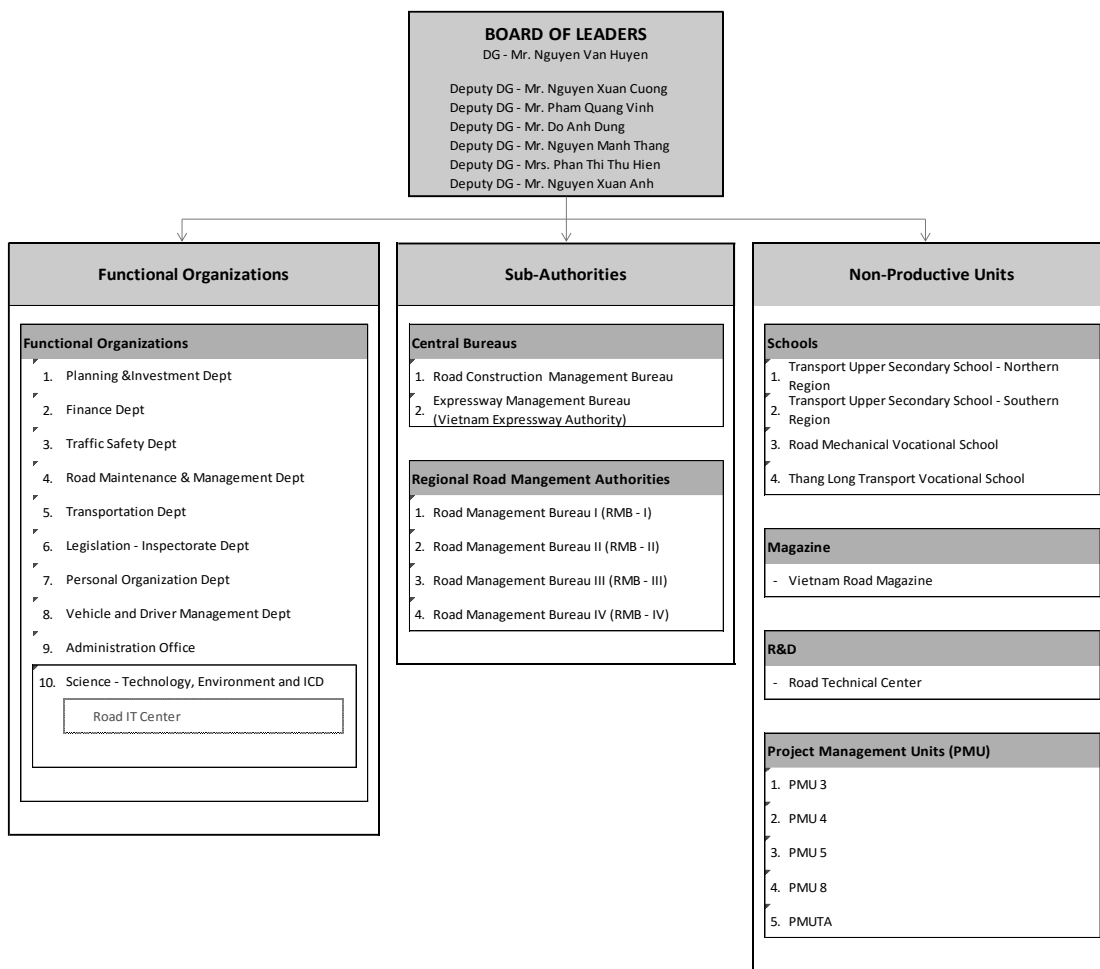
DRVN is an agency under MOT which was founded as Viet Nam Road Administration (VRA) pursuant to Decree No.07/CP dated on January 30, 1993. On April 1 2010, VRA changed its name to Directorate for Roads of Viet Nam (DRVN) under Prime Minister Decision No.107/2009 /QD-TTg dated August 26 2000, which was replaced by Prime Minister Decision No.60/2013/QD-TTg dated October 21 2013. The decision approves 16 departments and five non business units under DRVN, and Infrastructure Department was dissolved and Traffic Safety Department, Road Maintenance and Management Department were established. **Figure 3.2.2** shows DRVN organization chart.

Prime Minister's Decision No.60/2013/QD-TTg,<sup>1</sup> dated October 21 2013, stipulates new functions, tasks, powers and organization structures for DRVN. Accordingly, previous non-productive organization of RRMUs were reformed to the administrative organizations of

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<sup>1</sup> Prime Minister Decision, No.60/2013/QD-TTg dated on October 21 2013, on "To regulate Function, Duty, Authority and Organization Mechanism of Directorate for Roads of Vietnam under Ministry of Transport".

Regional Road Management Bureau (RMBs), and also administrative organization of Road Management Subsidiary Bureaus (SBs) were formed under RMBs, as state management on road and management organization, maintenance, protection of assigned national highway at grassroots level.



Source: DRVN, 2016

Figure 3.2.2 DRVN Organization Structure

## 2) Roles and Responsibilities

DRVN's major roles and responsibilities under MOT, which defined in the Prime Minister Decision No.60/2013/QD-TTg dated October 21, 2013, are stated below. Its main responsibility is to manage and maintain national road infrastructures in Viet Nam.

- To draft Laws and legal documents, plan strategies including long-term, five-year and annual plans and develop national projects and programs in the road sector,
- To formulate national standards, national technical regulation and norms on road sector,
- To manage road infrastructure including operation and maintenance,
- To manage road transport infrastructure construction and investment,

- To manage road transport,
- To improve road traffic safety,
- To improve environment protection in road transport,
- To conduct research on scientific improvements and technology transfer in road transport sector.

In addition to the responsibility for national road maintenance and management, Circular No.52/2013/TT-BGTVT issued by MOT on December 12,2013 stipulates DRVN responsibility for the construction and development of the national roads. DRVN is given authority of construction management for Group-B an project according to Decree No.11/2010/ND-CP on Prescribing the management and Protection of Road Traffic Infrastructures issued on February 24, 2004. The construction projects are being carried out by procurement from local construction enterprises. For managing construction projects, there are four (4) Project Management Units (PMUs) currently positioned under DRVN jurisdiction.

### (3) RMBs

#### 1) Organization Structure

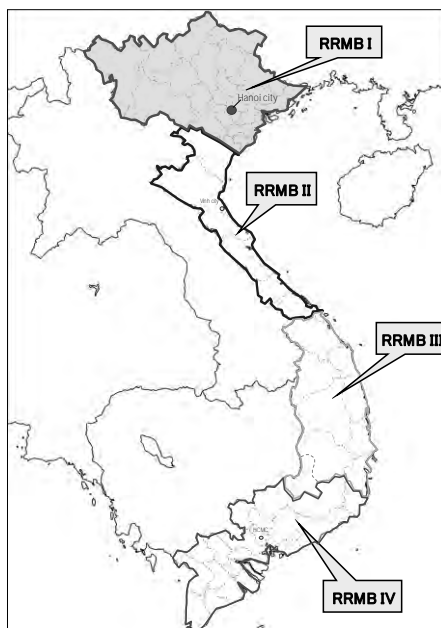
Regional Road Management Bureau, RMB, is a State Management agency under DRVN renamed after Regional Road Management Unit (RRMUs) based on Decision No.60/2013/QD-TTg. Following the Government’s restructuring policy of agencies, former non business units (RRMUs) were restructured to the state management authority performing the state management functions of road transport, maintenance and repair of national road infrastructure in the regional areas.

Currently, RMBs are in charge of the national road maintenance and management in the regions, dividing the whole country area into four regions; RMB I for Northern area, RMB II middle Northern area, RMB III middle southern area and RMB IV southern area as shown in **Table 3.2.2** and **Figure 3.2.3**. The national road under the jurisdiction of RMBs accounts for 8,553 km in total length, about 40.5 % of the entire national road network. Remaining sections of the national roads are managed and maintained by PDOTs under PPCs. RMBs also operate a range of medical and welfare services and have access to their local Vocational Training College, mainly oriented at present to provide technical and grass-roots managerial training to technicians and foreman-grade staff. **Figure 3.2.4** illustrates a RMB III organization chart.

**Table 3.2.2 Outline of RMB Administration**

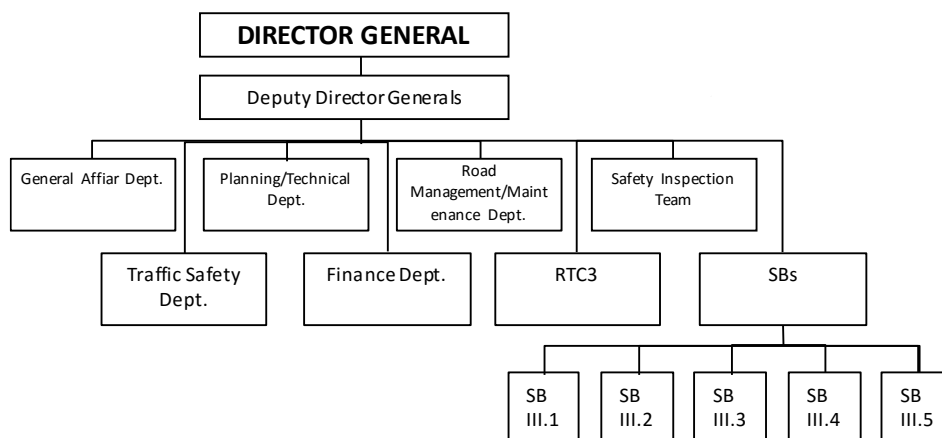
Items	RMB I	RMB II	RMB III	RMB IV
1 Location	Hanoi city	Vinh City	Da Nang City	HCMC
2 Jurisdiction region	Northern	North Central	South Central	Southern
3 Number of province/city under the jurisdiction	25	6	11	21
4 Total length of National Roads under the jurisdiction of direct management *	1994.35	2,577.28	1,538.42	2,443.42

Source: JICA Project Team 2015. (\*) Total length of national roads to be updated.



Source: JICA Project Team

**Figure 3.2.3 RMB Jurisdiction**



Source: RMB III, 2015

**Figure 3.2.4 RMB Organization Diagram (RMB III)**

## 2) Roles and Responsibilities

Roles and responsibilities of RMBs are stipulated in the Decision No.2173, 2174, 2175 and 2176/QĐ-BGTVT dated on December 10, 2013 and Decision No.131,132,133,134/ QĐ-TCDBVN dated January 15 2014, which all replaced to Decision No.2207,2208,2209,2010/QĐ-TCDBVN dated September 24 2014.

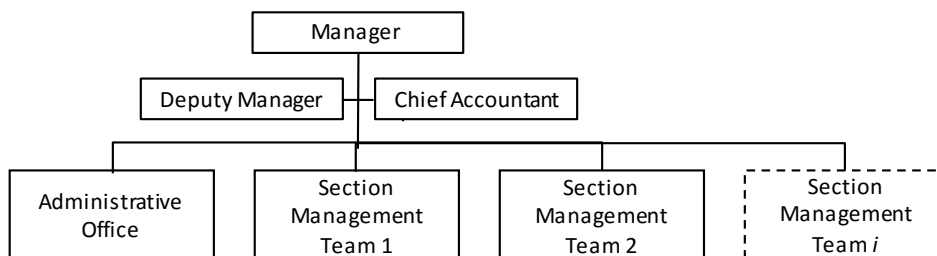
Some of their major assignments pertinent to the national road maintenance and management, are extracted from the above Decision and listed below. However, their main responsibility is to implement state managerial tasks on road transport mandated by DRVN.

- To plan the following and submit to DRVN for approval;
  - ✓ Long term, 5-year, annual plans, programs, projects, proposal on road transportation in its jurisdiction.
  - ✓ Regulations, standards, codes, economical-technical norms on management, maintenance and operation of road infrastructures.
- To implement state managerial tasks on road transport;
- To organize the management and maintenance of national highway system in assigned area according to regulations and norms about road management and maintenance;
- To formulate annual plans of road management, maintenance to submit to DRVN;
- To formulate price of public products, service in road management, maintenance for appraisal;
- To conduct routine maintenance for assigned highway sections;
- To act as Decision Maker or Project Owner in projects as delegated;
- To conduct inspection on compliance of regulations, procedures, norms;
- To conduct operation (or leasing) of road infrastructures as regulated.
- To assure smooth traffic along the National Highways within jurisdiction

**(4) Sub Bureaus**

**1) Organization Structure**

Regional Road management Subsidiary Bureaus (SBs) is established based on the Decision No.60/2013/QD-TTg and Decision No.4038/QD-BGTVT dated December 9 2013 as the stage management responsible for management and protection of infrastructure of the national road in the provinces under jurisdiction of each RMBs. 8 sub bureaus under RMB I, 6 sub bureaus under RMB II, 5 sub bureaus under RMB III, and 7 Sub bureaus under RMB IV.



**Figure 3.2.5 SBs Organization Diagram**



## **2) Roles and Responsibilities**

Roles and responsibilities of SBs are stipulated in Decision No. 258, 259, 260 and 261/QĐ-TCĐBVN dated February 11 2014. Managing RMBs is assigned to revise and manage scope of SBs as necessary. Some of their major assignments are as follow;

- To manage and protect assigned national roads:
- To urge, check, supervise and accept frequent maintenance and periodical repair:
- As for specialized inspection:
  - ✓ Construction and implementation of RMB's specialized inspection plans;
  - ✓ Implementation of specialized inspections for infrastructure protection; giving advice to RMB on punishments against violations;
- To ensure smooth traffic flows on national roads under management
- To manage, restore spare material stores for traffic control; to manage the usage of rescue equipment and motorbikes (if any) to support road rescue in the region under management;
- As for authorized national roads and local roads, coordinate with DOTs and functional agencies in management of activities on the road network, and updating local road infrastructure development;

### **(5) RTCs**

There are five (5) RTCs assigned to the maintenance and management of the national roads; four (4) of which belong to RMBs and one belongs to DRVN in Hanoi. All RTCs were public non business units<sup>2</sup> which were allowed to raise profits from contract-based consulting works, material testing, supervision, design, etc.

However, Prime Minister Decision, No.208/QĐ-TTg issued on February 3<sup>rd</sup> 2016 approved the reform plan of operational mechanism for public non-business units in line with the Government's decentralization policy. In this Decision, RTCs including RTC-Central, RTC-1, RTC-2, RTC-3 and RTC-4 shall be privatized within the period towards 2020.

### **(6) PDOT**

Department of Transportation (PDOT), which belongs to the regional administration of PPCs, has been also involved in the maintenance and management of the national roads in accordance with the Joint Circular No.12/2008/TTL-BGTVT?BNV. At present, there are fifty PDOTs involved in the national road maintenance and management as of December 2014.

At present, PDOTs are responsible for the maintenance of 10,815 km of National Roads, thus half of the National Roads are managed by DRVN through RMBs and the other half is managed by

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<sup>2</sup> There are two types of public business units 1) Public non business units whose operational cost are obtained from state budget partly or fully, and whose leaders are civil servants. 2) Public non business unit whose operational cost are not obtained from state budget (so called self-financed public non business unit), whose leaders are public officials.

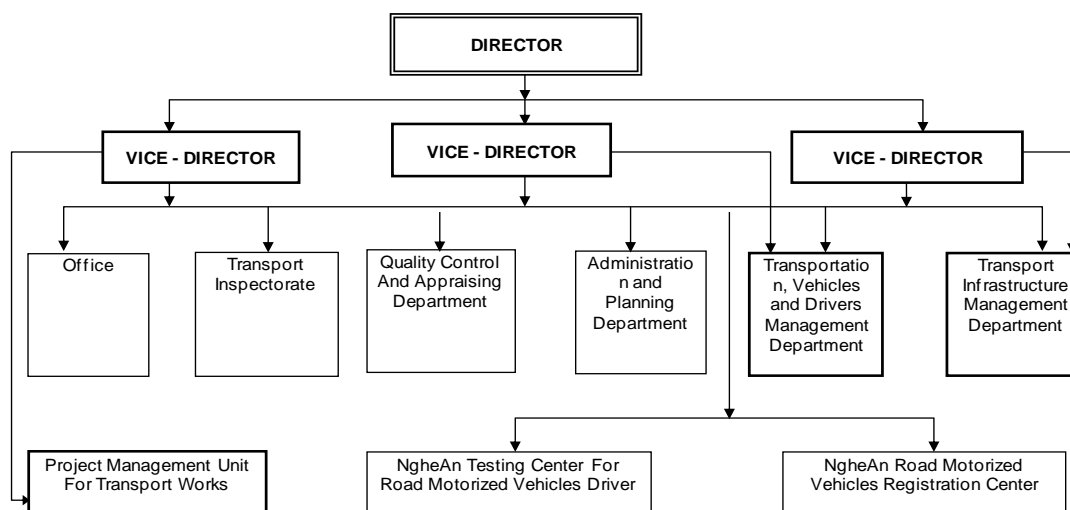
PDOTs. As the case of RMBs, the national road maintenance work is also undertaken by 65 subordinate bodies, so-called Provincial Road Repair and Maintenance Companies (PRRMCs) including government-owned enterprises and privatized companies. **Table 3.2.3** shows the outline of PDOTs jurisdiction. **Figure 3.2.6** shows an organization structure of PDOT in Nghe An Province

**Table 3.2.3 PDOTs Jurisdiction**

Regional Road Management Units	No. of Organizations	Length of National Roads under their jurisdiction (km)	Responsibilities	PRRMCs (No. of companies)
PDOTs	50	10,815 km	Road maintenance of National roads and Provincial Roads	65

Source: Data of National Highway System, DRVN, May 2015

Note: Length of National Highways is as of 31st December 2014).



Source: PDOT Nghe An (May, 2010)

**Figure 3.2.6 PDOT’s Organization Structure (Nghe An Province)**

**(7) Cooperating Agencies**

**1) Institute of Transport Science Technology (ITST)**

ITST was established as a material testing laboratory under MOT in 1956. After the two times of restructuring, Present ITST organization was established in 1966. ITST is a public business unit, which is run with MOT funds and its own funds financed by their consulting services. ITST headquarters is located in Hanoi, and its branches in Da Nang and Ho Chi Minh City with in total of 617 staff. Total budget in 2013 was 220 million VND, and within which 14% from MOT and remaining 86% is from consultant service.

However, Prime Minister Decision, No.208/QĐ-TTg on February 3<sup>rd</sup>. 2016 approved the reform of ITST in line with the Government’s decentralization policy. In accordance with this Decision, ITST shall be privatized for the period between 2021 and 2030.

## **2) University of Transport and Communications (UTC)**

UTC is currently under the management of Ministry of Education and Training (MOET), which previously under the management of MOT. Therefore many of MOT and DRVN staff and officials were graduated from UTC and still contribute to the capacity development of engineer in the field of transport. Current number of student is 32,000. Following shows departments under UTC.

- Civil Engineering Department (currently collaborating with JICA Phase II)
- Mechanical engineering Department
- Electrical & Electronic Engineering Department
- IT Department
- Transport Economics Department
- Institute of Construction Engineering
- Institute of Transport Safety and Environment
- Institute of Transport Planning and Management

## **3) University of Transport and Technology (UTT) and Secondary School**

MOT has the University of Transport Technology (UTT) and Secondary Schools in its organization. UTT focuses on technical training of engineer and technicians on such as survey, laboratory, construction technology, whereas UTC focuses on academic activities such as research and development, preparation of technical standards, participation to acceptance.

In accordance with the Prime Minister Decision, No.208/QĐ-TTg issued on February 3<sup>rd</sup> 2016, UTT shall be strengthened to be the key national university for the period from 2021 to 2030.

### **3.2.2 Regulations for Road Maintenance and Management**

The following are the major regulations closely associated with responsibility assignment of state management and road maintenance procedures. List of regulations reviewed by the Project are shown below;

#### **(1) Regulations Relevant to Responsibility Assignment**

- LAW ON GOVERNMENT ORGANIZATION No.76/2015/QH13, 19 June 2015
- DECREE No. 107/ND-CP, Government, 20 December 2012
- DECISION No. 60 /QĐ-TTg, PRIME MINISTER, 21 October 2013
- DECISION No. 2150/QĐ-TCĐBVN, DRVN, 6 December 2013
- DECISION No. 2151/QĐ-TCĐBVN, DRVN, 6 December 2013
- DECISION No. 400/QĐ-TCĐBVN, DRVN, 6 March 2014
- DECISION No. 2234/QĐ-TCĐBVN, DRVN, 18 December 2014
- DECISION No. 365/QĐ-TCĐBVN, DRVN, 21 March 2011

- DECISION No: 4038/QĐ-BGTVT, MOT, 9 December 2013
- DECISION No. 2207/QĐ-TCĐBVN, DRVN, 24 September 2014
- DECISION No. 2208/QĐ-TCĐBVN, DRVN, 24 September 2014
- DECISION No. 2209/QĐ-TCĐBVN, DRVN, 24 September 2014
- DECISION No. 2210/QĐ-TCĐBVN, DRVN, 24 September 2014
- DECISION No. 258/QĐ-TCĐBVN, DRVN, 11 February 2014
- DECISION No. 259/QĐ-TCĐBVN, DRVN, 11 February 2011
- DECISION No. 260/QĐ-TCĐBVN, DRVN, 24 February 2011
- DECISION No. 261/QĐ-TCĐBVN, DRVN, 11 February 2014

**(2) Regulations Relevant to Maintenance Procedures**

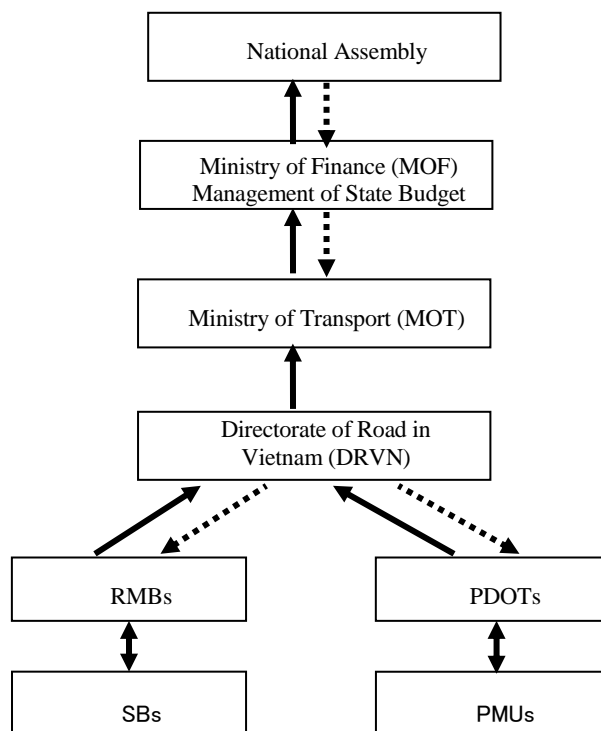
- LAW ON CONSTRUCTION, No.50/2014/QH13, 18 June 2014
- LAW ON PUBLIC INVESTMENT, No.49/2014/QH13, 18 June 2014
- LAW ON STANDARDS AND TECHNICAL REGULATIONS, No.68/2006/QH11, 29 June 2006
- LAW ON ROAD TRAFFIC, No.23/2008/QH12, 13 November 2008
- LAW ON BIDDING, No.43/2013/QH13, 26 November 2013
- Decree No.10/2013/ND-CP, 11 January 2013
- Decree No.11/2010/ND-CP, 24 February 2010
- Decree No.18/2012/ND-CP, 13 March 2012
- Decree No.32/2014/ND-CP, 23 April 2014
- Decree No.46/2015/ND-CP, 12 May 2015
- Decree No.59/2015/ND-CP, 18 June 2013
- Decree No.77/2015/ND-CP, 10 September 2015
- Decree No.114/2010/ND-CP, 6 December 2010
- Circular No.52/2013/TT-BGTVT, 12 December 2013
- Circular No.47/2012/TT-BGTVT, 12 November 2012
- Circular No.20/2014/TT-BGTVT, 30 May 2014
- Decision No.2988/QĐ-BGTVT, 6 August 2014
- Decision No.06/Decision-VRA, 4 January 2007
- DRVN DOCUMENT No.4754/TCĐBVN-KHDT, 4 September 2015
- Directive No.23/CT-TTg, 5 August 2014

**3.2.3 Annual Budget Proposal and Distribution**

Figure 3.2.7 shows the flow of budget proposal and distribution. Budget proposal for road maintenance originates from the regional organizations of RMBs and PDOTs to DRVN, MOT and MOF step-by-step. As regards the budget proposal for the national road maintenance under

PDOT jurisdiction, draft proposal are first assembled to DRVN and then proposed to MOT and MOF together with DRVN own budget proposals. To be noted here is that there is no coordination between regional agencies on road maintenance planning and budgeting. Draft budget proposals are sent to DRVN separately without any coordination. With this, planning capacity of RMBs and PDOTs is deemed critical to formulate maintenance plans in the budget proposal every year.

The budget proposal and distribution procedures follow the following steps;



Source: JICA Project Team

**Figure 3.2.7 Budget Proposal/Distribution Flow**

### (1) Processes of Budget Proposal

The process is stipulated in Chapter 4, Article 18, establishment, approval and adjustment of road works maintenance plan, and circular 52. The following the outline of these processes.

- SBs inspect road facilities of assigned section and submit Draft maintenance plan to RMBs.
- DPI of RMBs reviews the plan of SBs.
- In case of any maintenance required, DPI of RMBs submit budget plan to DRVN.
- DRVN Survey team including Department of Transport Infrastructure (DTI) of MOT, conduct survey in the field.
- Base on the survey results, select sections to conduct repair and priorities.
- Based on priorities, DPI of DRVN prepares budget plan for following year and submit to MOT.

- On receiving the proposal from DRVN, MOT examines again the contents and sends the MOT plan to Ministry of Finance, where budget proposals assembled from various ministries are examined again referring to the expected revenue amounts.
- The final budget proposal is subject to the decision of the National Assembly.

**(2) Processes of Budget Distribution**

- After National Assembly approved the budget, MOF shall decide to allocate the estimated amount to MOT.
- Then, MOT shall order DRVN to draft budget distribution plans to the regional agencies and report to MOT.
- After appraising these draft plans, MOT shall make a final decision on the budget allocation to the regional RMBs and PDOTs for the national road maintenance.
- DRVN convene a meeting with all RMBs and PDOTs to reallocate the budget constrained.
- Following the decision made at the meeting, RMBs and PDOTs reorganize renew their initial annual maintenance plans, work out new implementation plans and send them to DRVN for approval.
- Upon approval, RMBs and PDOTs move forward to the next step of making maintenance contracts with maintenance companies.

**(3) Current Budget Status**

DRVN has been faced with a chronic shortage of the national road maintenance budgets. **Table 3.2.4** shows proposed and distributed budgets for the past 14 years, and **Figure 3.2.8** also shows the growth of proposed and allocated budgets for this period.

It is often said that budget distribution can meet only 40 to 50% of the budget requirement. One of the reasons for this is that budget allocation keeps growing in recent years, but price escalation of unit costs (labor and materials) is much higher than the growth of budget allocation, which resulted in the reduction in work volumes.

Due to the budget constraint, RMBs and PDOTs cannot but directing their energy to the most seriously damaged roads structures and conducting reactive maintenance or repair works. In addition, this may discourage field engineers to follow existing maintenance norms and standards.

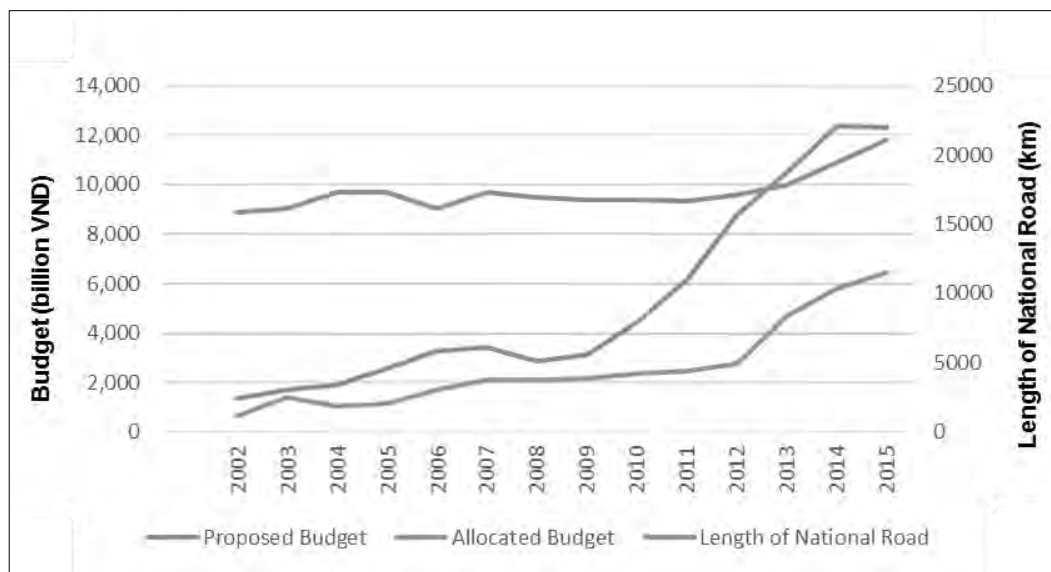
**Table 3.2.4 State Budgets for Maintenance, Repair Works and Construction**

Unit: million VND

	Proposed Budget			Allocated Budget			
	Total	Routine Maintenance	Periodical Maintenance & Unscheduled Maintenance	Total	Routine Maintenance	Periodical Maintenance & Unscheduled Maintenance	Basic Construction (Group C)
2002	1,352,087	264,197	1,087,870	661,791	182,680	416,480	62,631
2003	1,694,910	311,310	1,383,600	1,382,017	243,990	640,417	497,610
2004	1,885,155	328,605	1,556,550	1,056,484	284,200	700,384	71,900
2005	2,583,809	381,502	2,202,307	1,137,392	326,180	811,212	0
2006	3,272,701	474,796	2,797,905	1,704,300	433,000	1271,300	0

	Proposed Budget			Allocated Budget			
	Total	Routine Maintenance	Periodical Maintenance & Unscheduled Maintenance	Total	Routine Maintenance	Periodical Maintenance & Unscheduled Maintenance	Basic Construction (Group C)
2007	3,400,400	510,060	2,890,340	2,101,992	469,797	1405,015	227,180
2008	2,860,000	690,000	2,170,000	2,080,889	518,892	1384,628	177,369
2009	3,126,400	757,288	2,369,112	2,140,328	546,611	1,451,517	142,200
2010	4,424,000	1,028,000	3,396,000	2,380,717	627,089	1,697,242	56,386
2011	6,167,980			2,481,968			
2012	8,797,338			2,750,758	914,311	1,836,447	8,797,338
2013	10,491,247	2,890,051	7,601,196	4,667,990	1,148,579	3,519,411	10,491,247
2014	12,356,860	3,788,188	8,568,672	5,784,309	733,515	5,050,794	12,356,860
2015	12,308,486	4,261,365	8,047,121	6,474,926	721,480	5,753,446	12,308,486

Source: DRVN (2015)



Source: JICA Project Team

Figure 3.2.8 Growth of Budget Proposal and Distribution

### 3.2.4 Road Maintenance Fund

In January 2013, MOT has introduced Road Maintenance Funds in order to tackle the chronic shortage of road maintenance budget in accordance with Law on Road Traffic (No.23 / 2008 / QH12 enforced on July 1, 2009), Decree No.18/2012/ND-CP dated in Mar. 13, 2012, and Circular No.197/2012/TT-BTC dated in Nov. 15, 2012. Following summarized the outline of Road maintenance funds.

The Fund is divided into Central Fund and Local Fund. Central Fund is used for national road maintenance, and Local Fund is used for provincial road maintenance managed by PPCs.

Funding source is road user charge collected every year. Road user is to pay road user charge stipulated in circular at the time of vehicle registration. The charge is categorized by 4 wheel vehicle and motor cycle.

After the 1 year and 2 year of road use, discount is applied to road user charge. Annual road user charges by vehicle types and Annual road user charged by Motor cycle are shown in **Figure 3.2.5** and **Figure 3.2.6**.

Collected charges are divided into 65% to Central Fund, and 35% to Local Fund.

In addition to funding source from road user charges, Central Fund receives grant from central government, and Local Fund receive grant from PPCs.

According to DRVN, Road Maintenance Fund is applied to institutionalized road maintenance activities, and not applied to activities not institutionalized such as pavement condition survey carried out by JICA and WB.

**Table 3.2.5 Annual road user charges by vehicle types**

	Vehicle Type	Specification	Annual Charges (×1,000 VND)
1	vehicle (1)	Privately registered Vehicle, Less than 10seats	1,560
2	vehicle (2) Truck	Less than 10seats Total weight below 4t	2,160
3	Trailer	Total weight 4 ~ 13 t	2,760
4	vehicle (3) Truck	10~25seats Total weight 4~8t, Total weight below 8.5t	3,240
5	Trailer	Total weight 13 ~19t	4,200
6	Bus/ Truck	25~40seats Total weight 8.5~13t, Total weight below 8.5t	4,680
7	Trailer/ Semi Trailer	Total weight 19~27t, Total weight below 27t	5,160
8	Bus/ Truck	More than 40 seats Total weight above 19 t	7,080
9	Trailer	Total weight above 27t	7,740
19	Truck	Total weight above 19~27t	8,640
11	Truck	Total weight above 27t	12,480

(Note) 1000VND = JPY 5.2 (As of 2014.9)

**Table 3.2.6 Annual road user charged by Motor cycle**

	Vehicle Type	Specification	Annual Charges (×1,000 VND)
1	Motor Cycle	Engine Capacity: below 100 CC	50 – 60
2	Motor Cycle	Engine Capacity: above 100 CC	100 - 150
3	4 wheel Motor cycle	1 氣筒	2,160

### 3.2.5 Classification of National Road Maintenance

Management, Operation, and maintenance of road works is stipulated by Transport Minister in Circular No.10/2010/TT-BGTVT, April 19 2010, which is now replaced by Circular 52/2013/TT-



BGTVT, December 12, 2013 and amended by Circular 20/2014/BGTVT, May 30 2014 adjusting some articles of Circular 52. The Circular provides the classification of national road maintenance works which fall in three works; 1) routine maintenance and 2) periodical repair and 3) unscheduled maintenance. The following is the outline of these works.

**(1) Routine Maintenance**

Routine maintenance works are those carried out regularly on a daily, weekly, monthly or quarterly to monitor the status of the roads, to introduce solutions to prevent damages and failures, to repair minor damages, which may affect the quality of the roads, and to maintain normal operating status of the roads to ensure smooth and safe traffic.

**(2) Periodical Repair**

Periodic repair works are those carried out according to the frequencies stipulated in Circular 52/2013/TT-BGTVT, The work aims to restore road structures from defects incurred during road operation and to recover the strength-ensuring road and traffic functions. This Circular also stipulates that periodical repair for bridges be based on structure inspections and field experiments.

**(3) Unscheduled Maintenance**

Unscheduled Maintenance, which is sometimes translated into irregular maintenance, is to be carried out to failures or damages caused by natural disasters such as floods, typhoons or other unexpected incidents.

Besides road maintenance works categorized in Circular 52/2013/TT-BGTVT, DRVN is also assigned construction projects, includes a new road construction and development works such as reconstruction, realignment, widening and other large-scale civil works. The construction works whose responsibilities assignments belong to DRVN are Group-B and Group-C project, and Group-A project belongs to the responsibility of Ministry of Transportation. Group-B and C project are to be principally implemented by PMUs under DRVN jurisdiction, where five PMUs are now in operation.

**3.2.6 Road Maintenance Plan**

Annual Maintenance Plan and 3 year Road Maintenance Plan have been officially applied to the national road maintenance and management. In particular, the 3 year maintenance plan indicates long/mid-term investment perspectives of maintaining national road assets. In conjunction with these plans, systematization of planning tools for the 3 year road maintenance plans have been made since early 2000's upon receiving international donor assistance, focusing on the pavement facilities of the national roads. Recently in 2013, the above 3 year road maintenance plan is officially upgraded to 5 year road maintenance plans. On the other hand, an annual plan has been playing a key role in formulating a budget proposal. Further details of these plans are elaborated below:

**(1) Annual Plan**

Annual road maintenance plan is the prevailing means of formulating a budget plan. Regional agencies, including RMBs and PDOTs, play a key role in organizing the annual plan. Annual plan includes the budget plans for routine maintenance and periodic maintenance consisting of medium repair and big repair. The annual plan is absolutely based on the accumulation of maintenance costs following predetermined maintenance norms and standards. In formulating annual plans, much effort has been directed to repair works plan rather than routine maintenance plans, since works for the routine maintenance are prescribed in the maintenance norms and standards and a simple formula of budget estimate is presented. Allocated budget is normally reduced largely from proposed budget. Therefore at DRVN, regional agencies re-plan based on allocated budget for approval of DRVN.

**(2) 5-Year Road Maintenance Plan**

Medium Term plan for national road maintenance an official plan for DRVN and requires approval of MOT. DRVN promulgated the correspondence, No.1481/TCDBVN-KHDT dated on April 12 2013, giving instruction of development of mid-term plan in 2014-2016 for road infrastructure maintenance to RMBs and authorized PDOTs, which was issued upon receiving MOT Decision No.438/QĐ-BGTVT dated on March 6 2013. In September 2015, pursuant to Decree No.77/2015/ND-CP on annual and medium term public investment plan dated 10th September 2015, DRVN updated duration of mid-term plan from 3 year to 5 year.

**3.2.7 Standards and Norms for Road Inspection and Maintenance**

Routine maintenance including road facility inspection have been currently carried out in accordance with two standards; (1) Road Maintenance Norm 2014 (Decision No.3409/QĐ-BGTVT dated in September 08, 2014, and (2) Specification on Road Routine Maintenance TCCS 07:2013/TCDBVN (Decision No.1682/QĐ-TCDBVN).

**(1) Road Maintenance Norms 2014**

Road Maintenance Norms 2001, which is replaced to Road Maintenance Norm 2014 (Decision No. 3409/QĐ-BGTVT dated in September 08, 2014, is applied to the routine maintenance of the national roads. It stipulates information on norm issues including pay items, units of cost estimate, standard norms for labor and equipment. Generally, Road Maintenance Norms 2014 plays an important role in estimating routine maintenance costs.

**(2) Specification on Road Routine Maintenance TCCS 07: 2013/TCDBVN**

Specification on Road Routine Maintenance, TCCS 07:2013/TCDBVN (Decision No.1682/QĐ-TCDBVN), is disseminated as the second version of Technical Standard on Road Routine Maintenance 22 TCN 306-03 with supplementations and updates. The purpose of the Specification is to serve current need of road routine maintenance and management work for national roads. The

Specification shall be enhanced continuously during the use process hereafter, taking account of constructive opinions to be issued specialists, scientists, consulting firms, road construction and management units.

This Specification regulates technical requirements and provides some guidelines on the inspection and the routine maintenance of national roads managed by central and local agencies. This standard does not apply to periodical and unscheduled maintenance work of national roads, neither to provincial roads and local roads from communal level and below. For bridges on roads, this standard applies to small bridges. Special regulations specialized for the routine maintenance have been prepared separately for medium and big bridges.

The Specification regulates the following activities as main routine road maintenance activities; pavement crack sealing, pothole patching, repair slope protection, repair road geometry, vegetation control, drainage damage repair, masonry damage repair, mesh gabion repair, traffic management and safety and facility repair, painting and so forth,

**1) Routine Inspection:**

Road patrolling is the most prevailing inspection method which is implemented based on Decision No.47/2012/TT-BGTVT. The road patroller conducts visual inspection, checks, detects and records daily incidents occurring to the road system in line with the road-patrolling manual. Patrol staffs also do some minor tasks such as the repair on deteriorated marker posts and removal of rocks from roadway.

**2) Periodic Inspection:**

The periodic inspection is implemented monthly and quarterly for road structures and twice a year for bridge structures. In the quarterly inspection, RMBs and PDOTs staffs participate in the inspection.

**3) Special Inspection:**

Special inspection has never been done so often, but as required or in case of emergency, since the special inspection need special survey equipment for analytical evaluation. RTCs have been engaged in the special inspection on a contract basis. In the past, the special inspections have been carried out three times, in 2001, 2004 and 2007, to prepare for the data needed for the DRVN's HDM-4 trial.

**(3) Implementation Body**

All of the regional agencies are more or less involved in the road inspection. In General, road maintenance contractors conduct the routine inspection by patrolling. On the other hand, the periodic and the special inspection are principally carried out by RMBs and PDOTs.

**(4) Diagnosis of Road Structures**

**1) Pavement damage evaluation**

Specifications of Road Routine Maintenance 2013 stipulate the evaluation criteria for asphalt pavement and flexible pavement without surface treatment. Scoring methods is applied to the rating of pavement damages. Pavement evaluation is to be done for the pavement damages including cracks, potholes, loss of pavement materials, roughness, edge break etc. by applying 0 to 5 point scoring methods.

**2) Road quality evaluation**

Based on the damage levels of pavement including pavement strength, roughness, flatness etc., road maintenance grade level can be evaluated, classifying road conditions into “Good level”, “Medium level”, “Bad level” and “Very Bad level” as shown in **Table 3.2.7**.

**Table 3.2.7 Grade Conditions and Supplemental Criteria for Grade A2 Pavement Case**

Order	Road Classification	Pavement facility		
		Cement concrete, Asphalt concrete	Asphalt treated, penetrated macadam	Natural macadam, aggregate
1	<p><u>1. Good type</u> Roads with stable embankment, not sliding, width as the original, undamaged, cleared culvert, ditch. The pavement maintains intact without crack, spongy.</p> <ul style="list-style-type: none"> <li>- Maximum pothole, come-off</li> <li>- IRI index</li> <li>- Strength (compared to Requirement)</li> <li>- Roughness (Htb) corresponds to speed</li> </ul> <p><math>80 \leq V \leq 120</math> km/h</p>	<p>0% <math>IRI \leq 2</math> 100% <math>0.45 \leq Htb \leq 0.8</math></p>	<p>0% <math>IRI \leq 4</math> 100%</p>	<p>0.5% <math>IRI \leq 6</math></p>
2	<p><u>2. Medium type</u> Stable embankment, not sliding, width as the original, undamaged, cleared culvert, ditch. The pavement maintains intact without big cracks, there is spongy but its area does not exceed 0.5%, small cracks only (crack width <math>\leq 0.3</math>mm) and only cracks in each area 2-3m<sup>2</sup></p> <ul style="list-style-type: none"> <li>- Maximum pothole, come-off</li> <li>- IRI index</li> <li>- Strength (compared to Requirement)</li> <li>- Roughness</li> </ul>	<p>0.1% <math>2 &lt; IRI \leq 4</math> 90 - 99%</p>	<p>0.5% <math>4 &lt; IRI \leq 6</math> 90 - 99%</p>	<p>1% <math>6 &lt; IRI \leq 9</math></p>
3	<p><u>3. Bad Type</u> Slope protection of embankment is slid, roadside is settled, pavement is continuously cracked whose width is from 0.3-3mm. At the same time, there is pavement spongy from 0.6-1%</p> <ul style="list-style-type: none"> <li>- Maximum pothole, come-off</li> <li>- IRI index</li> <li>- Strength (compared to Requirement)</li> <li>- Roughness</li> </ul>	<p>0.3% <math>4 &lt; IRI \leq 6</math> 80-89%</p>	<p>1% <math>6 &lt; IRI \leq 8</math> 80-89%</p>	<p>3% <math>9 &lt; IRI \leq 12</math></p>
4	<p><u>4. Very bad type</u> Pavement is deflected, slope protection is slid, pavement is heavily cracked, the crack is thick and <math>&gt; 3</math>mm. With asphalt treated pavement, macadam, aggregate start to be peel off in each area.</p> <ul style="list-style-type: none"> <li>- Maximum pothole, come-off</li> <li>- IRI Index</li> <li>- Length (compared to Requirement)</li> <li>- Roughness</li> </ul>	<p>0.5% <math>6 &lt; IRI \leq 8</math> &lt;80%</p>	<p>3% <math>8 &lt; IRI \leq 10</math> &lt;80%</p>	<p>5% <math>12 &lt; IRI \leq 15</math></p>

Source: Specifications of Road Routine Maintenance 2013

**(5) National Standards and MOT Standards**

At present, technical standards specialized for periodic repair are not available, but construction standards have been applied to the periodic repair. There are two (2) types of standards applicable for the repair works; 1) those prepared by Ministry of Science and Technology as National standards called TCVN, and 2) those prepared by MOT as ministerial level standards called as Basic Standard, TCN. MOT published over 100 road design and construction standards edited into 13 volumes.

An instance of medium repair work explains that a project for the national road No.1 near Da Nang City, where a medium repair work worth of 1.4 billion VND was carried out with a thin layer asphalt surface placed on the pavement, incorporated three TCNs; 22TCN 271-01, 22TCN 282-02 and TCN 237-01. However, the field survey also has reported that there is a strong desire for establishing technical standards specialized for repair works, since there are big differences in working conditions between road maintenance and road construction. In particular, maintenance is in general implemented with traffic opened to the public..

**(6) Responsibility Assignment for Making Maintenance Standards**

The authority of making standards regarding the routine maintenance used to belong to Ministry of Transport. However, MOT decentralized the authority, assigning this task to DRVN by Circular 52/2013/TT-BGTVT, December 12, 2013 on providing for Road Administration and Maintenance. Article7 in the Circular prescribes that “DRVN is assigned the tasks of formulating, appraising and announcing basic technical standards on regular road maintenance”. However, the authority appears to be limited to making the technical standards for the routine maintenance. The Circular also prescribes that the standards and norms used for the capital construction works should be applied to the repair works or the unscheduled maintenance works.

**3.2.8 Quality Management of Road Maintenance and Acceptance**

Service-level requirement is prepared in the Specifications of Road Routine Maintenance 2013 for the inspection and the acceptance of routine maintenance works on the national roads. **Table 3.2.8** shows a sample evaluation criteria of the service level for road facility inspection and routine maintenance. Service levels requirements are prepared in the Specifications 2013 for the road facility shown in the table, traffic safety facility, drainage systems, plans and grass control, bridge facility, embankment and slope protections and lighting systems.

**Table 3.2.8 Service Level of Road Facility Inspection and Routine Maintenance**

Item	Required service level	Inspection method	Required time of repair or allowable error
Pothole	Without pothole	Inspection by eyes	Repair must be done within 2 days right after finding out
Patching	Patching must be: - Square or rectangular; - Equal to surrounding pavement;	- Inspection by eyes - Measuring tape and ruler 3m (checking flatness of	Patching do not follow requirement must be repaired within 14 days after being found.

Item	Required service level	Inspection method	Required time of repair or allowable error
	<ul style="list-style-type: none"> <li>- Patched with materials similar to those of surrounding;</li> <li>- There is no crack wider than 3mm around the patching.</li> </ul>	<ul style="list-style-type: none"> <li>the patching with surrounding pavement</li> <li>- Totally clear ruler (to measure crack)</li> </ul>	
Pavement crack (Longitudinal and horizontal cracks)	It is not allowed to have any cracks wider than 3 mm.	Measure crack width by totally clear ruler. For single cracks, crack area is calculated by width of 0.5m.	Crack wider than 3 mm must be treated within 28 days after finding.
Net crack on pavement (crocodile skin crack)	In 50 m long of pavement, crack area is not over 10% of road surface.	Crack area is pavement part surrounded the crack in rectangular or square shape	Area with much crack must be treated within 28 days after finding.
Cleaning pavement and roadside.	There are no soil, garbage, branch and other obstacles in the pavement.	Visual inspection	Soil, dust, garbage and obstacles must be removed within 1 hour if causing danger, traffic unsafety and within 7 days if they do not cause danger, traffic unsafety.
Settlement	There is not settlement deeper than 30 mm. It is not allowed positions deeper than 15mm over 5% of sections regulated in the contract.	Measured by tape.	Allowable settlements must be repaired within 56 days.
Settlement of vehicle strip	There is no vehicle settlement strip over 50 mm. There is no vehicle settlement strip over 25 mm over 5% of sections regulated in the contract.	Measured by tape.	Vehicle strip settlement over allowable level must be repaired within 56 days.
Peeling off	There is no pavement peel-off.	Visual inspection	Peeled off areas must be treated within 28 after finding.
Damage of road edge	There is no damage of road edge (come-off situation)	Visual inspection	Repair must be finished within 42 days after finding.
Elevation difference between roadside and pavement	Elevation difference at pavement edge is not over 50 mm.	Measured by tape	Repair must be finished within 42 days after finding.

Source: Specifications of Road Routine Maintenance 2013

### 3.2.9 Maintenance Management System

#### (1) Road Database Development

Field survey of this study has reported that RMBs and PDOTs preserve many data at their offices including road inventory data, road inspection data, repair history data, road geometry data, pavement deterioration data, environmental data, traffic accident data, road defects/distress and regional condition data. Many of these data has been managed in the forms of hard copy.

##### 1) RoSyBASE

Systematization of DRVN database system began in 2000 by applying RoSy database system to VRA which was first introduced by ADB. RoSy database system is a commercial and a computer-based pavement database for storing road inventory data, pavement condition data and traffic data. The data cover not only physical data, i.e. road lengths, widths etc., but also, traffic and pavement condition data, IRIs, cracks, potholes, traffic volumes, etc. The first data input by RoSy system was carried out by PMU II in the year 2000. JICA SAPI-I supported 2007 data input editing data input manuals and delivering them to the regional agencies

including RMBs, PDOTs, RRMCS, PRRMCS and RTCs in regions nationwide. However, unfortunately, RoSyBASE is not currently operable due to insufficient customization to the national road environment in Viet Nam and low quality data stored in the system.

## 2) Road Asset Database Development

DRVN set out the development of its own road asset database system in 2010 in cooperation with JICA Project for Capacity Enhancement in Road Maintenance. Database is the heart of any management system. Data available in Road Database can be best utilized for various purposes such as asset management and traffic operation management. With this, JICA Project Phase-I developed the framework of road asset databases, focusing on the development of database formats and off-line data input software system.

- Road asset (Road inventory) database.
- Pavement condition database
- Maintenance history database

The Project developed data formats and data input software for 29 road facilities shown in Table 3.2.9. Each of the above database has a table of “Road Main Detail” which integrally contains high priority data at the top of the database structure. Data conversion software will convert data to the PMS Dataset, selecting some from the Road Main Detail table. For example, a road inventory database has about 700 data items and Road Main Detail has 70 data items out of 700 data.

Since October 2015, road asset database development was taken over to World Bank Project (VRAMP) and further development shall be made to these databases and data input shall be also implemented to the databases with high preference.

**Table 3.2.9 Road Facilities in the Road Asset DB (29 Facilities)**

No.	Data Item	Priority	No.	Data Item	Priority
1	Road Main Details	I	16	Road Gradient	II
2	Pavement	I	17	Horizontal Curvature	II
3	Overlap Section	I	18	Slope	III
4	Bridge (VBMS Inventory Module)	II	19	Pedestrian Crossing Bridge	III
5	Road Intersection	II	20	Retaining Wall	III
6	Railway Crossing	II	21	Road Lighting	III
7	Submersible Drainage Facility	II	22	Roadside Plantation	III
8	River Crossing (Ferry, etc.)	II	23	Guard Fence	III
9	Pontoon Bridge	II	24	Disaster Response Storage	III
10	Tunnel	II	25	Median Strip	IV
11	Slab and Box Culvert	II	26	Road Sign	IV
12	Pipe Culvert	II	27	Kilo Post	IV
13	Vehicle Weighing Facility	II	28	Noise Barrier	V
14	Road Disaster Damage Inventory	II	29	Shade Fence	V
15	Pavement Marking	II			

## **(2) Pavement Management System (PMS) Development**

### **1) HDM-4**

HDM-4 has been developed by World Bank and used for over a decade to combine and economic appraisals of road projects and to analyze road network strategies. Since its first introduction to the VRA national roads in 1988, there have been six trials made from 2001 up to 2006 by World Bank and Asian Development Bank. DRVN decided to construct an external database system first, then to convert data from the external database to the dataset needed for HDM-4 analysis. RoSyBASE was expected to play a role as an external database for data conversion. However, HDM-4 finally could not become operable due to system and data trouble of RoSyBASE database system.

### **2) DRVN PMS**

DRVN set out developing DRVN's own PMS in cooperation with JICA Project for Capacity Enhancement in Road Maintenance Phase-I from September 2011 to March 2014 and Phase-II. From February 2015 to March 2018. PMS is focused on the road pavement on the Vietnamese national roads and can help assist road operators to formulate annual and 5-year pavement repair plans based on pavement condition survey data and forecasted future pavement deterioration. PMS system development is currently underway in cooperation with Kyoto University and UTC. PMS is a system to predict future deterioration as well as to formulate annual and Mid-term road maintenance plan utilizing data obtained through pavement condition survey. During the Phase I Project, trial of planning road maintenance plans targeting roads under RMBI jurisdiction was implemented. Currently based on this trial case, system upgrade is now underway and another test trial of planning shall be made for the road network of RMB II, III and IV, and pavement maintenance plan shall be formulated using PMS.

## **(3) Vietnam Bridge Management System (VBMS)**

DRVN reported has reported that there are around 4,500 bridges on the National Road Network and many of them are in poor condition and in need of periodical repair, rehabilitation or reconstruction. Due to the lack of appropriate bridge databases and management systems for planning, it is hard for DRVN to prepare strategic investment plans including priority settlement of the bridges which really need urgent improvement.

In order to cope with these problems, DRVN has decided to develop its own bridge management system, Viet Nam Bridge Management System (VBMS), in 2005 in cooperation with JICA. VBMS covers the functions of bridge inventory database, the function of bridge condition assessment and the function of planning and prioritization of bridges and bridge improvement plans. VBMS consists of the following modules;

- Bridge inventory module



- Bridge inspection module
- Planning and prioritization module
- Administration module

DRVN has already installed some modules on the website for operation including a bridge inventory module, an inspection module and part of planning and prioritization module up until 2015. Currently, DRVN is tackling the upgrade of the planning and prioritization modules.

### **3.3 PROBLEM IDENTIFICATION**

The following are the major findings identified in the problem identification, categorizing problems into three groups; 1) Maintenance technologies and 2) Human capacity development, and 3) Institutional issues.

#### **3.3.1 Maintenance Technology**

##### **(1) Insufficient Road Facility Inspection Standards**

The processes including road inspection, structure diagnosis and maintenance work selection are ones of the key activities in deciding the types and magnitudes of road maintenance and repair works which directly lead to up and down of the maintenance costs. However, the current status study has explained that Specifications of Routine Maintenance 2013 does not provide detailed information on road facility inspection including diagnosis and selection of repair works.

##### **(2) Insufficient Systematization of Planning Tools and Road Database Systems**

DRVN's mid-term planning system is not operable now. As road assets need to be maintained over the long course of road maintenance and taken over to the next generation, it is necessary for a road administrator to conduct maintenance based on the mid-term road maintenance plans in order to find out best economy in the long maintenance period. Sustainable effort is needed to enhance its budget proposal technologies including systematization of planning tools and road database systems.

#### **3.3.2 Human Capacity Development**

##### **(1) Insufficient Training Opportunities Given by Donor Project**

Although there have been many training courses conducted by donor countries since the year 2000 in conjunction with database and planning system development. However, technology transfer has not been well accomplished to the technologies that donor countries introduced to Viet Nam.

##### **(2) Insufficient Training Opportunities for Regional Organizations**

The field survey has clarified that regional agencies are given a few opportunities to undertake training courses and have strong demands for training courses. Their interests on the training

courses include those on the road inspection technology, data registration, database operation and planning of annual budgets.

### **3.3.3 Institutional Issues**

#### **(1) Limited Staffing for Road Maintenance**

DRVN institutional capacity, in particular staff employment including officers and technicians, is currently small and very much limited in number. In order to enhance efficiency in national road maintenance, much effort should be directed to the capacity enhancement of staff and systematization of maintenance work in particular for the activities closely associated with PDCA cycle of road maintenance.

#### **(2) Insufficient R&D Function**

DRVN's current institutional capacity of developing new technologies including software tools and database systems is not sufficient enough. As discussed in the above section, systematization of road maintenance technology is avoidable for DRVN. R&D function plays a role of not only developing, upgrading and maintaining new maintenance technologies, but also providing technical support and training programs to regional organizations.

## **CHAPTER 4 IMPROVE PMS DATA COLLECTION AND PROCESSING TECHNOLOGY (MEASURE 1)**

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### **4.1 ACTIVITY 1-1: FORMULATE PMS DATABASE**

#### **4.1.1 Introduction**

JICA Project for Capacity Enhancement in Road Maintenance in Vietnam Phase I (hereinafter referred to as “The JICA Phase I Project”) has developed Vietnam Pavement Management System (hereinafter referred to as “PMS”) for road maintenance planning including strategic, annual, and mid-term (3-year) maintenance plans. In order to formulate maintenance plans, PMS requires a total of sixty-one (61) data items including six (6) dummy data (hereinafter referred to as “PMS data”) which excludes repair work unit cost. PMS data include four types of data, namely road asset/inventory data (road main details), pavement condition data, maintenance history and traffic volume data, and these data are stored in respective database viz. road asset database, pavement condition database, maintenance history database and traffic volume database respectively. A data Conversion Software was also developed to integrate the required data from the aforementioned databases and formulate the PMS dataset in the defined structure (hereinafter referred to as “PMS dataset”).

Road Database System has also been developed under the JICA Phase I Project for RMB I jurisdiction only in MS-Excel platform using VBA programming language. The operation of database system was offline considering that a number of revisions is needed in data input format until fully customized in to Vietnamese context. The road database system includes Data Input System, Data Validation Check and Data Storage in the database system. Database system was developed for 29 road assets. This system has already used in RMB I to input Road Main Details (Road Inventory) of road asset database and the inputted data was used for formulating road maintenance plan of RMB I jurisdiction.

JICA Project in Capacity Enhancement in Road Maintenance in Vietnam Phase II (hereinafter referred to as “The JICA Phase II Project”) has implemented from February 2015 to upgrade the outputs of the JICA Phase I Project to make them applicable to the nationwide road network in Vietnam. As per the approved work plan, JICA Project Team is responsible for upgrading PMS data input system and RMBs are responsible for inputting PMS data. Therefore, in order to make the data input system applicable to the nationwide network and exclusively for inputting of PMS data, JICA Project Team in cooperation with DRVN has upgraded the PMS data input system first in offline (desktop-based) and then online (web-based) operating environment.

(1) PMS DATA

As discussed in previous section also, PMS requires basically a total of sixty-one (61) data items including six (6) dummy data. However, while upgrading the offline version PMS in to online, there are some minor modifications in PMS data to use data code etc. for more effective data management. The details of PMS data are shown in **Table 4.1.1**. According to the current data requirement of PMS, the following numbers of data are required.

- Road Asset Data (Road Main Details): 37
- Pavement Condition Data: 22
- Maintenance History Data: 4
- Traffic Volume Data: 8

**Table 4.1.1 List of PMS Data**

Category	S N	Data Items	Unit	Source of Data in PMS Database				
				Road Inventory	Pavement Condition Data	Maintenance History	Traffic Volume	
ROAD ASSET DATA	1	Section ID		⊙				
	2	Section ID 2		⊙				
	3	Road ID		⊙				
	4	Road Category ID		⊙				
	5	Route Number		⊙				
	6	Road Number Supplement		⊙				
	7	Branch Number		⊙				
	8	Road Name		⊙				
	9	Road Description		⊙				
	10	Jurisdiction Code		⊙				
	11	Jurisdiction		⊙				
	12	Management Agency Code		⊙				
	13	Management Agency		⊙				
	14	Structure Type			⊙			
	15	Crossing Type			⊙			
	16	Geographical Area			⊙			
	17	Year of Service Operation Open	yyyy		⊙			
	18	Month of Service Operation Open	mm		⊙			
	19	Year of Construction End	yyyy		⊙			
	20	Month of Construction End	mm		⊙			
	21	Road Section	From	km	⊙			
	22			m	⊙			
	23		To	km	⊙			
	24			m	⊙			
	25	Section Length		m	⊙			
	26	Analysis Area		m2		⊙		
	27	Number of Lanes			⊙			
	28	Direction			⊙			
	29	Lane Position Number			⊙			

Category	S N	Data Items	Unit	Source of Data in PMS Database			
				Road Inventory	Pavement Condition Data	Maintenance History	Traffic Volume
	30	Pavement Type Code		⊙			
	31	Pavement Type		⊙			
	32	Pavement Width	m	⊙			
	33	Pavement Thickness	cm	⊙			
	34	Climate	Annual Precipitation		⊙		
	35		Temperature		⊙		
	36	Terrain Type	Flat / Mountainous terrain		⊙		
	37	Road Class ID			⊙		
PAVEMENT CONDITION DATA	38	Year of survey			⊙		
	39	Month of survey			⊙		
	40	Pavement type			⊙		
	41	Crack Rate	Cracking	%		⊙	
	42		Patching	%		⊙	
	43		Pothole	%		⊙	
	44		Total	%		⊙	
	45	Rut Depth	Max	mm		⊙	
	46		Average	mm		⊙	
	47	IRI		mm/m		⊙	
	48	MCI				⊙	
	49	Year/month of survey		yyyy		⊙	
	50	Month of survey		mm		⊙	
	51	Pavement type				⊙	
	52	2nd Latest Condition Survey	Cracking	%		⊙	
	53		Patching	%		⊙	
	54		Pothole	%		⊙	
	55		Total	%		⊙	
	56	Rut Depth	Max	mm		⊙	
57	Average		mm		⊙		
58	IRI		mm/m		⊙		
59	MCI				⊙		
MAINTENANCE HISTORY	60	Year of the latest repair		yyyy		⊙	
	61	Month of the latest repair		mm		⊙	
	62	Repair Category				⊙	
	63	Repair Classification				⊙	
TRAFFIC VOLUME	64	Year of Latest Survey		yyyy		⊙	
	65	Month of Latest Survey		mm		⊙	
	66	Total Traffic Volume		AADT			⊙
	67	Heavy Traffic Volume		AADT			⊙
	68	Year of Latest Survey		yyyy		⊙	
	69	Month of Latest Survey		mm		⊙	
	70	Total Traffic Volume		AADT			⊙
	71	Heavy Traffic Volume		AADT			⊙

## **(2) PMS DATA INPUT SYSTEM**

In order to provide assistance in data inputting by avoiding data inputting error, a data input system has been developed under the JICA Phase I Project. However, the system has been developed for a comprehensive road asset database system exclusively for RMB I jurisdiction only. Under the JICA Phase II Project, data input system has been upgraded to make it applicable to nationwide road network and exclusively for inputting PMS related data.

### **4.1.2 Current Status of PMS Data and PMS Data Input System**

#### **(1) PMS Data**

##### **1) Road Inventory (Road Main Details) Data**

Previously, some basic road inventory data (road length, road width, pavement type, etc.) had been maintained in MS-Excel format however this information are not sufficient for PMS operation. There are some data stored in RosyBASE however these data are also not in usable level mainly due to poor data quality.

Under the JICA Phase I Project, RMB I has inputted road main details of all national roads under their jurisdiction and these data were used in formulating RMB I budget formulation. However, these data shall be updated regularly if there are any changes in road inventory.

Under JICA Phase II Project, road inventory data of RMB II, RMB III and RMB IV were also inputted by respective RMBs using upgraded PMS data input system.

##### **2) Pavement Condition Data**

Pavement condition data of 2004 and 2007 which were specifically prepared for HDM-4 dataset are available in DRVN. HDM-4 2004 data are available in MS-Excel format whereas 2007 data are available in MS-Access format. However, reliability of these data is very low and there are some issues such as data duplication, data missing, section overlapping, blank data and mistakes in data format (i.e. number and text). Therefore, these data are also not in usable level.

Under the JICA Phase I Project, pavement condition data of RMB I road networks have been collected using the pavement condition survey vehicle provided by JICA. Pavement condition data of approximately 2,300km (road-km) national roads in both directions have been collected and these data were used for formulating budget plan of RMB I. However, pavement condition shall be collected periodically and updated in the database accordingly.

Under JICA Phase II Project, pavement condition data of other RMBs (i.e. RMB II, RMB III, RMB IV and RMB I partly) national road network have been collected and data are ready for using in maintenance planning shortly.

### **3) Pavement Maintenance History Data**

There are pavement maintenance history data in 2004 HDM-4 dataset. However, there are no pavement maintenance history data after 2004 neither in RosyBASE 2007 data nor in any soft data format. Pavement maintenance history data including before/after comparison of repair works are preserved as a hard copy data in RMBs<sup>1</sup>.

As for RMB I road networks, the latest pavement maintenance history data required for running PMS were inputted by RMB I in 2013/2014. However, maintenance history data shall be updated regularly as there will be maintenance activities every year.

Under JICA Phase II Project, RMB I, RMB II, RMB III and RMB IV were requested to input/update maintenance history data of their respective networks. RMBs have sincerely cooperated and inputted the maintenance history data. However, inputted data do not cover the whole network. It is assumed that the missing of data is mainly due to either non-availability of data or no maintenance work.

### **4) Traffic Volume Data**

Since 2007, summary of traffic volume data (quarterly, biannual, and annual) has been preserved in MS-Excel format. However, these electronic data are preserved in a non-structural format as shown in **Table 4.1.2**. These non-structural data cannot be extracted directly by the PMS Data Formulation Module. The summary of traffic volume data is also prepared without separating into flow direction (i.e. up and down) even though data were recorded by traffic flow direction during traffic counting.

---

<sup>1</sup>Source: Vietnam Transport Sector Study, Progress Report, 2010

**Table 4.1.2 Traffic Volume Data Summarization Format (Non-Structural Format)**

Cốc §- êng Bé ViÔt nam		Céng hơp x- héi chñ nhũ viÔt nam											
Khu quñ lí y @- êng bé II		§ écl ĩp - tù do - h' nh phóc											
Sè: /QLGT		-----											
V/v: § Õn xe n' m 2010		Hũ néi, nguy th, ng 12 n' m 2010											
bñng t æng hĩ p @ Õm xe n' m 2010													
- <u>KÝnh gĩi</u> : Cóc @- êng bé viÔt nam													
§ VT: Xe/nguy @m													
Tªn @ êng	Tªn trĩm (Lý trnh)	Xe con	Xetñi nhñ	Xetñi H'ng trung 2 tróc - 6 b. nh	Xetñi H'ng n/Æg (3 tróc)	Xetñi H'ng N/Æg (trªn 4 tróc)	Xe Kh, ch nhá	Xe Kh, ch lí n	M, y kEb c«ng n«ng	Xe m, y Xe Lam	Xe @ p XÝch L«	Tæng Céng Xe « t«	Ghi chó
BTL-Néi Bũi	Km 10	6029	1142	445	66	54	1676	590	0	2181	700	10000	
L. na-Hou I'c	Km 16+500	3261	415	373	364	39	363	374	0	10810	852	5187	
Quèc lè 1													
1A (mĩi)													
1	L' na S-n Km 21+750	630	633	395	336	274	597	521	0	361	309	3432	
2	B'c Giang Km 94+950	594	773	525	270	311	596	540	159	2255	1957	3751	
3	Km 158+650	2421	2830	940	817	379	1538	938	0	6582	0	9861	
4	CQũ Thanh Trx	2442	2956	2368	1790	1235	1149	1454	0	8809	0	13393	
PV-CG	CQũ Khª Hái K192+880	7377	2655	2072	1009	717	2881	3187	0	8487	0	24940	
1A (cũ)													
1	§ oan VỦ Km 251	2198	1790	1198	889	730	1059	1514	33	3070	947	9412	
2	C. u Yªn Km 270	2174	2085	1522	1659	743	970	1635	11	7096	1689	10799	

Under JICA Phase II Project, RMBs were requested to provide traffic volume data of 2012-2015 in a structured format so that these data can be imported during PMS dataset formulation. RMBs have sincerely provided the traffic volume data of four years (2012-2015) in the requested format. Traffic volume data of 2016 was inputted using web-based PMS inputting system.

**(2) PMS Data Input System**

DRVN has no data input system in operation except the system developed under the JICA Phase I Project. Data input system developed under the JICA Phase I Project was exclusively developed for RMB I jurisdiction only and the system consists data input system for 29 road facilities and maintenance history data.

Under JICA Phase II Project, PMS data input system has been developed for all RMBs.

Vietnam Road Asset Management Project (hereinafter referred to as “VRAMP”) has been implementing since 2017 November in DRVN to develop a road asset database, data collection and formulating maintenance plans for nationwide national roads under management of DRVN and PDOTs. Therefore, it is anticipated that upon a completion of VRAMP project, a web-based Road Asset Management System (hereinafter referred to as “RAMS”) including a database system will be available in DRVN.



#### **4.1.3 Framework of Development of PMS Data Input System (Offline)**

##### **(1) Purpose of Development of PMS Data Input System**

The ultimate purpose of development of a PMS data input system is to prepare error free PMS data for smooth operation of PMS (i.e. formulating strategic, annual and mid-term road maintenance plans). This system will assist the PMS operator in inputting error-free and consistent data by duly validation check from all RMBs/SBs in an effective and efficient manner. This system also assist in data integration to be received from different SBs and RMBs.

##### **(2) Target Users**

PMS database users presumed in the development of the PMS data input system comprise concerned departments of DRVN's Headquarters (Department of Planning and Investment, Road Maintenance and Management Department, Science, Technology and International Cooperation Department, and Information Center, etc.), RMBs, and SBs.

###### **1) Departments in the DRVN Headquarters and MOT**

It is anticipated that Departments in the DRVN headquarters can use the PMS data stored in the PMS database for the following purposes;

- To utilize data for formulation of strategic maintenance plans for road pavement
- To operate and maintain the nationwide PMS database by gathering data from RMBs and SBs.
- To operate a web-based PMS data input system on the DRVN server
- To share data among management systems which are being used or to be developed in the future in DRVN
- To provide data for research (if any)

DRVN departments can use the PMS data input system for the following purposes;

- To integrate PMS data received from RMBs
- To search and export the data for making reports, etc.

###### **2) RMBs and PDOTs**

It is anticipated that RMBs can use the PMS data input system and PMS data for the following purposes;

- To utilize data for formulating annual and mid-term repair work planning
- To utilize data for formulating annual and mid-term maintenance budget proposal
- To share data among management system at regional level

RMBs can use the PMS data input system for the following purposes;

- To integrate (data assembling) the data received from related SBs
- To input PMS data

- To search and export PMS data for making reports, etc.

Note: As for PDOTs, it is believed that the same data input system can be used with updating of management jurisdiction however, it cannot be assured due to lack of data to confirm its applicability.

**3) Sub-bureaus**

It is anticipated the SBs can use the PMS data input system for the following purposes;

- To input PMS data
- To edit PMS data

**(3) Target Data Type and Items**

As aforementioned, PMS data consists of four types of data as listed below:

1. Road Main Details (Road Inventory Data)
2. Pavement Condition Data
3. Pavement Maintenance History
4. Traffic Volume Data

The PMS data type and data items are shown in **Table 4.1.3**.

**Table 4.1.3 PMS Data Type and Data Items**

SN	Road Main Details	Pavement Condition Data		Maintenance History	Traffic Volume			
1	Section ID	Latest Condition Survey	Year of survey		Latest Repair	Latest Survey	Year of Survey	
2	Section ID 2		Month of survey				Month of the latest repair	Month of Survey
3	Road ID		Pavement type				Repair Method	Total traffic volume
4	Road Category ID		Crack Rate	Cracking			Repair Classification	Heavy traffic volume
5	Route Number			Patching	<b>Sub-total=4</b>		Year of Survey	
6	Road Number Supplement			Pothole			2 <sup>nd</sup> Latest Survey	Month of Survey
7	Branch Number		Total	Total traffic volume				
8	Road Name		Rut Depth	Max	<b>Sub-total= 8</b>	Heavy traffic volume		
9	Road Description			Average				
10	Jurisdiction Code		IRI					
11	Jurisdiction	MCI						
12	Management Agency Code	2 <sup>nd</sup> Latest Condition Survey	Year of survey					
13	Management Agency		Month of survey					
14	Structure Type		Pavement type					
15	Crossing Type		Crack Rate	Cracking				
16	Geographical Area			Patching				
17	Year of Service Operation Open			Pothole				
18	Month of Service Operation Open			Total				

19	Year of Construction End		Rut	Max
20	Month of Construction End		Depth	Average
21	Road Section	From	IRI	
22		From (m)	MCI	
23		To	<b>Sub-total=22</b>	
24		To (m)		
25	Section Length			
26	Analysis Area			
27	Number of Lanes			
28	Direction			
29	Lane Position Number			
30	Pavement Type Code			
31	Pavement Type			
32	Pavement Width			
33	Pavement Thickness			
34	Climate	34		
35		35		
36	Terrain Type			
37	Road Class ID			
	<b>Sub-total=37</b>			

**(4) System Features**

**1) Operating Environment**

The PMS data input system can run in any computer if Microsoft Office is installed properly. The necessary add-ins such as database engine, .NET Framework etc. are already included in installation package and they will be installed automatically if needed. Except above requirements, there are no any other specific requirements such as RAM, graphics and processor.

**2) Data Input Control**

To avoid data input error, data input control functions are inserted in the data input interface. For the consistency of the data, core tables and input tables are inserted in the system. Core tables are not editable by the ordinary users. Only authorized system engineers can modify the core table. However, input tables are editable by the ordinary users. General information of roads such as road management information (i.e. RMB and SB), location information (i.e. province and city name), road name, and total road length are specified in the core tables. These data will be automatically displayed on the data inputting interface (window) upon the selection of RMB, SB, Road Name, etc.

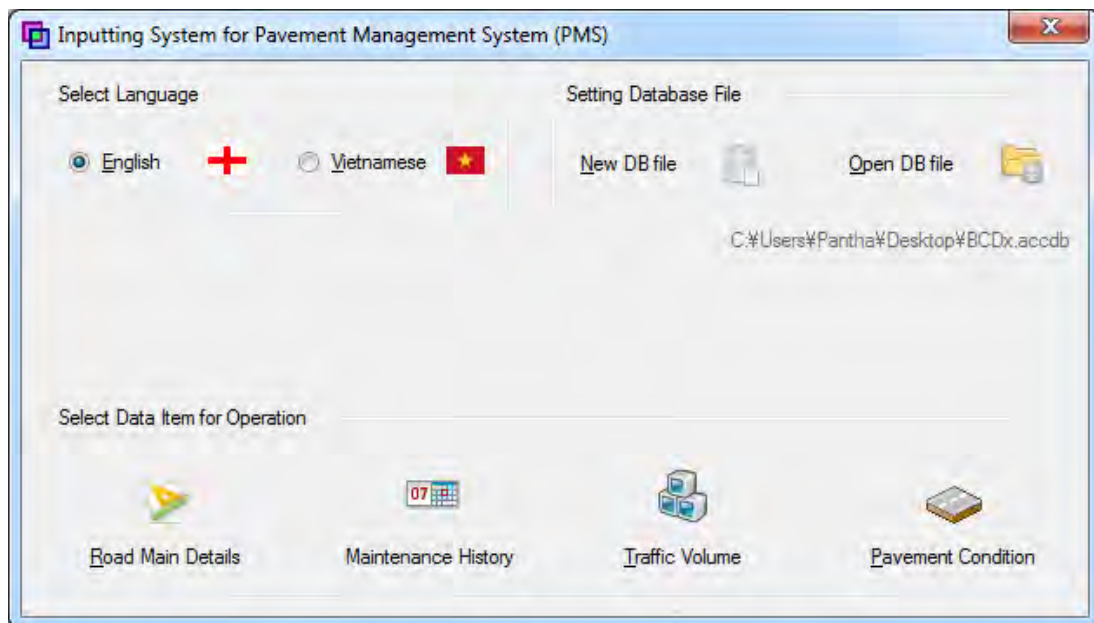
Also, wherever possible, data are coded and selection option is provided with drop down menu/combo-box. A provision of displaying error/caution message is also provided if an attempt is made to input data wrongly or in a different format. In those cells where dropdown lists are inserted, information shall be selected from the list only. Any attempts to inputting new information except listed-up in the dropdown menu, cause an error message. Data items which can be computed/generated internally based on inputted data, formulas have been inserted in those cells. Also, prevailing Vietnamese standards and regulation such as geometric design guide, road class and pavement design have been incorporated as much as possible.

### 3) Validation Check

Data validation check function is provided to check inputted data thoroughly with the set criteria. Validation check function for checking items such as section overlap, data range, blank data and data format type (number & text) is provided. Validation check starts from checking section overlap. If validation check identifies the section overlap, checking of other check items will be stopped and the process is backed to data input window automatically for necessary alteration in designated section. Section overlap is not allowed in any case. Similarly, a warning message will be displayed if any of the data are found invalid for other data items.

### 4) Bilingual Interface

The PMS data input system is designed in bilingual (i.e. Vietnamese and English) in a single interface and user can select either languages as per the user's preference. However, data stored in the PMS database can be accessed by either language interface regardless of which language's interface has been used.



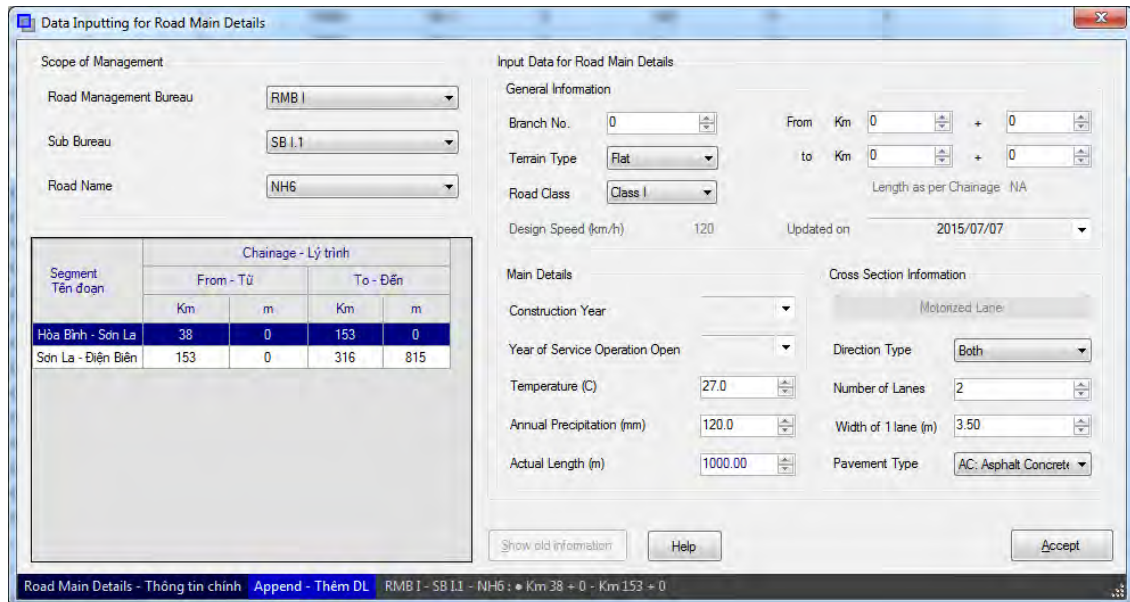
### 5) Offline and Web Operation

The PMS database can run either on web or offline. The developments of the offline and online versions have already completed. However, some modifications have made while upgrading to online system. All data inputted using offline system have been uploaded to online system. The online PMS data input system has already installed in PMS server which is located in DRVN.

(5) Main Functions

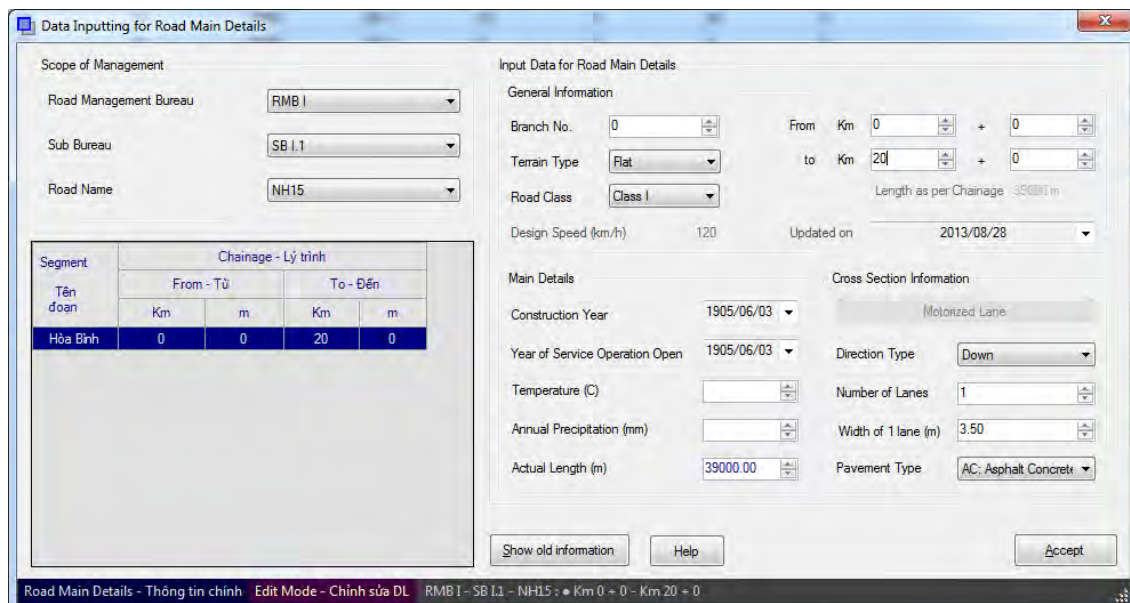
1) New Data Input

New data input function is designed for inputting new data of a particular section of road. Data can be inputted directly on the data inputting interface. General information data are stored in core tables and these data are available in drop-down menu (combo box).



2) Data Editing

Data editing function is designed for modifying the existing PMS data. Data to be edited can be selected from the list of existing data. If data of the same section is intended to modify in the same year, existing data will be overwritten. However, if data is edited in a different year, the history data will be persevered and the latest data will be displayed in the list of existing data.



### **3) Data Assembling/Integration**

Data assembling/integration function is designed to integrate the data to be received from different SBs and RMBs. At RMBs, this function can be utilized for integrating data received from different SBs of their management area in the regional database, whereas in DRVN this function can be used for integrating data received from different RMBs in the central database.

### **4) Data Search**

Data search function is designed to search the specific data available in the PMS database. Data can be searched by data sorting or filtering functions. These functions are embedded in the header of each data type.

### **5) Data Deletion**

Data deletion function is designed to delete the data from the PMS database when necessary. Data can be searched and deleted if necessary. However, care should be taken because once the data are deleted they cannot be retrieved.

### **6) Data Import/Export**

Data import/export function is designed to import/export the selected data from/in MS-Excel format. The exported data can be saved in user defined location.

### **7) Data Visualization and Review Tool**

After receiving the data inputted by RMB, it was realized that a data check and data visualization tool in the PMS data input system is necessary to effectively and efficiently check and verify the inputted data. While data reviewing, some issues such as data inputted in inconsistent lanes, road stretches/lanes are missing, and missing both directional data were found. Therefore, the supplement function is provided in the data input system to review and visualize the inputted data. The inputted data can be schematically visualized both in longitudinal and transverse (cross-section) directions as shown below.



**(3) Sub-Bureaus (SBs)**

The roles and responsibilities of SBs depend on the task assigned by RMBs. The following roles and responsibilities are anticipated from SBs:

- Data collection except pavement condition data
- Data inputting except pavement condition data
- PMS data updating (for RMB I jurisdiction roads)
- Participate in capacity enhancement trainings

**(4) JICA Project Team**

The roles and responsibilities of JICA Project Team are as follows:

- Upgrade/develop the PMS data Input system and PMS database structure
- Conduct trainings to the counterpart officials as nominated by DRVN
- Prepare training materials
- Monitor and supervise data inputting task
- Upgrade the data inputting system incorporating feedbacks from counterpart officials (if any)
- Upon a completion of upgrading/development work, integrate the system for web operation on the DRVN website

**(5) Special Consideration for Traffic Volume Data**

PMS needs only two traffic volume related data (i.e. total traffic volume (AADT) and heavy traffic volume (AADT), and these data shall be imported from the processed traffic volume data.

**4.1.5 IMPLEMENTATION SCHEDULE (OFFLINE SYSTEM)**

**(1) Implementation Phases and Schedules**

The overall implementation schedule is divided into five phases as follows:

**Phase 1:** Upgrade/development of PMS data input system (~ 07/2015)

**Phase 2:** Training on operation of PMS Data Input System (07/2015)

**Phase 3:** System revision/upgrading incorporating feedbacks received during OJT (~11/2015)

**Phase 4:** Data input/update, monitoring, and collection of feedbacks (10/2015~07/2016, 09-12/2016)

**Phase 5:** Data verification and system finalization incorporating the feedbacks (08/2016, 11/2016 ~01/2017)



**Table 4.1.4 Implementation Schedule**

Phase	Activities	2015										2016						2017		
		4	5	6	7	8	9	10	11	12	1	..	7	..	..	10	11	12	1	2
1	Input System Upgrade/Development	■	■	■	■															
2	Training (OJT)				👤															
3	Updating of System to Incorporate Feedback during OJT					■	■	■	■											
4.1	Data Input/Update									■ First Input					■ Revision					
4.2	Data Input Monitoring									■					■					
5	Data Verification													■ First		■ Second				

Note: Development of web-based data input system is described in **Section 4.3**.

**(2) Training**

In order to make familiar about PMS data input system, the On-the-Job Training (OJT) was conducted between 20, 22, 24 and 27 July, 2015 in RMBII, RMB IV and RMB III respectively.

The feedback and additional needs provided by trainees were incorporated in the system in phase 3 of the system upgrading.

**(3) Operation Manual of PMS Data Input System**

Operation manual of PMS data input system has prepared both in English and Vietnamese Language. PMS operation manual is included in **Appendix-4.1**.

**4.1.6 Status of Data PMS Inputting**

**a) Road Inventory and Maintenance History Data**

DRVN has instructed SBs of RMB II, RMB III and RMB IV for inputting of PMS data (road inventory and maintenance history) since October 2016 using the PMS data input system developed by the JICA Project Team in cooperation with DRVN. RMBs/SBs have submitted the inputted data in July 2016 as a first submission. JICA Project Team has reviewed the inputted data and prepared review report by summarizing the findings such as section overlapping, data missing, unusual data range, and data consistency among different data items (inter-relation among data items such as repair method and repair category, road class and design speed). The review report has been submitted to RMBs/SBs in August by requesting necessary amendments and data confirmation. RMBs/SBs have revised the data and submitted to JICA Project Team in December, 2016.

According to road statistics provided by DRVN (as April 2015), a total road network length in RMB II, III and IV jurisdictions is 5,364.24km. However, currently some roads may have been handed over to PDOT, BOT operators or vice versa. Also, some road sections may have planned for improvement and rehabilitation works or roads have been handed over to DRVN upon completion of roads improvements and rehabilitation works. Therefore, there is possibility of differences between actual road network length and data inputted length. The analysis of inputted data reveals that road inventory data of road length (network length) approx. 6,950km has been inputted. As for maintenance history data, only 60% of road inventory data has been inputted and it might be due to either unavailability of maintenance history data or no maintenance work after the new construction. As per PMS dataset formulation procedure, if maintenance history data are not available for a particular road section, road inventory data such as year of construction completion will be derived from road inventory data instead of maintenance history. Therefore, road network having road inventory data can be considered as target road length for maintenance planning provided that pavement condition survey data are also provided for the same road network.

Note: Both inventory and maintenance history data have been updated again when web-based data inputting system became operational.

#### **b) Traffic Volume Data**

The JICA Project Team has requested to DRVN in December 2015 to provide traffic volume data in the format provided by JICA Project Team. RMB I, RMB II, RMB III and RMB IV have already summarized traffic volume data of the year 2012, 2013, 2014 and 2015, and provided to JICA Project Team. JICA Project Team has reviewed the data and review report was provided to DRVN already. There are no serious issues on traffic data except some exceptionally high fluctuation of traffic volume in some counting stations.

Note: traffic volume data of 2016 has been inputted using web-based inputting system.

#### **c) Pavement Condition Data**

Pavement condition survey was implemented mainly in RMB II, RMB III and RMB IV. In RMB I network, pavement condition survey was implemented only in 2,318km of national roads. Since pavement condition survey and data processing are being done by RMBs. The pavement condition data of surveyed national road network (under management of RMBs) are ready for using in pavement maintenance planning.

### **4.1.7 Formulation of PMS Database**

Road inventory, maintenance history and Traffic Volume data are inputted using PMS data inputting system. However, pavement condition data are collected separately. Therefore, integration of these four types of PMS data (i.e. road inventory, pavement condition, and

maintenance history and traffic volume) is necessary to formulate the complete PMS database. In the PMS server, which has been already installed in DRVN, database has been designed in such a way that these four types of data are inter related and compatible to provide/share the data among various systems and sub-systems such as PMS, display system and analysis. Currently, PMS database can run as stand-alone database exclusively designed for PMS.

## **4.2 ACTIVITY 1-2: IMPLEMENT PAVEMENT CONDITION SURVEY**

### **4.2.1 Introduction**

In the early 2000, pavement asset management technologies including planning system (HDM-4) and database system (RoSyBASE) were introduced to DRVN through technical assistance offered by the World Bank and Asian Development Bank. In conjunction with these technical assistances, large-scale pavement condition surveys were implemented in 2004 and 2007 manually in order to support a formulation of databases and maintenance planning. Since then, no further large-scale pavement condition survey had been implemented until JICA Phase I Project.

Road pavement facility inspection standard briefly stipulates the current road routine maintenance standard, “Specifications of Road Routine Maintenance”, which was revised and enforced in 2013. Further information including the practical implementation guideline of pavement condition survey is needed.

### **4.2.2 Pavement Condition Survey**

JICA Phase II Project is expanding the pavement condition survey area to RMB II, III, and IV.

#### **(1) Objective**

- To provide pavement condition data to the development of PMS and the formulation of road pavement strategic budget simulations, annual and mid-term repair work plans
- To develop road facility inspection technologies
- To upgrade the current road routine maintenance standard

#### **(2) Selection of Road Sections**

Taking account of the survey budget limitation, the Project selected national road sections for the survey based on the following criteria,

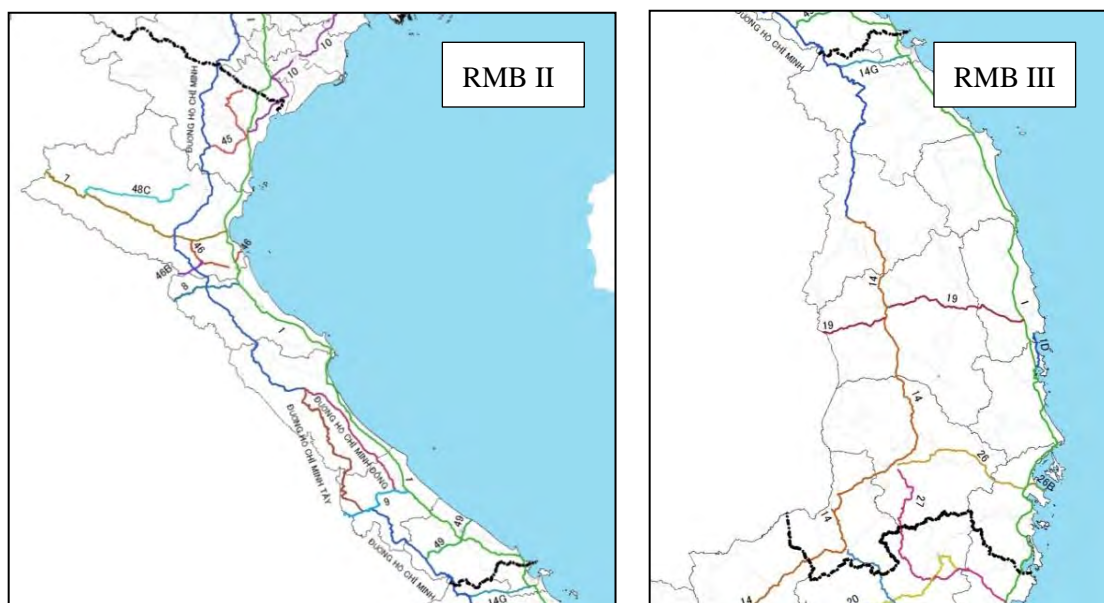
- Road sections under PDOTs jurisdictions are excluded.
- Road sections newly constructed and transferred after 2010 to DRVN are excluded.
- Road sections which have repair work plans to change pavement surface conditions on a large scale including overlays are excluded.
- Road sections scheduled to be transferred to Provincial People’s Committees are excluded.

- Road sections which exceed the maximum survey road length of 6,287km (or survey lane length is 12,574km) are excluded.

**(3) Selected National Roads**

- Preliminary selection was made in cooperation with DRVN and JICA. **Figure 4.2.1** shows route map of these roads.
- Final selection was made after the discussion with RMBs in charge for managing the regional road network.

**Table 4.2.1** shows the planned survey lane length and actual survey lane length of each route by RMBs. Total surveyed lane length is 10,296.9 km in RMB II, III and IV. The actual survey lane length is shorter than planned survey lane length by 2,277.2km because there are eliminated sections which are transferred to BOT operators and PDOTs. In order to cover the planned survey length, DRVN and JICA Project Team have discussed and agreed to conduct pavement condition survey for remaining planned survey length (the additional survey length) in RMB I road network.



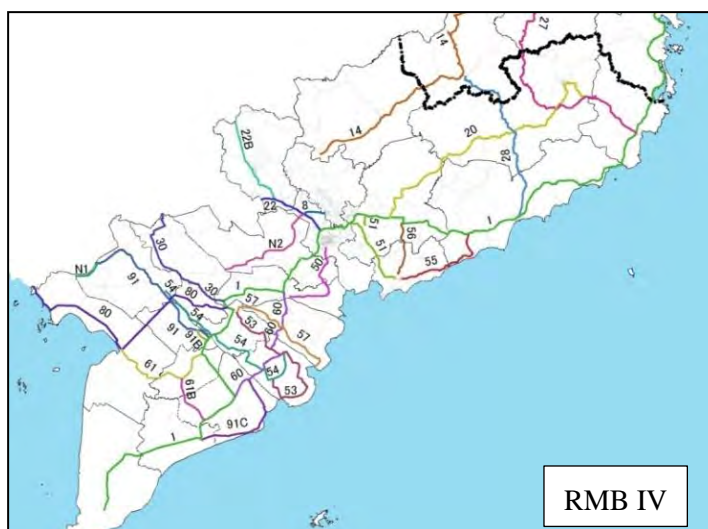


Figure 4.2.1 Target Route Map

Table 4.2.1 Target Survey Length by RMB

RMBs	Route Name	Planned Survey Lane Length (km)	Actual Survey Lane Length (km)
II	NH I	434.6	351.5
	NH7	438.9	431.3
	NH8	111.7	111.2
	NH9	182.0	179.3
	NH10	88.2	78.2
	NH12C	183.4	183.0
	NH 45	260.4	252.8
	NH 46	212.8	210.1
	NH 46B	95.8	90.3
	NH 48C	257.3	257.3
	NH 49	108.5	149.2
	Nghi sơn - Bãi Trành	89.1	89.1
	Đ. HCM	1184.8	1185.1
	Đ. HCM (N Tây)	603.3	602.9
	Đường Nhánh	64.6	58.8
	Other Roads	648.0	0.00
<b>Sub-total</b>		<b>4963.3</b>	<b>4,230.1</b>
III	NH.1	414.9	414.9
	Hầm Hải Vân	58.2	58.2
	NH1D	65.1	50.2
	Đ. HCM	602.5	592.1
	NH.14	134.4	173.5

	NH.14G	132.0	132.0
	NH.19	359.6	304.9
	NH.26	349.7	314.6
	NH.26B	28.6	26.4
	Đường Nhánh	30.1	0.0
	Other Roads	326.0	-
	NH.27C	-	134.2
	<b>Sub-total</b>	<b>2,501.2</b>	<b>2201.2</b>
IV	NH.1	1,543.1	943.4
	NH.20	550.9	0.0
	NH.28	248.8	248.8
	NH.30	172.9	172.8
	NH.50	2.4	47.3
	NH.51	19.6	0.0
	NH.53	390.0	241.1
	NH.54	240.5	233.3
	NH.56	38.2	38.2
	NH.57	19.5	19.6
	NH.60	166.5	125.3
	NH.61	201.0	172.2
	NH.61B	55.9	49.3
	NH.63	92.3	92.3
	NH.80	56.2	157.9
	NH.91	306.1	226.3
	NH.91B	35.6	0.0
	NH. Route N1	46.6	0.0
	NH. Route N2	187.4	187.4
	Đường Nhánh	69.2	0.0
	Other Roads	667.0	-
	NH. 22	-	95.1
	NH. 22B	-	239.3
	NH. 27	-	53.6
Quản Lộ - Phụng Hiệp	-	232.0	
Nam Sông Hậu	-	290.6	
	<b>Sub-total</b>	<b>5,109.6</b>	<b>3865.6</b>
	<b>Total</b>	<b>12,574.1</b>	<b>10,296.9</b>

**(4) Additional Survey**

The total actual survey lane length in RMB II, III and IV is 10,296.9km which is shorter than the total planned survey lane length by 2,277.2km. In order to cover the planned survey length, DRVN and JICA Project Team have discussed and agreed to conduct pavement condition survey for remaining planned survey length (the additional survey length) in RMB I road network as shown in **Table 4.2.2**. Eight (8) roads covering 2,319.19 km as lane length was planned for additional survey in RMB I road network.

**Table 4.2.2 Additional Survey Route in RMB I**

No.	National Roads	From	To	Road Length (km)	Lane Length (km)	Remarks
1	Expressway (Hanoi - Thai Nguyen)	Km0+00	Km63+800	62.41	<b>249.65</b>	NH3 new (Ha Noi - Thai Nguyen)
2	NH3	Km33+300	Km344+436	293.48	623.95	Thai Nguyen - Cao Bang
3	NH2	Km30+600	Km163+000	119.47	285.53	Vinh Phuc - Tuyen Quang
4	NH10	Km6+500	Km144+200	98.85	280.51	Hai Phong - Ninh Binh
5	NH21B	Km66+500	Km90+130	23.40	93.60	Ha Nam - Nam Dinh
6	NH70	Km0	Km198+050	200.49	419.09	Phu Tho - Lao Cai
7	NH279	Km0	Km116	111.35	236.85	Dien Bien
8	Ho Chi Minh Highway	Km438	Km503	65.00	130.00	Hoa Binh
<b>Total</b>				<b>974.45</b>	<b>2319.18</b>	

The additional field survey in RMB I have completed in 12<sup>th</sup> November 2016. The actual surveyed length of the additional survey in RMB I is 2,318.17 km as shown in **Table 4.2.3**. The total surveyed length is in RMB I. Thus, the total surveyed lane length of RMB I, II, III and IV is 12,615.1 km.

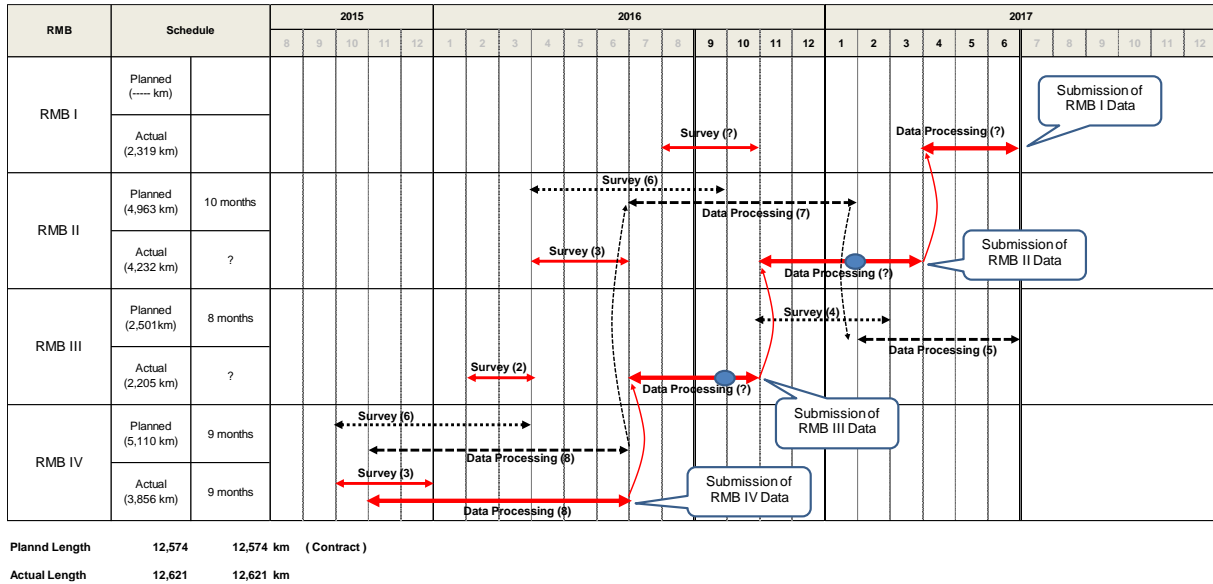
**Table 4.2.3 Surveyed Length in RMB I**

RMB	Route Name	Planned Survey Lane Length (km)	Actual Survey Lane Length (km)
I	NH.2	285.53	282.01
	NH.3	623.95	620.55
	NH.3 new (Expressway (Hanoi – Thai Nguyen))	249.65	249.65
	NH.10	280.51	280.40
	NH.21B	93.60	93.60
	NH.70	419.09	419.09
	NH.279	236.85	242.86
	HCM	130.00	130.00
<b>Total</b>		<b>2,319.18</b>	<b>2,318.17</b>

**(5) Implementation Schedule**

Table 4.2.4 shows the schedule of planned and actual of pavement condition surveys. The field survey, the data analysis and the data processing completed in end of April.

**Table 4.2.4 Implementation Schedule**



**(6) Implementation Method**

There are 4 main steps in the pavement condition survey. The first step is the calibration of the survey vehicle before start of field survey in each RMB. The second step is the field survey using the calibrated survey vehicle along the target roads. The third step is data analysis at the office in Hanoi. The last and final step is data processing at the office in Hanoi. These procedures for implementing pavement condition survey and preparation of pavement condition data are explained in detailed in Pavement Condition Survey Manual (Volume 2.1) of this Final Report.

**a) 1<sup>st</sup> Step: Calibration of the Survey Vehicle**

The pavement condition data should be reliable data for pavement maintenance planning. Pavement condition data shall be prepared from the surveyed data collected by the survey vehicle. The sensors attached to the survey vehicle should be checked before survey start in each RMB.

The vehicle calibration includes calibration of distance measuring equipment, laser displacement sensor for IRI, laser scanner for rut depth, road camera for cracking, front view camera and long test.

Calibration of the survey vehicle has been conducted by RTC-C by themselves in each RMB. The below figure shows the calibration scene in the field.





**Figure 4.2.2 Calibration Scene of Distance (left photo) and Laser Scanner (right photo)**

**b) 2<sup>nd</sup> Step: Field Survey**

After completing the calibration of the survey vehicle, the field survey was conducted on the target roads in each RMB. The starting and ending point have marked by paint in each road. After marking the starting and ending point, the survey vehicle has been driven for the field survey. During the survey, the survey operator pushed the button beside of starting point, every kilometer-post, starting and ending point of eliminated section (if exit within the survey section) and ending point of the target route to record the position into the surveyed data.

Upon completion of field survey, the survey operator delivered the storage HDD for the data analysis operator to do the data analysis and processing. The below figures show the example of marking on the road surface and field survey by the calibrated vehicle.



**Figure 4.2.3 Marking (left photo) and Field Survey (right photo)**

**c) 3<sup>rd</sup> Step: Data Analysis**

The data analysis operator copied the surveyed data from the storage HDD to conduct the data analysis. In the data analysis, PC operators performed interpretation of the crack, adjusted the center line and outside line, checked the abnormal rutting shape and IRI shape and prepared the analyzed data to do the data processing.

JICA Project Team checked the interpretation results. JICA Project Team noticed that there were some misunderstandings on the definition of the crack and patching while performing the interpretation by RTC-C. Therefore, JICA Project Team conducted the additional OJT using the actual surveyed data in RTC-C to maintain the reliable pavement condition data.

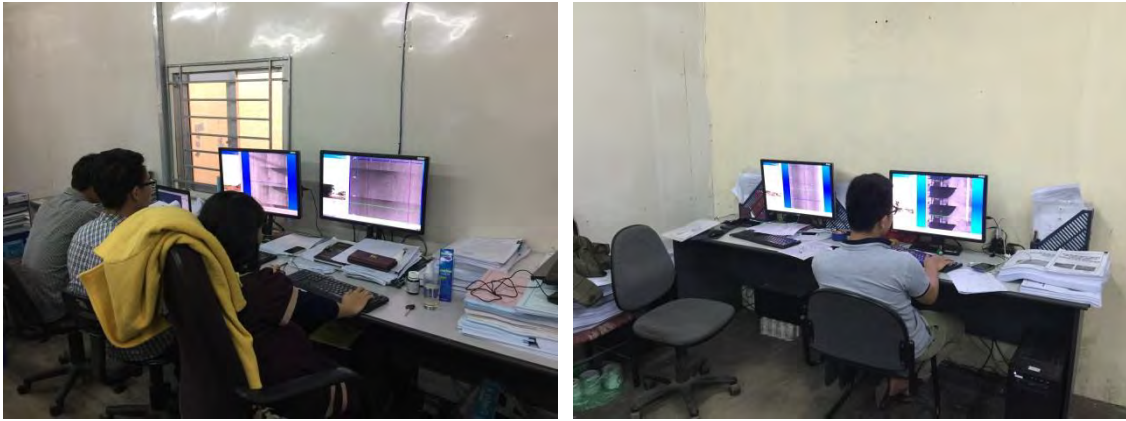


Figure 4.2.4 Data Analysis Works in RTC-C

**d) 4<sup>th</sup> Step: Data Processing**

The data processing creates the final pavement condition data. After completing the interpretation data in the data analysis step, the analysis operator has done the data processing of All RMBs.

The created pavement condition data has been checked including length (i.e. comparison between planned and actual surveyed), quality/precision of the crack interpretation and road width setting. Quality of the data should be kept within the acceptable level to maintain the reliability of data.

**(7) Progress of the Pavement Condition Survey**

Field survey has been conducted from RMB IV to RMB I. In accordance with order of the field survey, the data analysis and processing have also been done in the same order (i.e. from RMB IV to RMB I). Data processing was completed and data were uploaded to PMS server.

**Table 4.2.5 Progress of Pavement Condition Survey**

RMBs	Field survey		Data Analysis and processing		
	Start Date	Completed Date	Start Date	Completed Date	Progress Ratio
RMB IV	11/6 (2015)	1/2 (2016)	11/24 (2015)	7/8 (2016)	100%
RMB III	2/27 (2016)	3/10 (2016)	5/4 (2016)	10/15 (2016)	100%
RMB II	4/25 (2016)	5/27 (2016)	11/14 (2016)	2/28 (2017)	100%
RMB I	8/3 (2016)	11/12 (2016)	3/15(2017)	4/28(2017)	100%

**(8) Trainings on Pavement Condition Survey**

JICA Project Team conducted the training on pavement condition survey in JICA Phase II Project. **Table 4.2.6** shows the training record of pavement condition survey. JICA Project Team transferred each technology required in carrying out pavement condition survey to DRVN through the trainings. As the result of training, JICA Project team prepared “Pavement Condition Survey Manual” (Volume 2.1) using the training document and the manual introduced in 2014 together with Pavement Condition Survey Vehicle (Instruction Book of REAL Mini, 2014).

**Table 4.2.6 Training on Pavement Condition Survey**

Training	Date	Venue	Contents	Reference Manual
OJT on Pavement Condition Survey	04.11.2015	RMB IV	Overview of pavement condition survey	<ul style="list-style-type: none"> <li>▪ Overview [PCS-Vol.1]</li> </ul>
	23.02.2016	RMB III		
	25.04.2016	RMB II		
Intensive Training	23.11.2017	Hanoi	Management work of pavement condition survey	<ul style="list-style-type: none"> <li>▪ Management Manual [PCS-Vol.2]</li> <li>▪ Data Preparation [PCS-Vol 5]</li> <li>▪ Data Validation [PCS-Vol.6]</li> </ul>
	24 – 30.11.2017	Hanoi	Survey and data preparation work of pavement condition survey	<ul style="list-style-type: none"> <li>▪ Operation (Field survey &amp; Data analysis) [PCS-Vol3]</li> <li>▪ Instruction Book of REAL Mini [PCS-Vol4]</li> </ul>

**4.2.3 Pavement Condition Survey Result**

JICA project team has analyzed the pavement condition of every RMB in detailed. In analyzing the pavement condition of every RMB road network, analysis has been done by the data into two categories as "Summary of Pavement Condition Survey length" and "Summary of Pavement Condition". Summary of Pavement Condition consists of "Pavement Condition in all RMBs" and "Pavement Condition in each RMB".

**(1) Summary of Pavement Condition Survey Length**

- The length of surveyed lane based on PC data is 12,531.375km. (Lane-km)
- The pavement types consist of Asphalt Concrete (hereafter AC) as 10,045.110km (80.16%), BST as 1,911.185km (15.25%), Cement Concrete (hereafter CC) as 572.625km (4.57%), and Other such as unpaved road as 2.455km (0.02%).
- RMB IV has the longest length of the pavement type BST as 33.95%.
- RMB II has the longest length of the pavement type Cement Concrete as 9.37%.
- RMB IV has all the pavement types such as “AC”, “BST”, “CC”, and “Other”.

**Table 4.2.7 Table1.1 The Length and Ratio of Each Pavement Type**

RMBs	Pavement Type	Length (km)	Ratio (%)	Total Length (km)
RMB I	AC	2,242.145	97.09	2,309.290
	BST	58.800	2.55	
	CC	8.345	0.36	
	Other	0	0	
RMB II	AC	3,373.115	80.44	4,193.355
	BST	427.470	10.19	
	CC	392.770	9.37	
	Other	0	0	
RMB III	AC	1,904.595	86.83	2,193.470
	BST	122.865	5.60	
	CC	166.010	7.57	
	Other	0	0	
RMB IV	AC	2,525.255	65.84	3,835.260
	BST	1,302.050	33.95	
	CC	5.500	0.14	
	Other	2.455	0.06	
ALL	AC	10,045.110	80.16	12,531.375
	BST	1,911.185	15.25	
	CC	572.625	4.57	
	Other	2.455	0.02	

**(2) Summary of Pavement Condition**

**1) Pavement Condition in All RMBs**

The pavement conditions are evaluated by Crack Ratio, Rut Depth (Max), Rut Depth (Average), and IRI (International Roughness Index).

**a) The Average Value of the Evaluated Pavement Conditions**

The average values of each evaluated pavement condition are shown in **Table 4.2.7**.

The features of the damages from the pavement condition survey result are as below:

- The average of the crack ratio is 3.14%. The 63% of the total target length have no cracks;
- The average of the rut depth (max) is 20.23mm. The 82% of the total target length are the sections with less than 30mm;
- The average of the average rut depth is 8.44mm. The 90% of the total target length are the sections with less than 15mm; and

- The average of the IRI value is 5.86mm/m. Approx. 20% of the total target length are the sections with more than 12mm/m.

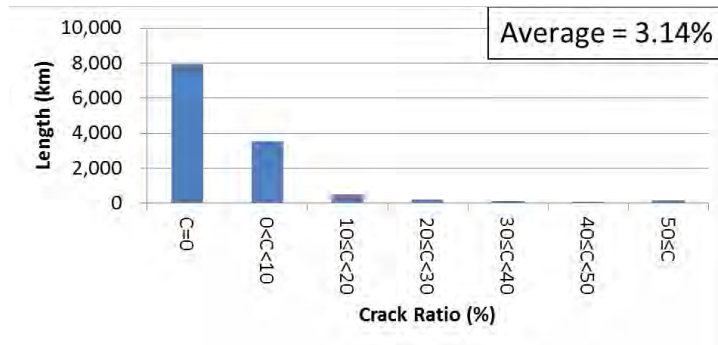
Based on the above features of each damage, the pavement conditions on the target routes could be considered as below:

- The pavement condition is in good condition because 60% of the road have no cracks;
- Some deep ruts are generated in limited sections transversally, however, the rut depth is small on the whole; and
- Large irregularities in a longitudinal direction occur in many places.

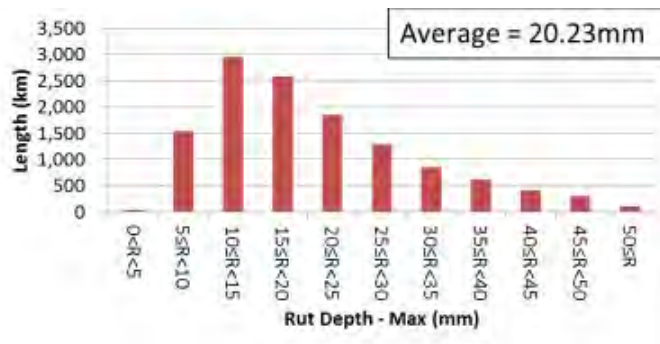
**Table 4.2.8 The Average Value on Each Pavement Type**

Pavement Type	Crack ratio (%)	Rut depth (mm)		IRI (mm/m)
		Max	Average	
<b>ALL</b>	3.14	20.23	8.44	5.86
AC	2.50	19.49	8.47	5.03
BST	6.78	25.02	9.17	9.59
CC	2.34	17.05	5.41	7.85
Other	-	26.39	11.89	14.34

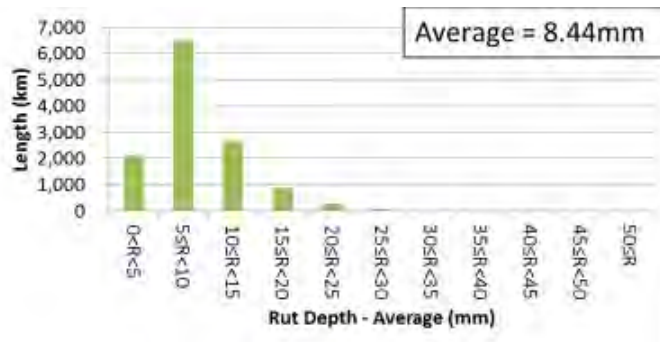
### Crack Ratio



### Rut Depth (Max)



### Rut Depth (Average)



### IRI

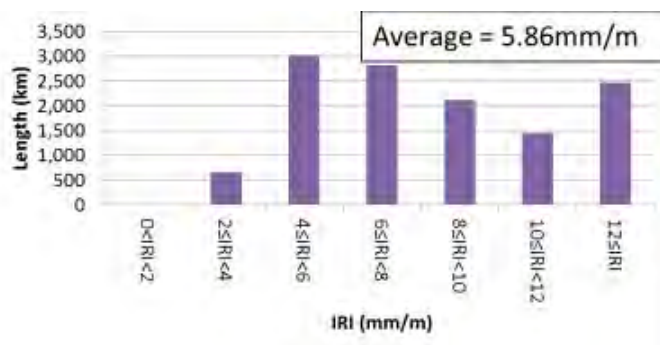
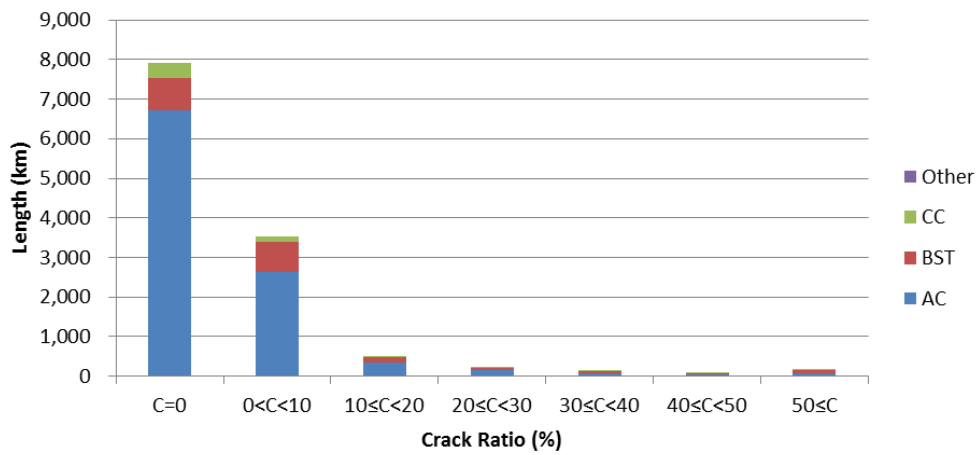


Figure 4.2.5 Distribution of the Pavement Conditions

**b) The Result of Each Evaluated Pavement Condition**

(i) Cracks

- Average: 3.14%
- The average by pavement type: AC; 2.50%, BST; 6.78%, CC; 2.34%
- (The crack ratio in the “Other” section is out of scope in this survey because the crack interpretation was impossible.)
- The crack ratio is 0% on 63% of the total length, which is 7,924.875km.
- The sections with the crack ratio less than 10% occupied 91%.



**Figure 4.2.6 Distribution of the Crack Ratio**

**Table 4.2.9 The Length of the Crack Ratio in Each Pavement Type**

Pavement Type	Rank of Crack Ratio						
	C=0	0<C<10	10≤C<20	20≤C<30	30≤C<40	40≤C<50	50≤C
AC	6,725.120	2,634.890	348.880	140.160	74.405	44.420	77.235
BST	815.875	757.190	127.170	70.070	43.505	27.835	69.540
CC	383.880	141.625	29.925	12.320	3.305	0.960	0.610
Other	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total	7,924.875	3,533.705	505.975	222.550	121.215	73.215	147.385

(Unit: km)

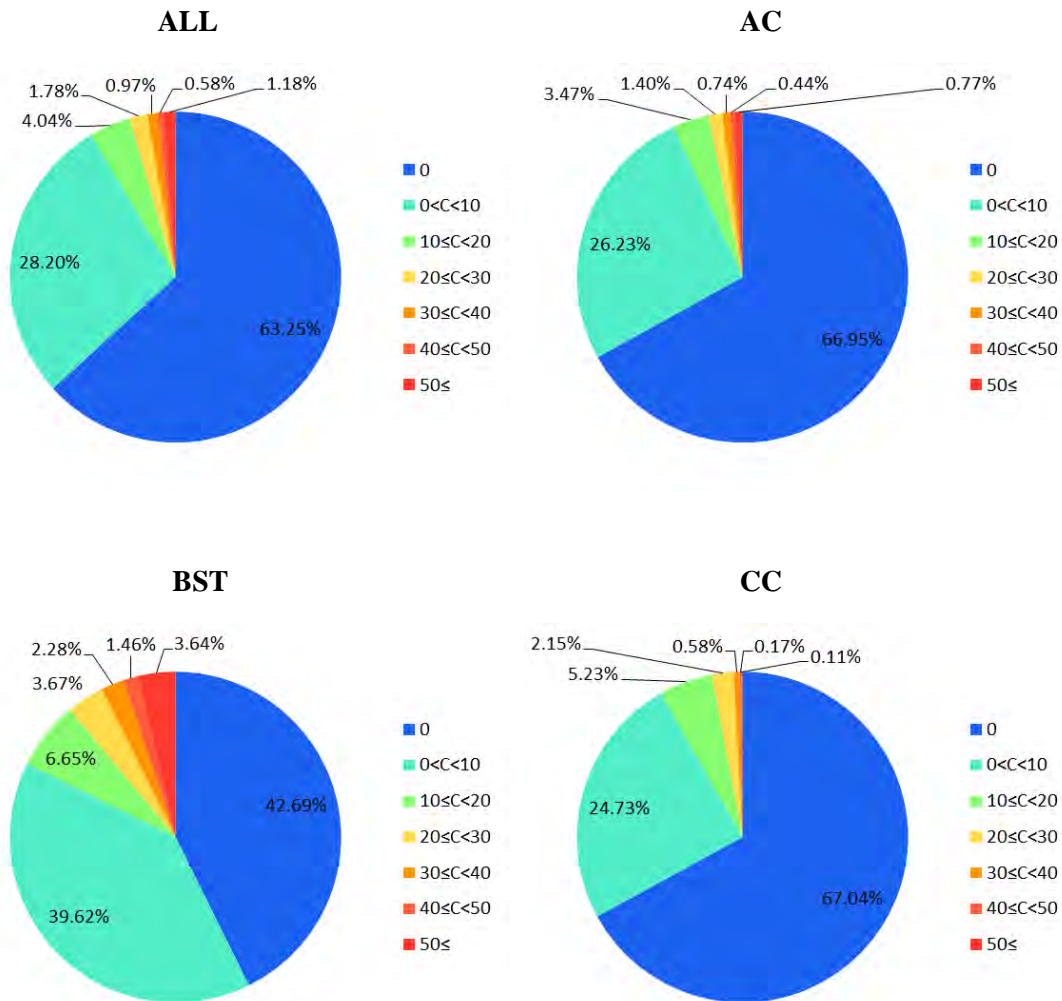


Figure 4.2.7 Proportion of the Crack Ratio in Each Pavement Type

(ii) Rut Depth (Max)

- Average: 20.23mm
- Average by pavement type: AC; 19.49mm, BST; 25.02mm, CC; 17.05mm, Other; 26.39mm
- The sections with more than 10mm and less than 15mm are the majority, which occupied approx.24%, 2,951.720km of the total.
- The sections with the rut depth (max) less than 30mm occupied 82%.



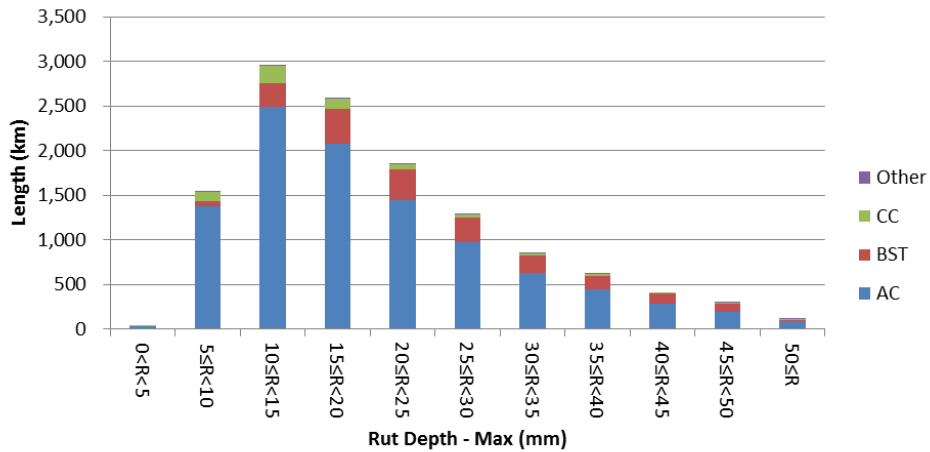


Figure 4.2.8 Distribution of the Rut Depth (Max)

Table 4.2.10 The Length of the Rut Depth (Max) in Each Pavement Type

Pavement Type	Rank of Rut depth						
	0<R<5	5≤R<10	10≤R<15	15≤R<20	20≤R<25	25≤R<30	30≤R<35
AC	29.245	1,381.785	2,496.415	2,082.755	1,445.130	973.750	627.740
BST	1.800	53.710	262.665	381.625	343.240	275.720	199.790
CC	0.215	97.025	192.550	120.400	62.515	36.680	26.445
Other	0.000	0.015	0.045	0.510	0.560	0.680	0.245
Total	31.260	1,532.550	2,951.720	2,585.800	1,852.005	1,287.510	854.465

Pavement Type	Rank of Rut depth			
	35≤R<40	40≤R<45	45≤R<50	50≤R
AC	441.485	283.855	197.035	85.885
BST	156.725	121.480	92.885	21.210
CC	18.065	9.200	8.350	1.180
Other	0.225	0.000	0.145	0.030
Total	616.725	414.535	298.560	108.335

(Unit: km)

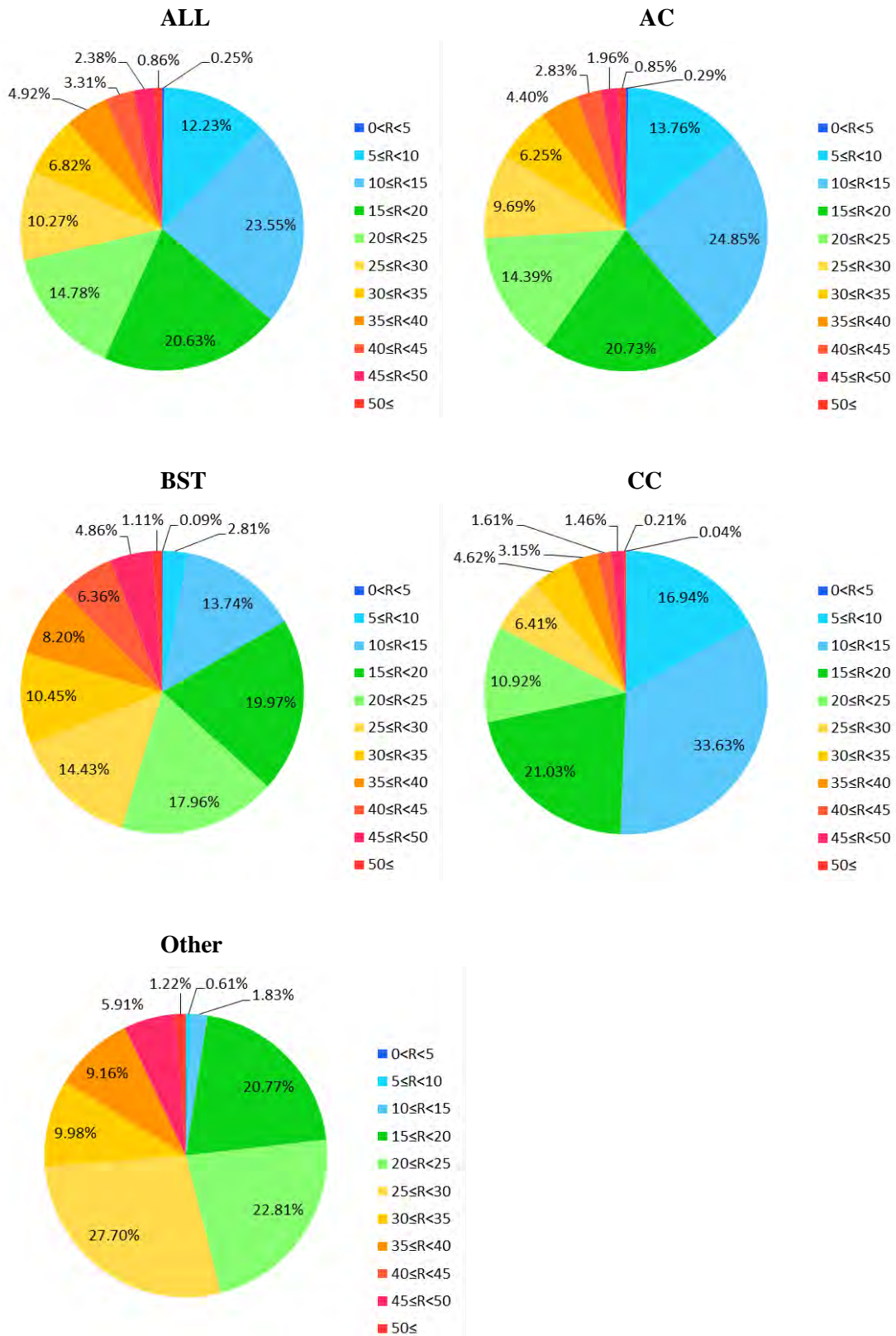


Figure 4.2.9 Proportion of the Rut Depth (Max) in Each Pavement Type

(iii) Rut Depth (Average)

- Average: 8.44mm
- Average by pavement type: AC; 8.47mm, BST; 9.17mm, CC; 5.41mm, Other; 11.89mm
- The sections with more than 5mm and less than 10mm are the majority, which occupied 52%, 6,518.655km.
- The sections with the rut depth (average) less than 15mm occupied 90%.

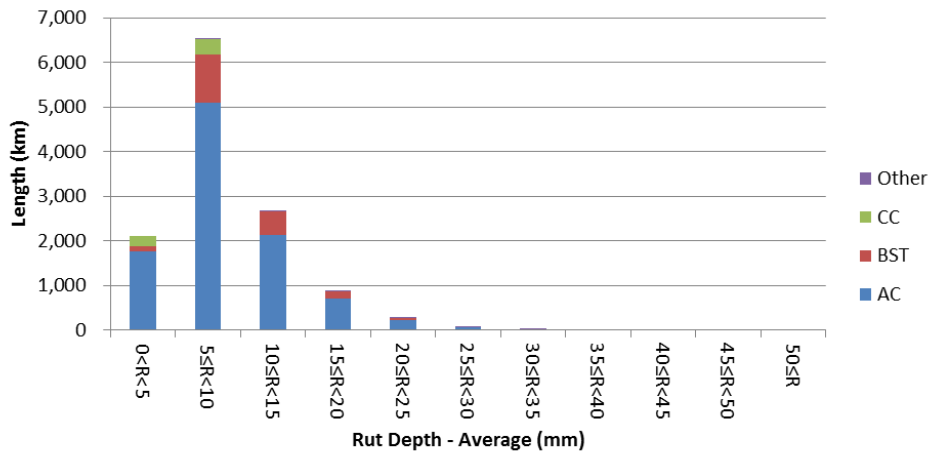


Figure 4.2.10 Distribution of the Rut Depth (Average)

Table 4.2.11 The Length of the Rut Depth (Average) in Each Pavement Type

Pavement Type	Rank of Rut depth						
	0<R<5	5≤R<10	10≤R<15	15≤R<20	20≤R<25	25≤R<30	30≤R<35
AC	1,774.350	5,095.525	2,143.505	706.490	224.885	67.990	23.500
BST	113.510	1,084.945	507.415	157.065	39.085	6.810	0.865
CC	215.080	337.285	19.275	0.865	0.110	0.000	0.000
Other	0.000	0.900	0.905	0.560	0.070	0.005	0.015
Total	2,102.940	6,518.655	2,671.100	864.980	264.150	74.805	24.380

Pavement Type	Rank of Rut depth			
	35≤R<40	40≤R<45	45≤R<50	50≤R
AC	5.490	2.235	0.620	0.210
BST	0.010	0.000	0.000	0.000
CC	0.010	0.000	0.000	0.000
Other	0.000	0.000	0.000	0.000
Total	5.510	2.235	0.620	0.210

(Unit: km)

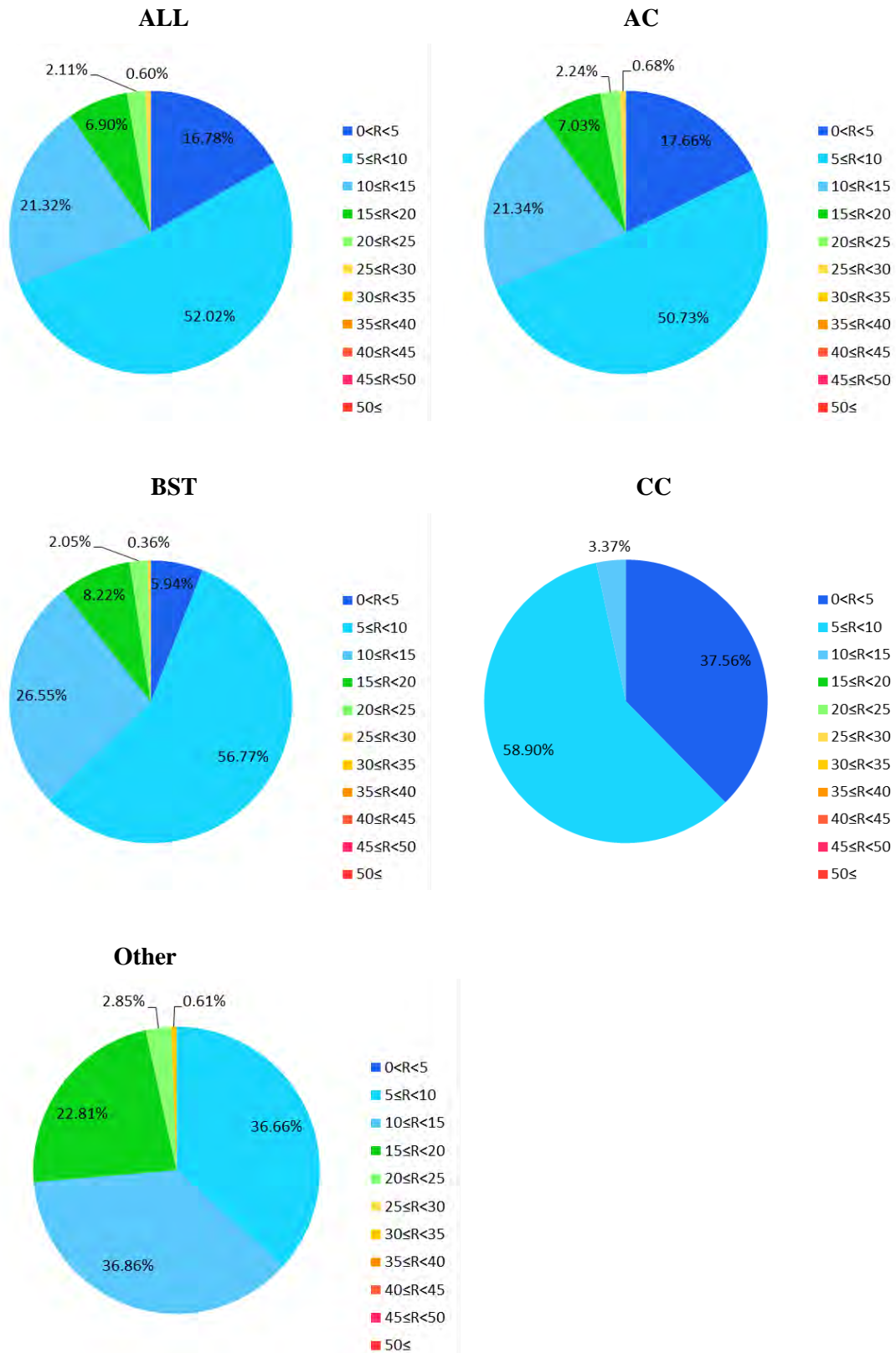


Figure 4.2.11 Proportion of the Rut Depth (Average) in Each Pavement Type

(iv) IRI

- Average: 5.86mm/m
- Average by pavement type: AC; 5.03 mm/m, BST; 9.59 mm/m, CC; 7.85 mm/m, Other; 14.34 mm/m
- The sections with more than 4mm and less than 6mm are the majority, which occupied 24%, 3,015.925km.
- The IRI more than 12mm/m occupied approx.20%.

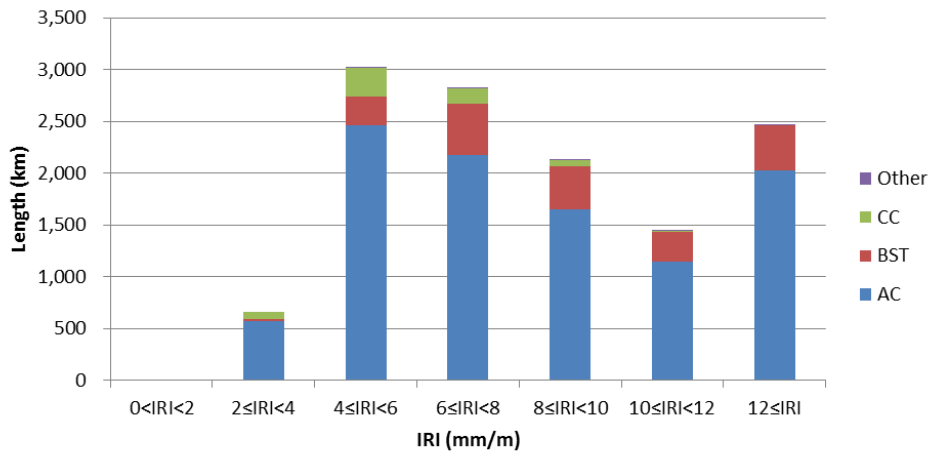


Figure 4.2.12 Distribution of the IRI

Table 4.2.12 The Length of the IRI in Each Pavement Type

Pavement Type	Rank of IRI						
	0 < IRI < 2	2 ≤ IRI < 4	4 ≤ IRI < 6	6 ≤ IRI < 8	8 ≤ IRI < 10	10 ≤ IRI < 12	12 ≤ IRI
AC	1.380	575.440	2,463.685	2,179.345	1,650.025	1,148.765	2,026.160
BST	0.850	16.795	276.350	487.665	416.795	279.200	432.050
CC	0.000	67.710	275.875	155.040	53.740	14.395	5.865
Other	0.000	0.000	0.015	0.455	0.430	0.315	1.240
Total	2.230	659.945	3,015.925	2,822.505	2,120.990	1,442.675	2,465.315

(Unit: km)

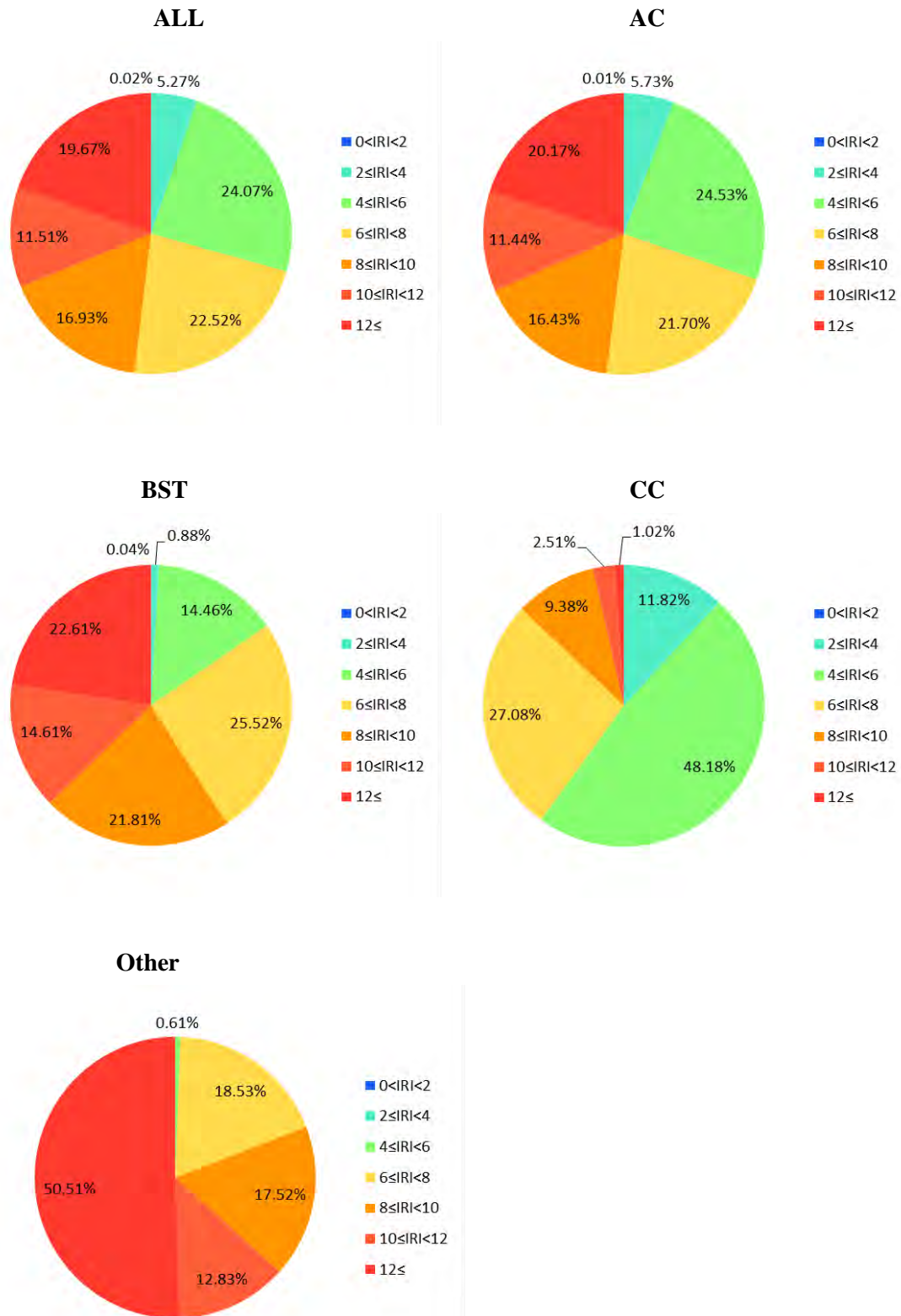


Figure 4.2.13 Proportion of the IRI in Each Pavement Type

## 2) Pavement Condition in each RMB

The pavement conditions of each RMB are evaluated by crack ratio, rut depth (max), rut depth (average), and IRI. The average values of each pavement condition in each RMB are shown in **Table 4.2.12**.

- The crack ratio in RMB III is bigger than those of the other RMB but not so bad in general.
- Seeing by pavement type, BST has bigger values than AC and CC in every damage category in RMB I, RMB II, and RMB III.
- CC has a bigger value than BST in RMB IV.

**Table 4.2.13 Average Value of Each Condition in RMBs**

RMBs	Pavement Type	Crack ratio (%)	Rut depth (mm)		IRI (mm/m)
			Max	Average	
RMB I	<b>ALL</b>	<b>2.02</b>	<b>22.06</b>	<b>10.39</b>	<b>4.79</b>
	AC	1.35	21.79	10.34	4.55
	BST	27.91	32.78	12.58	12.76
	CC	1.60	18.23	6.02	11.14
	Other	-	-	-	-
RMB II	<b>ALL</b>	<b>3.09</b>	<b>20.23</b>	<b>8.09</b>	<b>6.10</b>
	AC	2.37	19.24	8.01	5.25
	BST	11.09	30.55	10.94	11.17
	CC	0.57	17.58	5.62	7.93
	Other	-	-	-	-
RMB III	<b>ALL</b>	<b>6.29</b>	<b>19.28</b>	<b>7.75</b>	<b>5.72</b>
	AC	4.63	19.20	7.97	5.06
	BST	31.70	25.41	8.30	13.88
	CC	6.52	15.68	4.83	7.33
	Other	-	-	-	-
RMB IV	<b>ALL</b>	<b>2.08</b>	<b>19.66</b>	<b>8.04</b>	<b>6.32</b>
	AC	2.09	18.02	7.79	5.15
	BST	2.06	22.82	8.51	8.53
	CC	3.55	18.92	7.21	12.58
	Other	-	26.39	11.89	14.34

## 4.3 ACTIVITY 1-3: DEVELOP WEB-BASED PMS DATA INPUT SYSTEM

### 4.3.1 Introduction

As described in **Section 4.1**, data input system has been developed to provide assistance in data inputting by avoiding data inputting error. Offline data input system which was developed

and tested by trial run was used for inputting of road inventory and maintenance history data of RMB II, RMB III and RMB IV. Training on operation of data input system (offline) was also conducted in July 2015 and the participants' feedbacks were also incorporated in the system. Confirmation of users' needs and easy operability were also confirmed by using the system in OJT and real data inputting. The necessary revision on the system to make it more users' friendly and fulfill the requirements of the users has also completed. With such confirmation, inputting system has upgraded to web-based to make it further users' friendly considering the convenience of data sharing and operability. The web-based system assists in operating of PMS database input system from any location provided that computers or mobile devices are connected to the internet. This web-based data input system is specifically prepared for inputting and management of PMS related data. As for inputting and management of comprehensive road asset database, VRAMP is now developing it.

#### **4.3.2 Framework for Web-based System Development**

##### **(1) Objective**

The ultimate purpose of development of a web-based PMS data input system is to prepare error free PMS data for smooth operation of PMS (i.e. formulating strategic, annual and 5-year road maintenance plans) which can operate on the DRVN website. This system also assists in data integration (i.e. pavement condition and traffic volume) which may not necessarily be inputted by using this data input system such as traffic volume data or pavement condition survey data.

##### **(2) Target Users**

The target users of this web-based PMS data input system are same users as described in **Section 4.1.3 (2)** (i.e. MOT, DRVN, RMBs, SBs and PDOTs) of this chapter.

##### **(3) Target Data Types and Items**

The target data types and data items for this web-based PMS data input system are similar to the data types and data items as described in **Section 4.1.3 (3)** of this chapter.

##### **(4) System Features and Main Functions**

In addition to web related features, the main functions of this web-based PMS data input system are similar to the features as described in **Section 4.1.3 (4)** and **Section 4.1.3 (5)**. Web related features such as easy accessibility via internet, link to other PMS related systems (i.e. PMS, Pavement Condition Data Display System, Pavement Condition Data Analysis System and Pavement Monitoring System (PMoS)), and internet security features are supplemented in the desktop (offline) based PMS data input system.



A powerful tool for data visualization has been developed to visualize road inventory, maintenance history and traffic volume both in longitudinal and transverse direction in a single window as below.

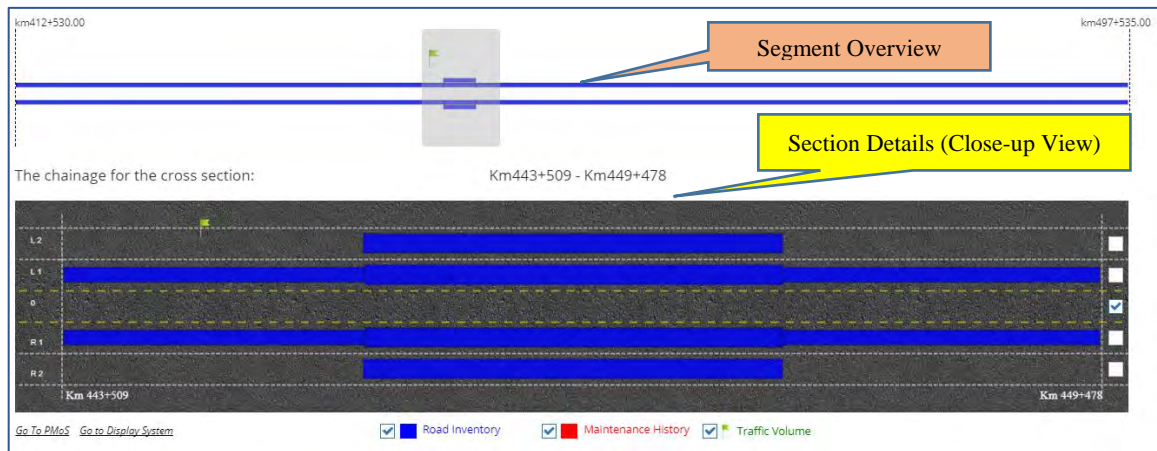


Figure 4.3.1 Data Visualization Tool

#### (5) System Development Arrangement and Schedule

Development work of PMS data input system was outsourced to Hanoi based local IT Company. The development work has started from October 2015 and completed at the end of April, 2016. The IT Company has developed the data input system in close coordination with JICA Project Team and DRVN by taking consideration of DRVN's needs. The necessary technology transfer training were also conducted to concerned stakeholders.

#### 4.3.3 Clustering of PMS Data Inputting

Inputting data are clustered into different groups considering the convenience of the data inputting. For example, in case of road inventory, information is grouped into 5 clusters as below.

##### (1) Scope of Road Management

The scope of road management including RMB, SB, Road Name and Segment details shall be selected from the dropdown menu. This information is managed in master table stored in the database. This information is common to inputting of road inventory, maintenance and traffic volume data.

**(2) General Information and Location**

The specific location such as chainage (Kilometer post), geospatial information (GPS data) and administrative location of road can be inputted under this cluster.

**(3) Motorized Lane Information**

The details of motorized lane such as directional position (with respect to traffic flow), number of lane, lane position and lane width can be inputted under this cluster.

**(4) Other Information**

Other information such as construction year, service operation start year, temperature and annual precipitation of the area can be inputted under this cluster.

The screenshot shows a web form titled "Road Inventory" with a sub-section "Other Information". It contains the following fields:

- Construct Year (calendar icon)
- Service Start Year (calendar icon)
- Temperature(oC)
- Annual Precipitation (mm)
- Actual Length (m)
- Remark (text area)

**(5) Pavement Material Details (Pavement Structure)**

Pavement layer (pavement structure) is grouped into one and pavement layer information from friction layer to subgrade shall be inputted wherever applicable fully or partially.

The screenshot shows a web form titled "Road Inventory" with a sub-section "Material Detail". It includes a "Surface" dropdown and a table for defining pavement layers:

Layer	Material type	Thickness (cm)	Description
1. Friction Course	<input type="text"/>	<input type="text"/>	<input type="text"/>
2. Wearing Course 1	<input type="text"/>	<input type="text"/>	<input type="text"/>
3. Wearing Course 2	<input type="text"/>	<input type="text"/>	<input type="text"/>
4. Binder Course 1	<input type="text"/>	<input type="text"/>	<input type="text"/>
5. Binder Course 2	<input type="text"/>	<input type="text"/>	<input type="text"/>
6. Base Course 1	<input type="text"/>	<input type="text"/>	<input type="text"/>

#### **4.3.4 System Operability**

PMS data inputting system has already installed in PMS server (www.pms.drvn.gov.vn) located in DRVN and RMBs/SBs has already used in updating of road inventory, maintenance history and traffic volume data in October/November 2017. The system is operating smoothly. User manual and video clip of PMS data inputting system have been developed in Vietnamese and English language.

#### **4.3.5 System Updating in the Future**

PMS data shall be updated regularly wherever and whenever there are changes in inventory and maintenance history. Generally, system updating may require in cases, updating of master tables etc. in the back end and updating of system for modifying system functions and features.

##### **(1) Updating of Master Table, etc.**

Updating of master table etc. which are managed in back end such as Road Name, Road Code, Jurisdictions, Segment etc. can be updated at back end. Only the authorized users who have rights to modify such master table can update such information. Authorized officials in DRVN (system administrator) can update the master table etc.

##### **(2) Updating of System Functions and Features**

Updating system functions and features can be updated only by IT professionals who have deep knowledge of system development. It is recommended to outsource this type of updating to IT specialized company. Before starting of system updating, all stored data shall be stored safely to avoid any accidental loss of data.

## **CHAPTER 5 UPGRADE PMS TO APPLY ROAD NETWORK OF RMB I, II, III, AND IV, AND FORMULATE DRAFT REPAIR WORK PLAN (MEASURE 2)**

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### **5.1 ACTIVITY 2-1: UPGRADE PMS**

#### **5.1.1 Introduction**

A road infrastructure is a national asset to be taken over to the next generations, thus road functions need to be carefully maintained for a long duration of road maintenance. The basic principle of road maintenance is to select “right works”, “right places” and “right timings” of maintenance and repair works in order to ensure the best economy over the long course of road maintenance. With this, road operators are encouraged to shift from the current ex post fact maintenance to strategic planned maintenance. In line with this basic principle of road maintenance, in JICA Phase I Project, JICA Project Team in collaboration with DRVN has developed Pavement Management System (PMS) for national roads under jurisdiction of RMB I. PMS can formulate the following maintenance plans by best utilizing the result of pavement deterioration evaluation.

- Strategic maintenance plan
- Annual maintenance plan
- Medium-term maintenance plan (5-year)

In JICA Phase II Project, in order to make PMS applicable to the nationwide national road network, JICA Project Team in collaboration with DRVN is now upgrading PMS which can run on the DRVN web server.

#### **(1) Maintenance Plans**

In order to maintain the road in serviceable condition, a systematic maintenance plan is needed, and the maintenance plan may comprise of long-term, medium term and short term maintenance plans. Considering the procedure of requesting and approval of maintenance budget in Vietnam, separate modules (for strategic plans and repair work plans) are developed in PMS to assist the decision makers by providing the decision support tools in formulating the maintenance plans.

##### **1) Strategic Maintenance Plan**

The strategic maintenance plan is to be prepared by simulating the budget requirement and corresponding pavement conditions for the following four (4) scenarios consisting of non-budget constraint scenario (Scenario 0) and three (3) scenarios;

Scenario 0: Non-budget constraint

Scenario 1: Maintain the Current Budget Level (With Budget Constraint)

Scenario 2: Maintain the Current Pavement Condition Level

Scenario 3: Maintain the Target Management Level

The simulation results (budget requirement and corresponding road condition) of above three scenarios provide guidance to MoT and DRVN leaders in making the decision for allocating the maintenance budget for medium to long term. Strategic maintenance plan provides a total amount of budget required for number of years (for analysis period).

## **2) Annual Maintenance Plan**

Annual maintenance plan is prepared for implementing the repair work for a year. Regional agencies, including RMBs and PDOTs, play a key role in formulating the annual plan. Annual plan includes the budget plans for routine maintenance and periodic maintenance consisting of medium repair and big repair. This plan is prepared considering the pavement deterioration progresses; result of pavement deterioration evaluation. The annual maintenance budget shall be within the budget framework as decided/set by the strategic maintenance plan. Annual maintenance plan for consecutive years can be prepared from the list of medium-term repair work plans (5-year) by eliminating the preceding years' repaired sections.

## **3) Medium-term Repair Work Plans (5-year)**

From 2015, DRVN submits a medium-term budget proposal to MoT for the approval. MoT approves the budget with modification based on the availability of maintenance budget. Medium-term repair work planning module helps in providing supporting document for making medium-term budget proposal. Repair work plans are to be prepared with due consideration of deterioration progresses over the planning period.

### **5.1.2 Design Concept of PMS Development**

PMS is a supporting system to decision maker of MoT/DRVN in making pavement maintenance budget plans by applying a systematic and scientific approach. Upon receiving the computation results, DRVN/RMB officials are kindly requested to carry out field verification to make their final judgment on the national road maintenance budget plans. If computation results recommend for big repair, pavement structural investigation such as pavement bearing tests are necessary to design the pavement structure and actual repair work cost estimation. Therefore, it is important to understand that PMS is not 100% automatic software for formulation of maintenance plans.

#### **(1) Purposes of Applying PMS**

PMS was developed to meet the demand of the following activities.

**1) To formulate a strategic budget plans (medium – long term)**

- To get MOT approval
- To show the vectors of annual road maintenance plans
- To prepare explanatory materials for the annual budget proposal
- For the purposes of research and investigation

**2) To formulate annual and medium-term pavement repair work and budget plans**

- To assist RMBs to formulate annual and medium-term maintenance budget proposal including pavement repair works
- To assist DRVN to prioritize maintenance budget allocations

**3) To evaluate the effects of pavement maintenance works**

- To evaluate the effects of pavement repair works

**(2) PMS Users**

System users presumed in the development of PMS comprised of concerned departments of DRVN's Headquarters, RMBs, SBs, and authorized PDOTs (in the future).

**1) Departments in the DRVN Headquarters**

- To formulate strategic plans for road pavement maintenance
- To prioritize maintenance budget proposal gathered from RMBs and authorized PDOTs.

**2) RMBs**

- To formulate annual and medium-term maintenance proposal including pavement repair works
- To formulate implementation plans upon budget allocation

**3) PDOTs (in the future) for authorized national roads**

- To formulate annual and medium-term maintenance budget proposal including pavement repair works
- To formulate implementation plans upon budget allocation

**4) SBs**

- To formulate annual maintenance plan
- To formulate annual maintenance implementation plan

**(3) Road Maintenance Activities on Target**

It should be noted that the routine maintenance including non-pavement maintenance and pavement ex post fact minor repair are deemed the activities relevant to restoring serviceability, but not to reducing aging of pavement. It is generally understood that the effects of aging reduction are hardly anticipated in the pavement ex post fact maintenance.

In general, km-based fixed rate maintenance budgets have been widely used in estimating annual routine maintenance budgets, separately from the pavement maintenance planning system.

In addition, reconstruction in the development works, which comprise widening, realignment, etc., has been carried out mainly for the purpose of increase in road capacity, so that it should be handled separately from the pavement maintenance planning system.

**Table 5.1.1 Road Maintenance Activities on Target**

Category	Maintenance Activities (20013 Technical Standards on Road Routine maintenance in Vietnam)	Objectives of Measures			
		Increase Capacity	Increase Strength	Reduce Aging	Restore Serviceability
1. Routine Maintenance					
1.1 Non-Pavement maintenance	<ul style="list-style-type: none"> <li>• Culvert box cleaning</li> <li>• Side ditch cleaning</li> <li>• Grading</li> <li>• Grass and bush control</li> </ul>				X
1.2 Pavement Ex post fact maintenance (= Reactive Maintenance)	<ul style="list-style-type: none"> <li>• Pothole patching 12 cm</li> <li>• Pothole patching 30 cm</li> <li>• Edge repair</li> <li>• Graveling (15 cm thickness)</li> </ul>				X
2. Unscheduled Maintenance	<ul style="list-style-type: none"> <li>• Emergency works</li> <li>• Disaster restoration</li> </ul>				X
3. <b>Periodic Maintenance (Proactive Maintenance)</b>	<ul style="list-style-type: none"> <li>• <b>Crack seal</b></li> <li>• <b>Single surface treatment</b></li> <li>• <b>Double surface treatment</b></li> <li>• <b>Asphalt concrete overlay (30mm / 50 mm / 70mm)</b></li> </ul>			X	X
4. Development Works					
4.1 Rehabilitation	<ul style="list-style-type: none"> <li>• Structural Overlay (Replacement of pavement)</li> </ul>		X	X	X
4.2 Reconstruction	<ul style="list-style-type: none"> <li>• Realignment</li> <li>• Widening</li> </ul>	X	X	X	X
5. New Road Construction		X	X	X	X

*Note: PMS can formulate plans for category (3) and (4.1) only.*

**(4) Overall System Structure Architecture Design**

The overall PMS system structure developed for this project was examined. Necessary IT infrastructure such as Server, etc. (PMS server) required for web operation of PMS has already installed at DRVN, where all basic database and application management are installed. PMS server (www.pms.drvn.gov.vn) is already accessible to users via internet. Pavement condition data, which was compiled by survey, was imported directly into DRVN’s database system. Access to PMS related systems are managed by system administration module using system back end functions. Access right is defined and controlled based on assigned responsibility to DRVN departments and subsidiary organizations (i.e. RMB, SB, etc.).



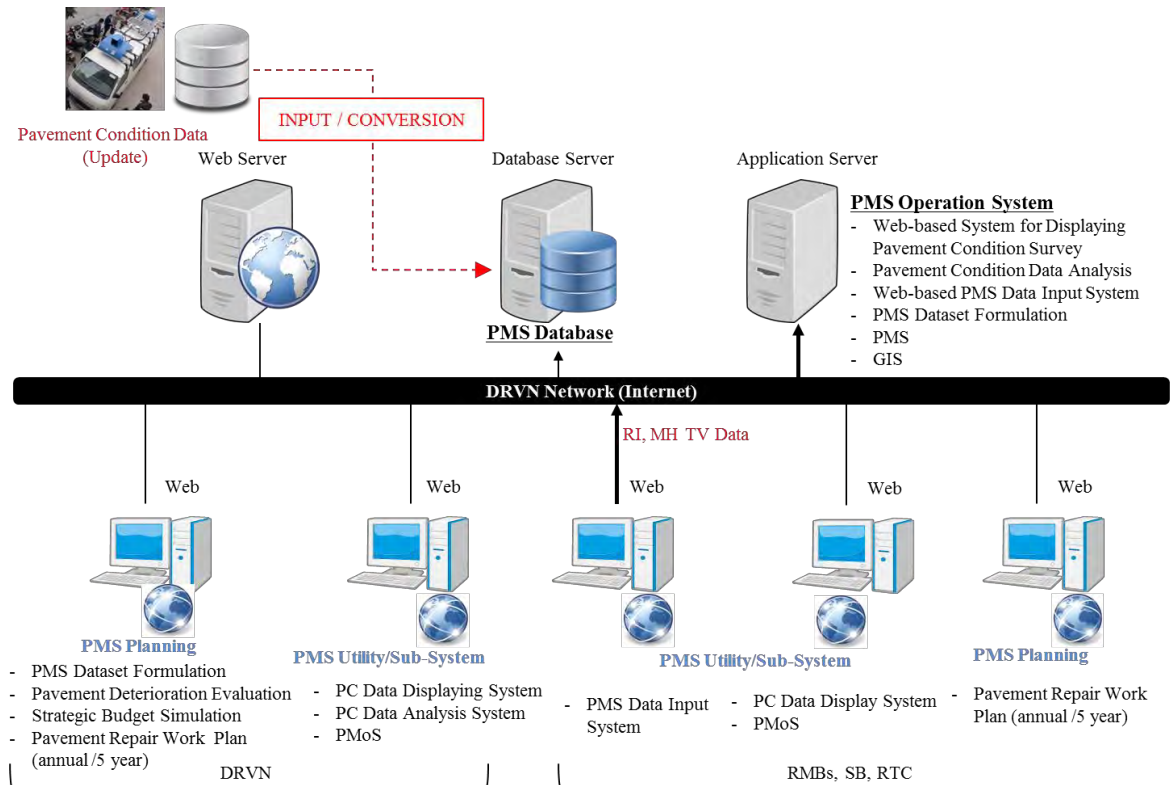


Figure 5.1.1 Overall PMS Structure Architecture (Web-based)

### (5) PMS Operation Options

The following three PMS operation options were considered while upgrading the PMS.

- Fully web-based system
- Hybrid system (web and desktop based)
- Fully desktop-based system

The merits and demerits of each operation type are considered. However, based on discussion with DRVN, the fully web-based system is selected, and system had been upgraded accordingly.

### 5.1.3 PMS Operation and Modules

#### (1) General Flowchart of PMS Operation

PMS consists of four modules, namely PMS dataset formulation (data integration and synchronization), pavement deterioration evaluation, strategic budget simulation and repair work planning (annual and medium-term) modules. However, pavement deterioration evaluation, strategic budget simulation, and repair work planning are the main computation modules because PMS dataset formulation module is provided to integrate project base data, data synchronization and finally prepare three different module datasets from the PMS dataset. The concept of master database is considered in PMS to preserve the key data within the PMS because output of each module can be utilized by other modules as well as by other tools in pavement management. The general PMS operation flowchart is illustrated in **Figure 5.1.2**.

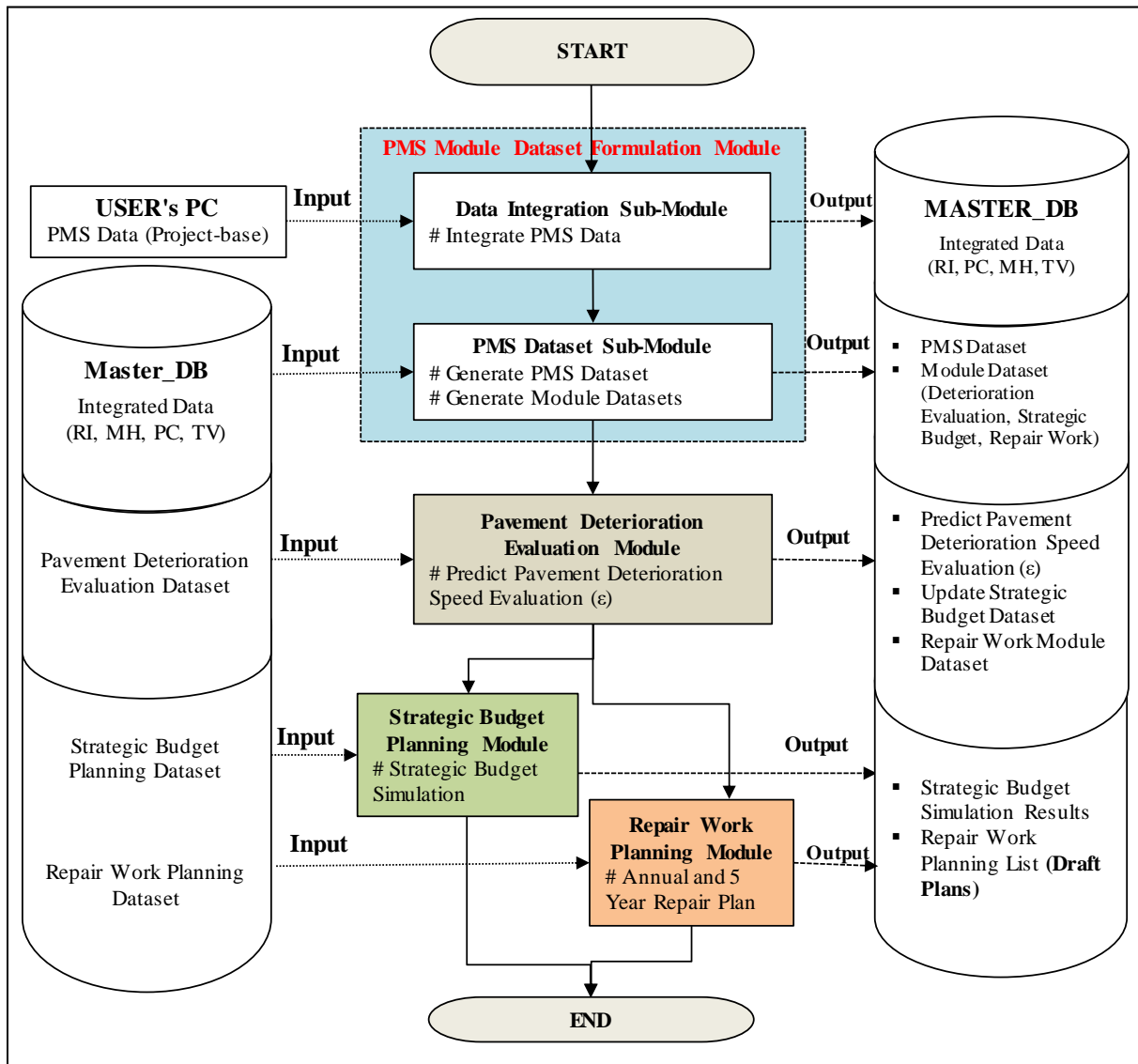


Figure 5.1.2 PMS General Operation Flowchart

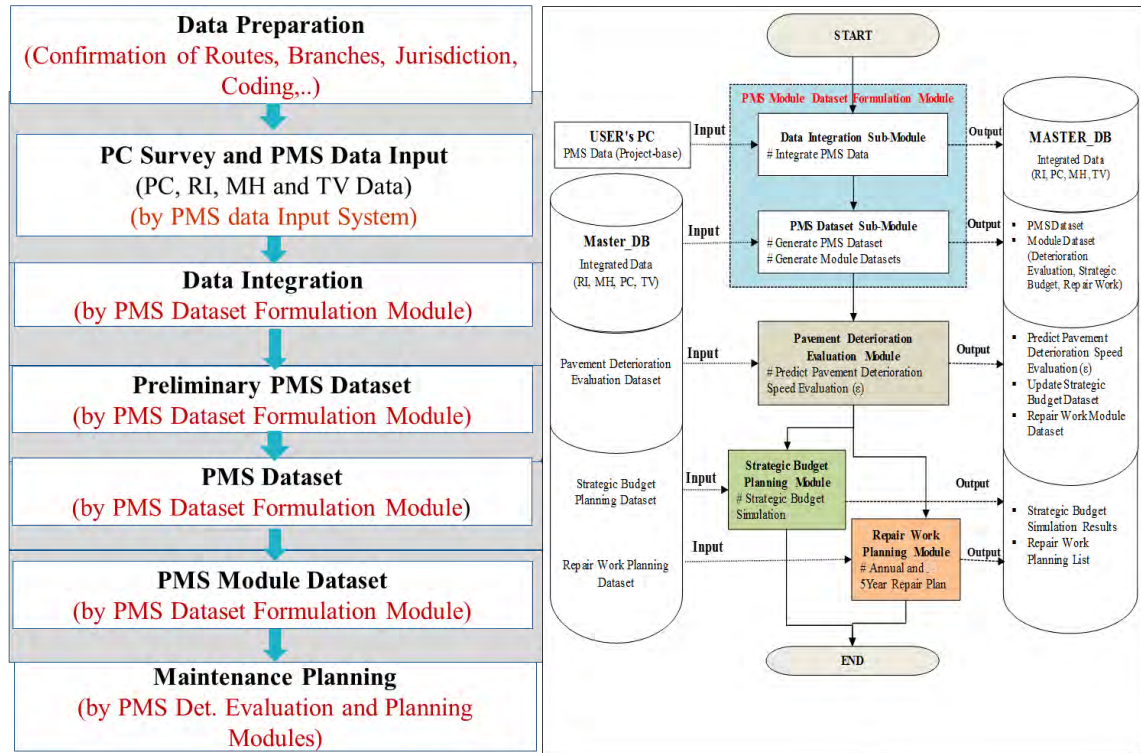
(2) PMS Modules

As mentioned in the previous section also that PMS consists of four (4) main modules, namely PMS dataset formulation module, pavement deterioration evaluation module, strategic budget planning module and repair work planning module. The outlines of each module are explained in succeeding sections.

1) PMS Dataset Formulation Module

PMS dataset formulation module formulates the PMS dataset by integrating PMS data inputted in project basis and stored in PMS database. This module first integrates the project base data in to integrated form and then formulates the PMS dataset by synchronizing road inventory, pavement condition, maintenance history and traffic volume data. Module datasets (deterioration evaluation, budget simulation and repair work planning) are formulated basically from the PMS

dataset and later updated by the result of pavement deterioration evaluation. General procedure of PMS dataset formulation is shown in **Figure 5.1.3**.



**Figure 5.1.3 General Procedure of PMS Dataset Formulation**

## 2) Pavement Deterioration Evaluation Module

### a. Outline

Pavement deterioration evaluation module is a statistical deterioration prediction model. The deterioration predictions are made based on recorded pavement condition (two-time series) data stored in the database. The prediction logic owes to Kyoto Model's analytical theories, which includes following features;

- Prediction of pavement deterioration based on Markov transitional hazard model
- Adoption of benchmarking method to identify road sections which may need further investigation

The flow of Pavement Deterioration Evaluation Module is shown in **Figure 5.1.4**, **Figure 5.1.5**, and **Figure 5.1.6**. The target region and distress type for evaluation are selected by system users.

- Target region : RMB I, RMBII, RMB III and RMB IV
- Distress type : Crack, Rut and IRI

There are four steps for evaluation.

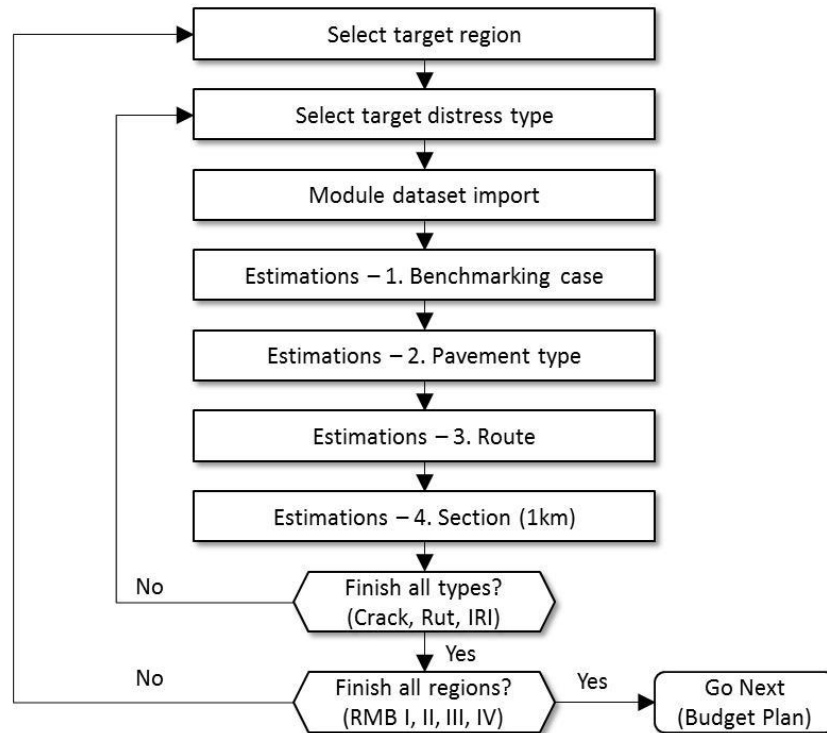
Step-1: Benchmarking case (average in selected region)

Step-2: Evaluation for each pavement type (AC, BST and CC)

Step-3: Evaluation for each route (separated by route and branch)

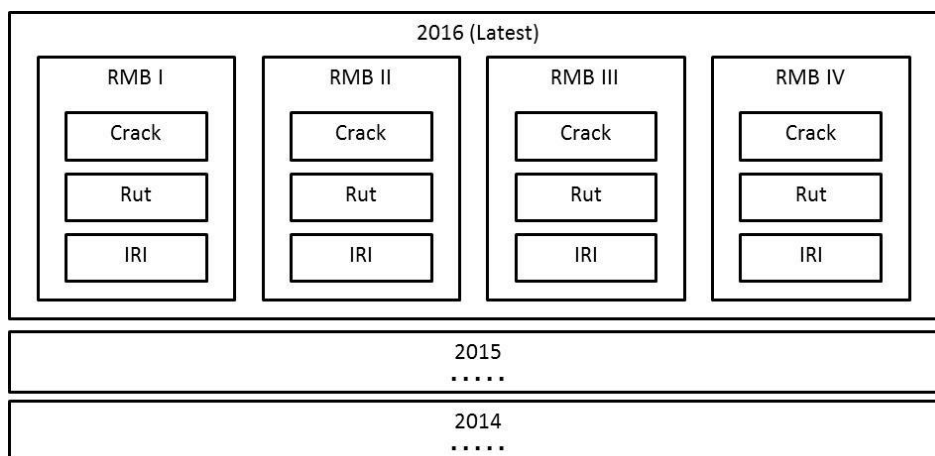
Step-4: Evaluation for each kilometer section (1 km and each direction)

All outputs files can be downloaded by user as MS-Excel files for wide utilization.



**Figure 5.1.4 Flow of Pavement Deterioration Evaluation Module**

Outputs data files are stored into the common database and other modules (Budget Planning Module and Repair Work Planning Module) access outputs files as input data. The following figure is the conceptual figure of archived outputs data structure.



**Figure 5.1.5 Archived Outputs Data Structure of Pavement Deterioration Evaluation Module**

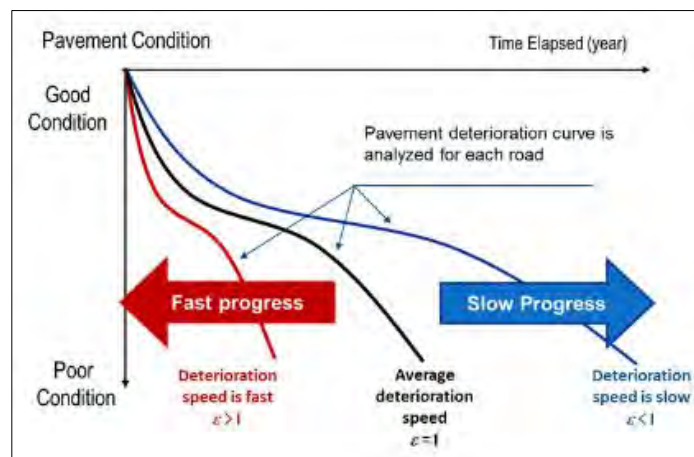
**b. Markov Transitional Hazard Model**

Markov transition model makes the assumption that future condition is determined stochastically on the present condition. Observed condition changes at sections for some time intervals enable to estimate appropriate pavement deterioration model, without any configuration which is required by empirical deterioration model. Pavement condition is a result of complex variable factors such as traffic volume, pavement type and structure, and precipitation, whereas main the concern is how pavements deteriorate as time goes with present condition, therefore, this model focus on condition transition probabilities from one condition to another condition rank. Markov hazard model is the main algorithm and estimates the transition probabilities from a certain ranking to other rankings, which estimates for each pavement condition index (crack rate, rutting depth and IRI) one by one. This evaluation is done by each region and by pavement types (Asphalt, Bituminous Surface Treatment and Cement Concrete).

**c. Bench-marking Evaluation**

In order to take in influential factors on pavement deterioration to the pavement deterioration model, a factor analysis is important. The factor analysis, which evaluates factor’s magnitude of impact on deterioration, are performed by using actual data collected.

Bench-marking evaluates a relative speed (epsilon;  $\epsilon$ ) of a group specified by factors to the benchmarking case ( $\epsilon = 1$ ) which is an average deterioration speed of whole analysis sections. In the case that  $\epsilon$  is larger than 1.0, it means that the pavement deterioration of such group deteriorates faster than the benchmarking speed. On the contrary, the case that  $\epsilon$  is smaller than 1.0, pavement deterioration progress is slower than the benchmarking speed. The concept of benchmarking is illustrated in the following **Figure 5.1.6**.



**Figure 5.1.6 Benchmarking of Pavement Deterioration Speed**

**3) Strategic Budget Simulation Module**

The strategic budget planning module simulates the budget requirements for four (4) scenarios, namely no-budget constraint scenario (scenario 0), maintain the current budget level (scenario 1), maintain the current pavement condition level (2), and maintain the target management level

(scenario 3). The output of this module will be very much useful for MoT/DRVN leaders to make road maintenance plan strategically setting the future direction of road condition and maintenance strategy. The module simulates the progress of pavement deterioration and budget plans over the specified period (preferably medium term) and produce the output in the form of repair cost, repair length, pavement indices transition (crack, rutting and IRI) and risk. The module can simulate for any specified period (for example 5, 10, 20, or 30 years) however considering the prospects of changes in traffic characteristics and socio-economic condition, maintenance planning for long-term seems to be unrealistic especially in the country where economic growth is rapidly increasing.

The risk is defined as the percentage (%) of length of non-repair section due to budget constraint to the length of full length of road network. Risks are displayed for whole target sections. If no budget constrain, risk line will align with zero level because all damage sections are always repaired timely.

*Risk (%) = Length of non-repair work due to budget constraint (km) / Length of full length of road network.*

The module allows the user to define repair policy (repair type corresponding to pavement deterioration ranking), repair unit cost and simulation condition (simulation period and no. of simulation time), and budget condition (with or without budget constraint). The output of simulation results can be preserved in master database as well as in user's defined location.

Users set the target regions and routes for simulation. Multiple regions and routes can be selected according to the purpose of the budget simulation.

All outputs files can be downloaded by user in MS-Excel file format for wide utilization. **Figure 5.1.7** shows the general operation flow of strategic budget simulation module.

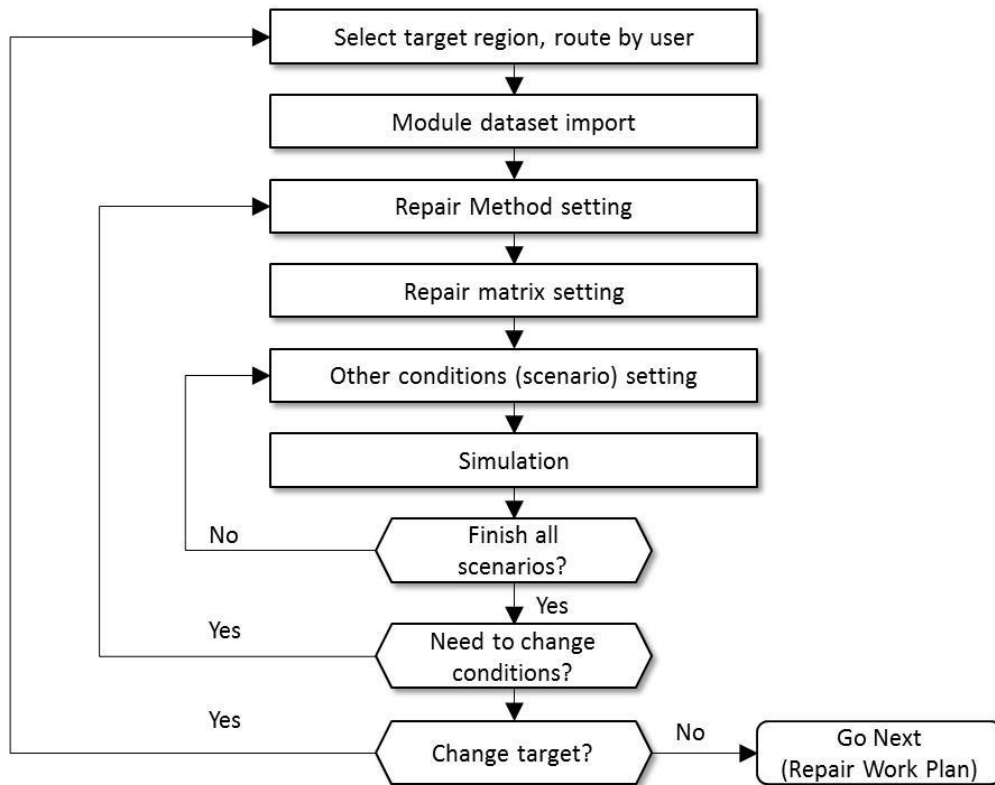


Figure 5.1.7 Flow of Strategic Budget Simulation Module

#### 4) Pavement Repair Work Planning Module

Repair work planning module formulates annual and 5-year repair work plan by due consideration of pavement deterioration progresses. The pavement deterioration conditions of each 100m section for target planning year are computed using output of pavement deterioration evaluation module. This module helps to planner by providing suggested repair method, repair cost, repair work volume and repair priority for each 100m section. The general flowchart of repair work planning module is shown in **Figure 5.1.8**.

Repair method identified/suggested by the module is purely based on pavement deterioration conditions (damage level) which are to be collected the surface condition of the pavement. Therefore, any defects on pavement layers including subgrade and foundation cannot be detected and thus predicted. Therefore, detailed field investigation shall be conducted in the sections where big repair works are suggested by the module.

The first output from the module shall be considered as “candidate list” for repair work plans. It is highly recommended to conduct for field verification of the candidate list to formulate the repair work project for contracting out for repair. The module also provides the functions to formulate proposal list (after field verification) and final project list (after approved from MOT/MOF).

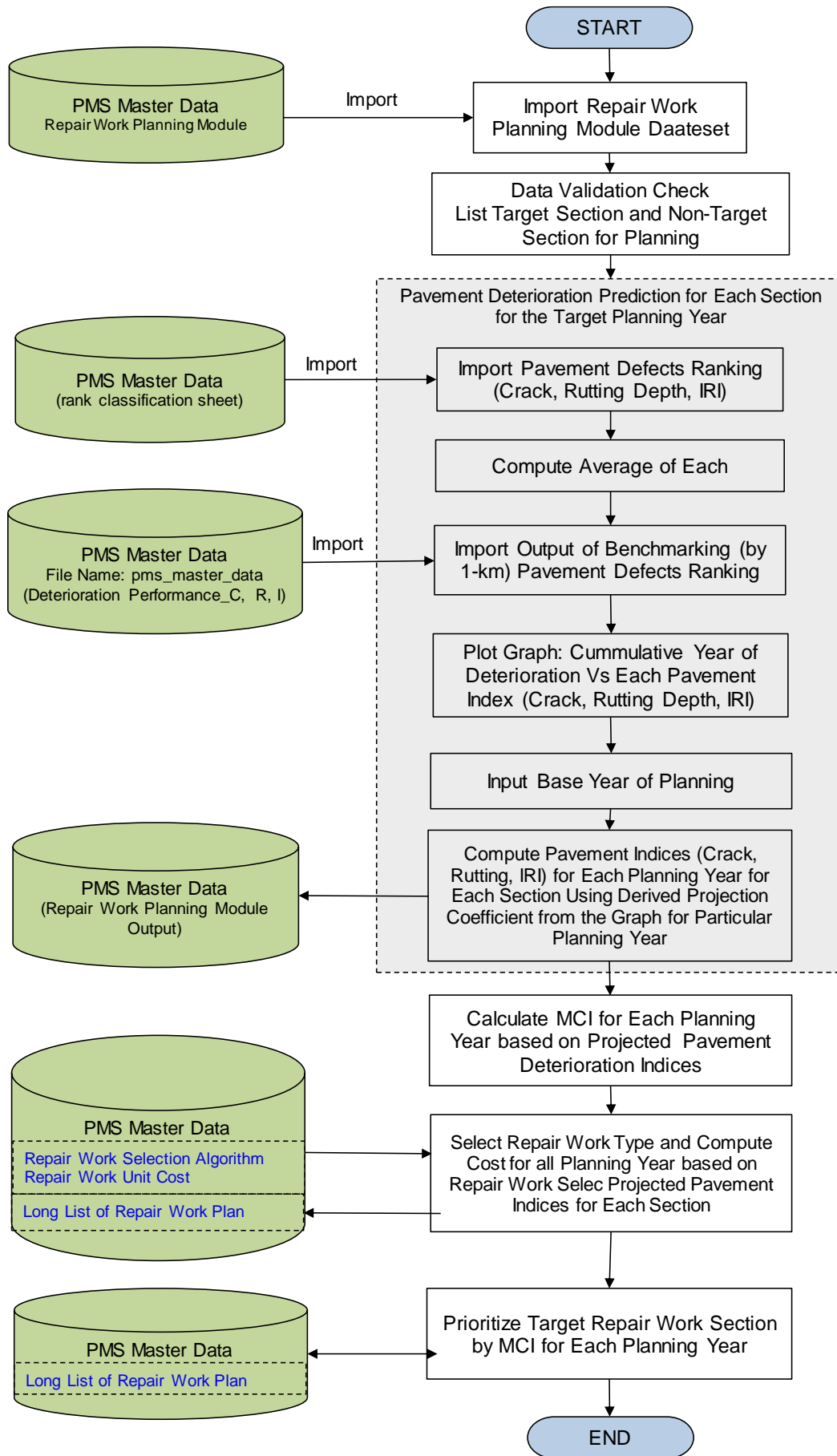


Figure 5.1.8 General Flowchart of Repair Work Planning Module



**5.1.4 Framework of Upgrading of PMS (Module-Wise)**

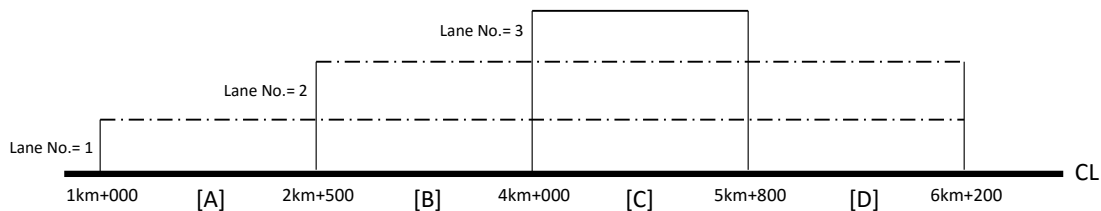
As the basic function of PMS has already developed under JICA Phase I Project, the more focus was given to improve and expand the scope of PMS operation in JICA Phase II Project.

**(1) Pavement Deterioration Evaluation Module**

The following items were considered for the upgrading of pavement deterioration evaluation module.

**1) Lane-wise Pavement Deterioration Evaluation**

In the recent days, DRVN is implementing pavement repair work by lane. Therefore, lane-wise pavement deterioration evaluation is necessary to utilize the deterioration evaluation result in maintenance planning. Since lane wise planning concept was not incorporated in phase I version, the module has been upgraded to make it applicable for lane-wise pavement deterioration evaluation. **Figure 5.1.9** and **Figure 5.1.10** illustrate the lane-wise PMS data structure which will be utilized for dataset preparation, deterioration evaluation and maintenance planning. The output of the module will also be in the same structure.



**Figure 5.1.9 Multi-lane Pavement Data**

	Route Name	U/D	From	To	Section length	Lane No.	width
[A]	*****	U	1km 000	1km 100	100	1	3.5
	*****	U	1km 100	1km 200	100	1	3.5
	...	...	...	...	...	...	...
[B]	*****	U	2km 500	2km 600	100	1	3.5
	*****	U	2km 600	2km 700	100	1	3.5
	...	...	...	...	...	...	...
[C]	*****	U	2km 500	2km 600	100	2	3.5
	*****	U	2km 600	2km 700	100	2	3.5
	...	...	...	...	...	...	...
[D]	*****	U	4km 000	4km 100	100	1	4.0
	*****	U	4km 100	4km 200	100	1	4.0
	...	...	...	...	...	...	...
[D]	*****	U	4km 000	4km 100	100	2	4.0
	*****	U	4km 100	4km 200	100	2	4.0
	...	...	...	...	...	...	...
[D]	*****	U	4km 000	4km 100	100	3	4.0
	*****	U	4km 100	4km 200	100	3	4.0
	...	...	...	...	...	...	...
[D]	*****	U	5km 800	5km 900	100	1	3.0
	*****	U	5km 900	6km 000	100	1	3.0
	...	...	...	...	...	...	...
[D]	*****	U	5km 800	5km 900	100	2	3.0
	*****	U	5km 900	6km 000	100	2	3.0
	...	...	...	...	...	...	...

**Figure 5.1.10 Multi-lane Pavement Data Structure**

**2) Applicability to Nationwide National Road Network**

Pavement deterioration evaluation module developed under JICA Phase I Project was specifically developed for national road network under RMB I jurisdiction only. However, the module was developed in flexible platform so that it can be easily modified to make it applicable for other remaining RMBs including PDOTs. Under JICA Phase II Project, the module has been upgraded to make applicable for nationwide national road network. As for applicability to PDOTs, it cannot be assured because there are no data (i.e. PMS dataset) required for verifying its applicability.

**3) System Performance Improvement**

The utmost effort has been made to develop the most efficient system from the point of view of system performance and operability in phase I version also. The same effort has been continued during upgrading of the module. The feedbacks of the users were sincerely respected and considered for incorporation in the module.

**(2) Strategic Budget Simulation Module**

The following items were considered for the upgrading of strategic budget simulation module.

**1) Lane-wise Strategic Budget Simulation**

In the recent days, DRVN is implementing pavement repair work by lane. Therefore, lane-wise strategic budget simulation is necessary to utilize the output of simulation while repair work planning. Since lane wise planning concept was not incorporated in phase I version, the module has been upgraded to make it applicable for lane-wise strategic budget simulation.

**2) Automation of Strategic Budget Scenario Simulation**

In JICA Phase I version PMS, budget simulation can be performed for four (4) budget scenarios as explained in **Section 5.3.3** and illustrated in Error! Reference source not found.. However, these simulations shall be performed by trial and error and final decision shall be made by user itself. This method of simulation is not so convenient for the user. Therefore, the module has been upgraded incorporating the automation of the simulation procedure based on scenario input condition.

**3) Common Repair Work Type (Repair Work Selection Matrix)**

In the Phase I version of PMS, the repair work type used in budget planning module and repair work planning module are not necessarily the common. Therefore, there is possibility of discrepancies in output between budget planning module and repair work planning module. As a result of discrepancies, the budget simulated by budget planning module and budget estimated by repair work planning module may not match each other. Therefore, the module has been upgraded incorporating a common repair work selection algorithm (matrix) for strategic budget simulation and repair work planning modules.

**4) Default Setting of Simulation and Budget Condition**

In the Phase I version of PMS, simulation condition (simulation year, no. of simulation) and budget condition (with or without budget constraint) are required to be input by users on their own decision and thus there is possibility of inputting irreverent conditions during the simulation. Therefore, in order to avoid such kind of possibility, default value of simulation and budget conditions has set while upgrading the module. However, any customization is possible if necessary.

**5) Applicability to Nationwide National Road Network**

Budget planning module developed under JICA Phase I Project was specifically developed for national road network under RMB I jurisdiction only. However, the module was developed in flexible platform so that it can be easily modified to make it applicable for other remaining RMBs including PDOTs. Under JICA Phase II Project, the module has been upgraded to make applicable for nationwide national road network. As for applicability to PDOTs, it cannot be assured because there are no data (i.e. PMS dataset) required for verifying its applicability.

**6) System Performance Improvement**

The utmost effort has been made to develop the most efficient system from the point of view of system performance and operability in phase I version also. The same effort has been continued during upgrading of the module. The feedbacks of the users were sincerely respected and considered for incorporation in the module.

**(3) Annual and Medium-term Repair Work Planning Module**

The following items were considered for the upgrading of Annual and medium-term (5-year) Repair Work Planning Module;

**1) Update of Repair Work Selection Algorithm**

As the repair work type to be suggested by the module shall be compatible with the existing Vietnamese practice, pavement design standard, inspection guidelines, maintenance standards and norms, the repair work selection algorithm has reviewed and updated in consultation with maintenance management department of DRVN. The repair work plans formulated using repair work selection matrix were also checked in the field. Therefore, revisions were made a number of time to make the matrix the most suitable in the field conditions. While developing PMS system, repair work selection algorithm has set in a flexible platform in order to let users for easy updating and customization. The final revised repair work selection matrix is shown in **Table 5.1.2, Table 5.1.3, and Table 5.1.4.**

**Table 5.1.2 Algorithm for the Selection of Pavement Repair Work (AC Pavement)**

Rutting Depth (mm)  Crack Ratio (%)	Light defects	Medium defects		Heavy defects	
	<b>A</b>	<b>B</b>	<b>C</b>		<b>D</b>
	[0; 10)	[10; 25)	[25; 30)	[30; 40)	≥ 40

Light defects	A	[0; 10)	No Treatment Exclusive of Emergency Works	Minor Rut Repair (e.g. Hump Milling)	Overlay and Cutover & Overlay	Cut Surface Course and Replacement
Medium defects	B	[10; 20)		Minor Crack Repair (e.g. Crack Seal, MS, TL-2000)		Minor Repair for Crack and Rut (e.g. Hump Milling + Crack Seal)
		[20; 30)	Cut Surface Course and Replacement			
	C	[30; 40)	Overlay and Cutover & Overlay		Cut Surface Course and Replacement	
Heavy defects	D	≥ 40	Cut Surface Course and Replacement	Cut Surface Course and Replacement	Cut Surface Course and Replacement	

**Notes:**

- (1) The system support maintenance planning for pavement in terms of periodical repair.
- (2) Routine or emergency work shall be handled separately. The budget for routine maintenance shall be decided based on lumpsum (ad-hoc basis).
- (3) Regarding heavily deteriorated pavements, it shall be handled as the scheme of rehabilitation or improvement. Repair works for heavy defects (Rank D) regarding RUTTING and CRACKING shown in the above table are tentatively selected for pavement repair work planning for specifying candidate repair sections. Repair works shall be designed based on the results of detailed inspection and further site verification.
- (4) Given the maintenance plans prepared by the systems, road operators are requested to finalize including site verification, further investigation (such as pavement load bearing testing) for actual implementation maintenance plans.

**Table 5.1.3 Repair Work Selection Algorithm for BST Pavement**

Rutting Depth (mm)			Light defects	Medium defects		Heavy defects
			A	B	C	D
Crack Rate (%)			[0; 25)	[25; 35)	[35; 50)	≥ 50
			Light defects	A	[0; 10)	No Treatment Exclusive of Emergency Works
Medium defects	B	[10; 20)				
	Medium defects	C	[20; 30)	SBST	DBST	
[30; 50)			DBST			
Heavy defects	D	≥ 50	Surface Reconstruction (TBST)			

**Notes:**

- (1) The system support maintenance planning for pavement in terms of periodical repair.
- (2) Routine or emergency work shall be handled separately. The budget for routine maintenance shall be decided based on lumpsum (ad-hoc basis).
- (3) Regarding heavily deteriorated pavements, it shall be handled as the scheme of rehabilitation or improvement. Repair works for heavy defects (Rank D) regarding RUTTING and CRACKING shown in the above table are tentatively selected for pavement repair work planning for specifying

candidate repair sections. Repair works shall be designed based on the results of detailed inspection and further site verification. Given the maintenance plans prepared by the systems, road operators are requested to finalize including site verification, further investigation (such as pavement load bearing testing) for actual implementation maintenance plans.

**Table 5.1.4 Algorithm for the Selection of Pavement Repair Work (CC Pavement)**

Pavement Deterioration Index				Measures
Crack Index (cm/m <sup>2</sup> )	Light defects	A	[0;30) (TBD)	No Treatment Exclusive of Emergency Works
	Medium defects	B	[30;40) (TBD)	Localized Repairs (1)
		C	[40;50) (TBD)	Localized Repairs (2)
	Heavy defects	D	≥ 50 (TBD)	Full Repair Replacement of concrete slabs

**Note:**

- (1) TBD: setting the proper value is under discussion.
- (2) The system support maintenance planning for pavement in terms of periodical repair.
- (3) Routine or emergency work shall be handled separately. The budget for routine maintenance shall be decided based on lumpsum (ad-hoc basis).
- (4) Regarding heavily deteriorated pavements (Ranking D), the system supports to identify the targeted sections with the repair work of replacement of concrete slabs. Decision on whether or not to treat foundation or subgrade shall be made based on the results of detailed inspection and further site verification.
- (5) Given the maintenance plans prepared by the systems, road operators are requested to finalize including site verification, further investigation (such as pavement load bearing testing) for actual implementation maintenance plans.
- (6) Localized repairs consisting of variety of methods such as crack sealing, patching and partial replacement that shall be decided by site verification.

**2) Lane-wise Repair Work Planning**

In the recent days, DRVN is implementing pavement repair work by lane. Therefore, lane-wise repair work planning is necessary. Since lane wise planning concept was not incorporated in phase I version of PMS, the module has been upgraded to make it applicable for lane-wise planning.

**3) Applicability to Nationwide National Road Network**

Repair work planning module developed under JICA Phase I Project was specifically developed for national road network under RMB I jurisdiction only. However, the module was developed in flexible platform so that it can be easily modified to make it applicable for other remaining RMBs including PDOTs. Under JICA Phase II Project, the module has been upgraded to make applicable for nationwide national road network. As for applicability to PDOTs, it cannot be assured because there are no data (i.e. PMS dataset) required for verifying it.

**4) System Performance Improvement**

The utmost effort has been made to develop the most efficient system from the point of view of system performance and operability in phase I version also. The same effort has been continued during upgrading of the module. The feedbacks of the users were sincerely respected and considered for incorporation in the module.

**5) Repair Work Unit Costs**

Repair work unit cost is necessary for estimating repair work cost. Therefore, all possible/candidate repair work types to be used in road maintenance are considered while developing repair work unit cost module. While customizing the repair work selection algorithm, the repair work unit cost shall also be used accordingly.

Repair work unit cost shall be updated annually because repair work unit cost generally varies every year. In consultation with maintenance management department of DRVN, the following possible repair work types are incorporated in the PMS and requested to DRVN to provide unit cost of the year 2016 by each RMB.

**Table 5.1.5 Repair Work Type and Unit Cost**

SN	Pavement Type	Repair Category/Method		Repair Work Unit	Year	Unit Cost			
						RMB I	RMB II	RMB III	RMB IV
1	Asphalt Concrete (AC)	10101	Hump Milling (<=30mm)						
		10102	Hump Milling (<=40mm)						
		10103	Hump Milling (<=50mm)						
		10104	Hump Cutting and Micro-Surfacing (Type II)						
		10105	Hump Cutting and Micro-Surfacing (Type II)						
		10106	Hump Cutting and TL2000						
			10201	Crack Sealing-L (~ crack ratio 10%)					
			10202	Crack Sealing-L (~ crack ratio 20%)					
			10203	Crack Sealing-L (~ crack ratio 30%)					
			10204	Crack Sealing - A (30%)					
		10205	Crack Sealing - A (40%)						

SN	Pavement Type	Repair Category/Method		Repair Work Unit	Year	Unit Cost			
						RMB I	RMB II	RMB III	RMB IV
		10206	Crack Sealing - A (50%)						
		10207	Crack Sealing - A (60%)						
		10208	Micro-Surfacing - II						
		10209	Micro-Surfacing - III						
		10210	TL2000 - Dressing						
		10211	Micro-Surfacing (Type II) and Crack Sealing						
		10212	Micro-Surfacing (Type III) and Crack Sealing						
		10213	TL2000 - Dressing and Crack Sealing						
		10301	Hump Cutting (<30mm) and Crack Sealing						
		10302	Hump Milling and Crack Sealing & Micro-Surfacing (Type II)						
		10303	Hump Milling and Crack Sealing & Micro-Surfacing (Type II)						
		10304	Hump Cutting and Crack Seal and TL2000						
		10401	AC Overlaying (3cm)						
		10402	AC Overlaying (4cm)						
		10403	AC Overlaying (5cm)						
		10404	AC Overlaying (6cm)						
		10405	AC Overlaying (7cm)						
		10406	Cut and AC Overlaying (5cm)						
		10407	Cut and AC Overlaying (6cm)						
		10408	Cut and AC Overlaying (7cm)						
		10409	Cut and AC Overlaying (12cm)						
		10501	Cut Surface Course and Replacement (5cm)						
		10502	Cut Surface Course and Replacement (7cm)						
		10503	Cut Surface Course and Replacement (12cm)						
		10504	Surface Recycling & Overlaying						
		10505	Deep Recycling & Overlaying						
		10506	Cut & Replacement (Full Structure)						
2	Bituminous Surface Treatment (BST)	20101	Single Bituminous Surface Treatment (DBST)						
		20201	Double Bituminous Surface Treatment (DBST)						
		20301	Triple Bituminous Surface Treatment (TBST)						
		20302	Repair of Macadam of 10cm thick and TBST						
		20303	Repair of Macadam of 15cm thick and TBST						
3	Cement Concrete (CC)	30101	Localized Repair (1)						
		30201	Localized Repair (2)						
		30301	Replacement of Concrete Slabs, 22cm thick						

**(4) Integration to RAMS**

Vietnam Road Asset Management Project (VRAMP) is intending to develop a comprehensive Road Asset Management System (RAMS) including integration of PMS and VBMS. Therefore, PMS has also developed considering the requirements of integration with RAMS. The actual integration module will be developed under VRAMP. A proper data exchange mechanism between RAMS and PMS shall be defined and each system shall be compatible for the data exchanging through the web/internet.

**5.2 ACTIVITY 2-2: FORMULATE PMS DATASET**

**5.2.1 Introduction**

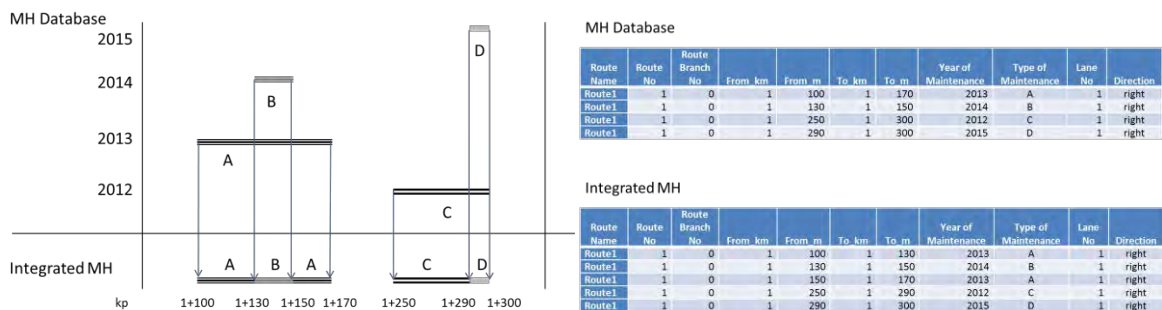
PMS dataset is to be prepared using four types of data, namely road inventory, pavement condition, maintenance history and traffic volume data. Among these four data, only pavement condition data are collected in homogeneous section (i.e. 100m). Road inventory data and maintenance history data are collected in random sectioning whereas traffic volume data are collected as point data. Also, data are to be collected and stored in different time (i.e.) and when formulating PMS dataset, the latest data shall be used. Therefore, in order to formulate homogenous dataset by integrating the latest all these four types, PMS dataset formulation module has developed as a module of PMS.

**5.2.2 PMS Data Management Function**

Data management function is one of the important roles of the Web-based PMS. PMS database manages road inventory and maintenance history as project based data, therefore they allow multi-year data and duplications in section. The first step is “PMS database integration” which integrates road inventory and maintenance history database into a single year sectional unique database. Following figure shows an illustration of such data integration.

Data Integration of RMD/MH

Route1\_Branch1\_Right Direction\_Lane1



**Figure 5.2.1 Sample Case of PMS Data Integration**



In the second step, “PMS Module Dataset Formulation” is conducted by rounding up (normalize) chainage into 100m, then synthesize all necessary data where under present jurisdiction of DRVN by filtering of Road Administration DB.

In the third step, “Produce PMS Module Dataset” is conducted and formulate PMS Module datasets which are input data for PMS Planning Modules. The system operates PMS Planning Modules using prepared PMS Datasets and input condition data. Results are stored in databases accordingly.

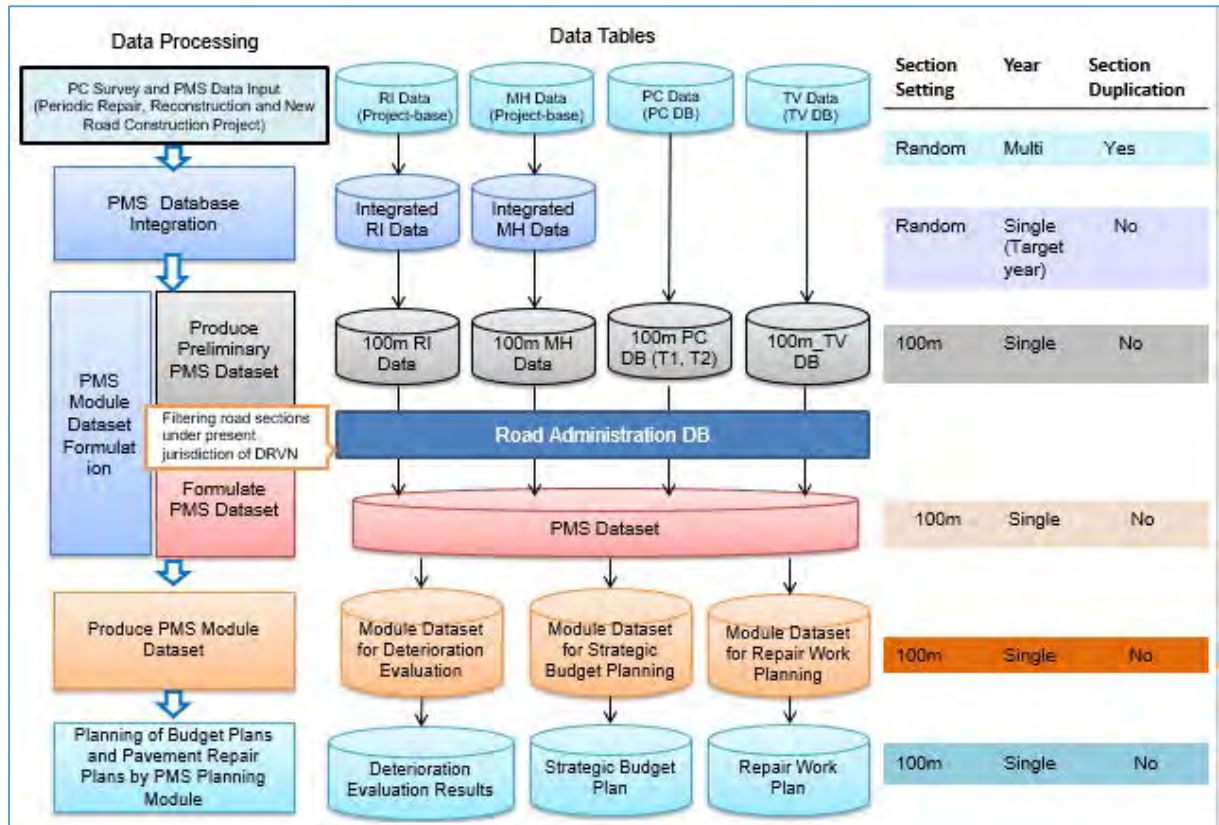


Figure 5.2.2 Data Integration Flow from PMS Database to PMS Dataset, and Module Dataset

### 5.2.3 PMS Dataset Formulation Module (Formulation of PMS Dataset)

PMS Dataset Module prepares PMS dataset for strategic budget simulation and repair work planning. Each data tables are recorded in history data as variable section data. Those are integrated and synthesized from different databases.

PMS Dataset will be created once a year or once in several years before conducting budget planning using the latest data stored in PMS database by DRVN DPI officials. Since only one PMS dataset for a year is allowed to formulate and store, the final and authorized PMS dataset shall be used for planning by all planners of DRVN and RMBs.

In this regard, PMS dataset formulation module should have the following functions;

- Integrate road Inventory (RI) and Maintenance History (MH) data

- Integrate Pavement Condition (PC) data
- Convert point data into section data (for traffic volume data)
- Synthesize location information among road asset, maintenance history, traffic volume and pavement condition data
- Data integration into PMS Dataset
- Data validation check
- PMS dataset management (view, delete, authorize, etc.)

#### **5.2.4 Formulation of PMS Module Dataset**

The system extracts necessary data from PMS dataset and prepares dataset for pavement deterioration evaluation module, strategic budget simulation module and repair work planning module. Parameters and necessary reference tables are also managed.

In this regard, PMS dataset formulation module should have following functions;

- Prepare module dataset for pavement deterioration evaluation
- Prepare module dataset for strategic budget simulation incorporating pavement deterioration evaluation results
- Prepare module dataset for repair work planning incorporating pavement deterioration evaluation results
- Manage necessary parameters and reference tables
- Execute compiled calculation programs of each simulations and planning
- Store output files

#### **5.2.5 Method of Formulating PMS Dataset**

##### **(1) Base Road Section**

PMS planning software prepares repair work plan in 100m section. Therefore, base road section is designed as 100m section. To consolidate base road section management, road administration table (segment table) is used for identifying present jurisdiction of each road. With some supplemental information, base road section is to be prepared for PMS dataset by the system. Using these sections as primary dataset, synthesize PMS dataset extracting the related data from respective data tables as shown in **Figure 5.2.2**.

##### **(2) Differences in RA, RI, MH, PC, and TV Data Attribute**

To create PMS Dataset, it is necessary to consider the differences in identifier of each table. For this regard, following table and figure shows difference between RI, MH, PC and RA. Direction, lane position number and overlapping cases shall also be considered.

**Table 5.2.1 Features of RA/RI/MH/PC/TV**

<b>DB</b>	<b>Section Length</b>	<b>Coverage</b>	<b>Continuity of Sections</b>	<b>New Registration Data Unit and Register</b>	<b>Direction</b>	<b>Lane Position</b>
Road Administration (RA)	Variable	All NH	Continuous	Section (DRVN)	No	No
Road Inventory (RI) or (RMD)	Variable	All NH (Desirable)	Continuous	Project section (RMB/ Contractor)	Yes	Yes
Maintenance History (MH)	Variable	Maintenance Work Conducted Sections	Discontinuous	Section Project (RMB/ Contractor)	Yes	Yes
Pavement Condition (PC)	Basically 100m*	Surveyed (Not recently conducting Periodic Maintenance)	Continuous	Field Survey (RMB/ Contractor)	Yes	Yes
Traffic Volume (TV)	Location	Location Surveyed	Discontinuous	Survey Station (DRVN)	Yes	No

\* PC section is occasionally divided shorter than 100m where physically or administrative discontinuous.

Following Figure illustrates some typical differences between RA/RI/MH/PC/TV as follows,

- RA data has only section data without neither direction nor lane position number.
- PC data has actual length but RA, RMI, and MH do not. It requires special data processing for the section more than 1,000m.
- PC data mainly starts from existing KP and end at existing KP, however there is a few cases of non-existence of KP.
- PC data define road direction by actual surveyed direction, therefore no definition of “single lane”, which is used for RMI and MH. Instead of that, overlapping field explains by recording “UD”, in case the section is used both right and left directions.

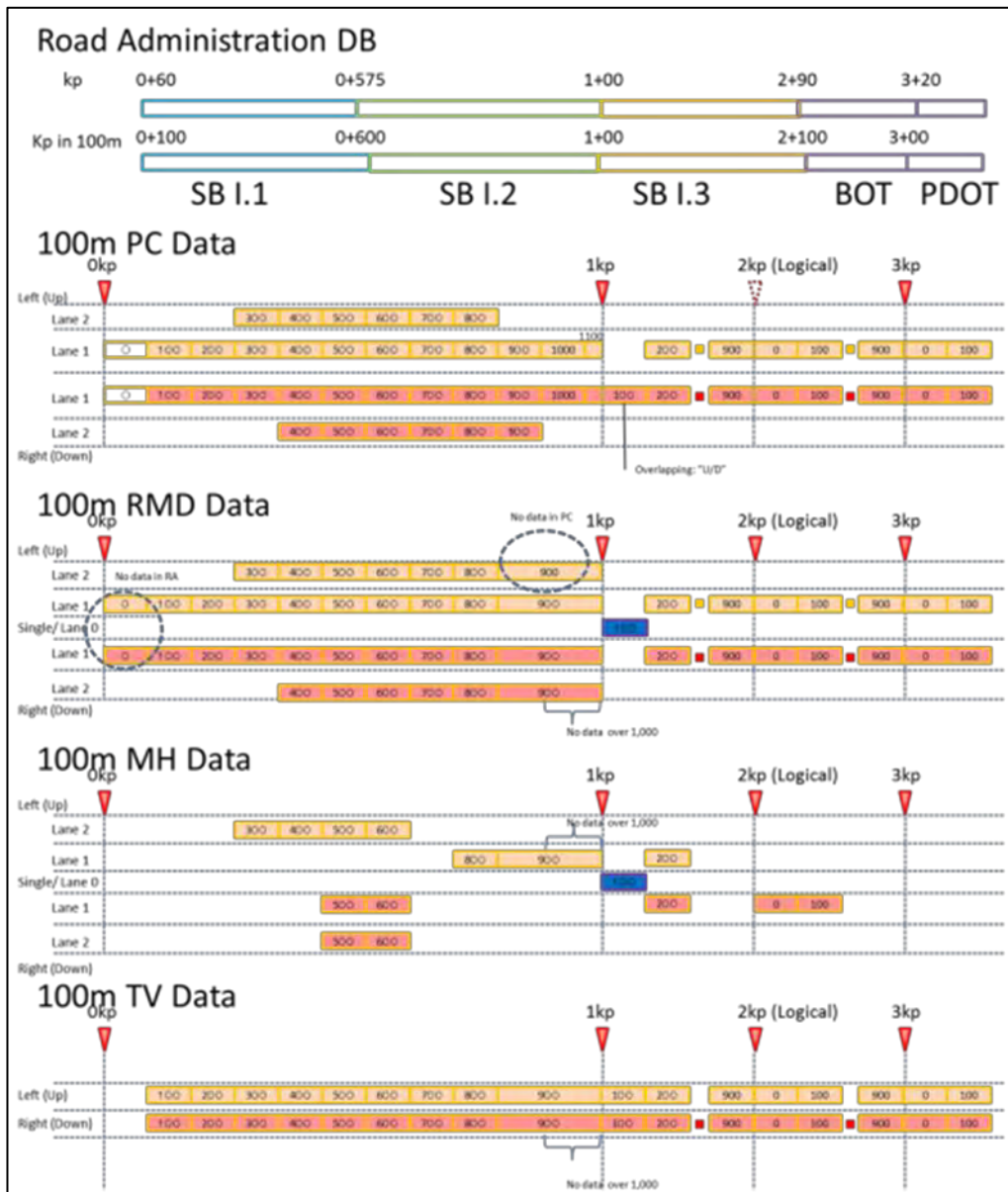


Figure 5.2.3 Summary of Difference in RA/RMD/MH/PC/TV

(3) Formulation of Preliminary PMS Dataset

PC data are stored in PC data table after conducting PC Survey. This data has some differences with other PMS Databases as follows;

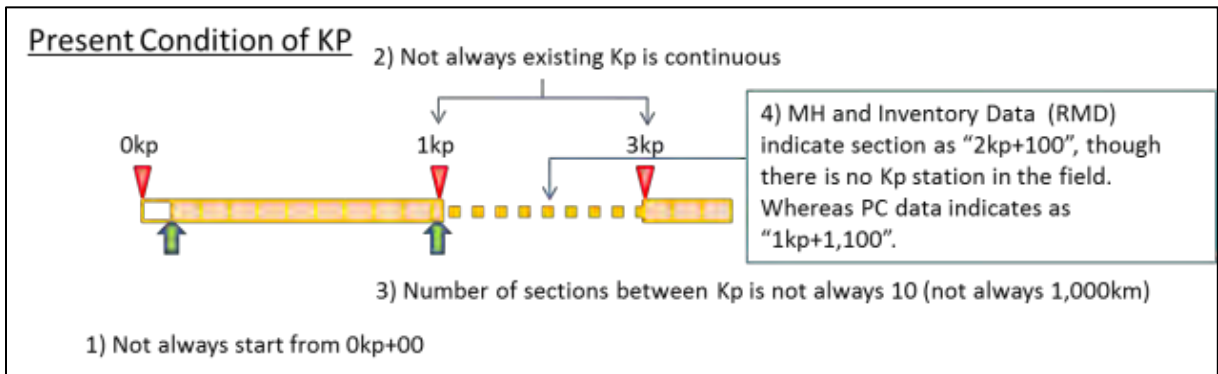
- PC sections are basically 100m from existing milestones of kilopost (kp), though, occasionally divided shorter than 100m where physically or administrative discontinuous exists to elaborate precise condition of the site.
- There is a case of milestone of kp not existing. In such case, PC data are recorded as cumulative length from existing milestone of kp. For example, 1,100m from kp-1 but the milestone of kp-2 does not exist, then PC data record as “kp-1+1,100”. On the other hand, maintenance history or inventory data records such location as “kp-2+100”.

In order to synthesizing to other data, following series of data processing is conducted;

- For the PMS planning, evaluate unit is 100m, therefore shorter sections are to be unified and given representative values.
- To create PMS dataset, PMS base section is to be created from road administration data under the unique coding rule. To matching to the rule, logical kp is introduced and to be applied to PC data where kp does not exist.
- To realize above mentioned coding rule, irregular kp sections are listed and referred to identify where to apply logical kp.

**[Logical KP]**

Even though actual physical kp does not exist in the field, a virtual kp (which does not exist in the field) is used for management purposes. To make pavement condition (PC) data compatible to other database, logical kp (virtual kp) is introduced inside the system and applied to PC data.



**Figure 5.2.4 Data Structure and Section Identifier of RA/RMD/MH**

**5.3 ACTIVITY 2-3: FORMULATE PAVEMENT REPAIR WORK DRAFT PLAN**

Repair work plans are to be prepared based on PMS data and setting of other system operation data such as repair work selection matrix and unit cost of repair method.

**5.3.1 PMS Dataset**

PMS dataset were formulated using road inventory, maintenance history and traffic volume data inputted by RMBs/SBs and pavement condition data collected by pavement condition survey vehicle. Since pavement condition data are key for formulating repair work plans, target road network is limited to the road network where pavement condition survey was conducted. **Table 5.3.1** shows the summary of PMS data used in formulating repair work draft plans.

**Table 5.3.1 Summary of PMS Data and PMS Dataset Coverage (as of 23/11/2017)**

Particulars	Unit	RMB I	RMB II	RMB III	RMB IV
Network Length	Road-km	2,346	2,839	2,203	3,357
PC Survey	Road-km	2,192 (2012) (91%)	2,054	834	1,647

Particulars	Unit	RMB I	RMB II	RMB III	RMB IV
		974.45 (2016) (46%)	(72%)	(38%)	(49%)
PC Data	Lane-km	4,385 (2012)	3,955	2,076	3,638
		2,309 (2016)			
Road Inventory	Lane-km	2,687	5,835	4,841	7,632
Maintenance History	Lane-km	404	972	145	309
Traffic Volume	-	2012-2016	2012-2016	2012-2016	2012-2016
<b>Network Coverage of PMS Dataset for Planning</b>	-	<b>45%</b>	<b>70%</b>	<b>35%</b>	<b>45%</b>

### 5.3.2 Pavement Deterioration Performance Evaluation

Pavement deterioration performance has been evaluated using the PMS dataset prepared for each region. The step of deterioration performance evaluation is shown as below.

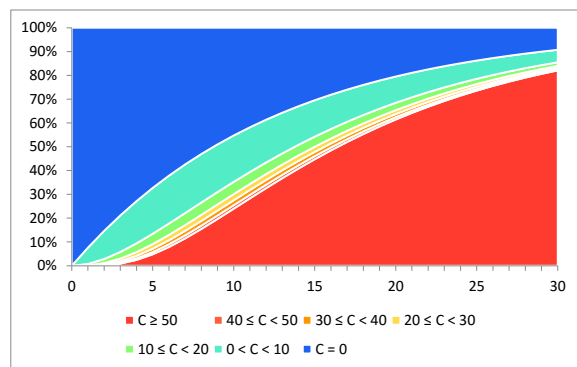
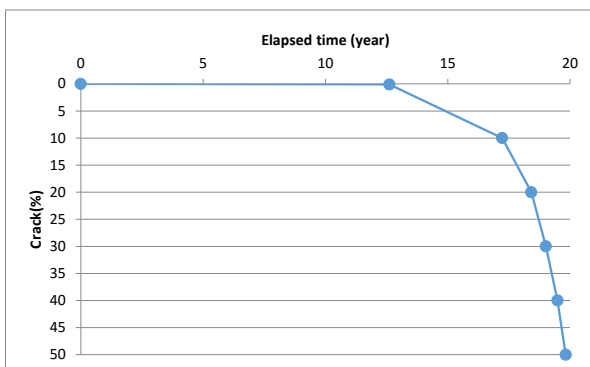
- Step-1 : Bench-Mark case
- Step-2 : Bench-Mark evaluation for each pavement type
- Step-3 : Bench-Marking evaluation for each route
- Step-4 : Bench-Marking evaluation for each 1km section

Each evaluation step is conducted for each condition index (Crack, Rut and IRI) and each region (RMB I, II, III and IV).

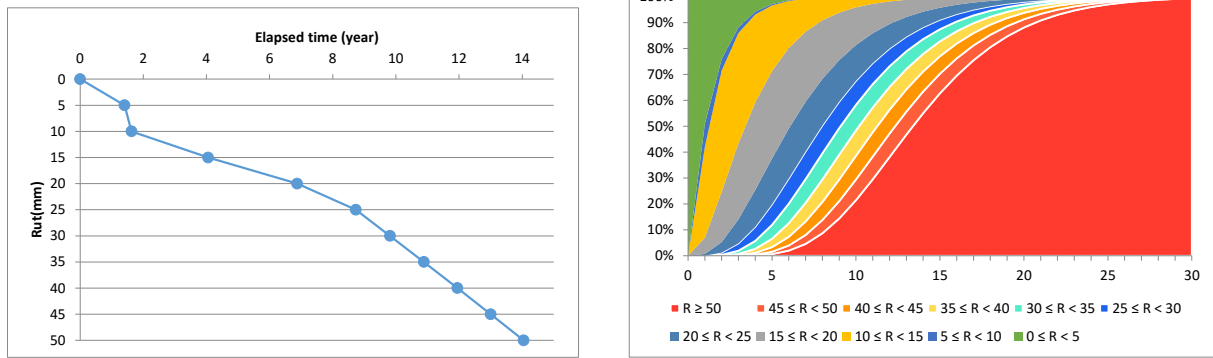
Error! Reference source not found. shows the Bench-Mark case (average deterioration performance curve) of in whole RMB I national road network of crack, rut and IRI.

\* In this report, only the results of RMB I is shown on behalf of all RMBs.

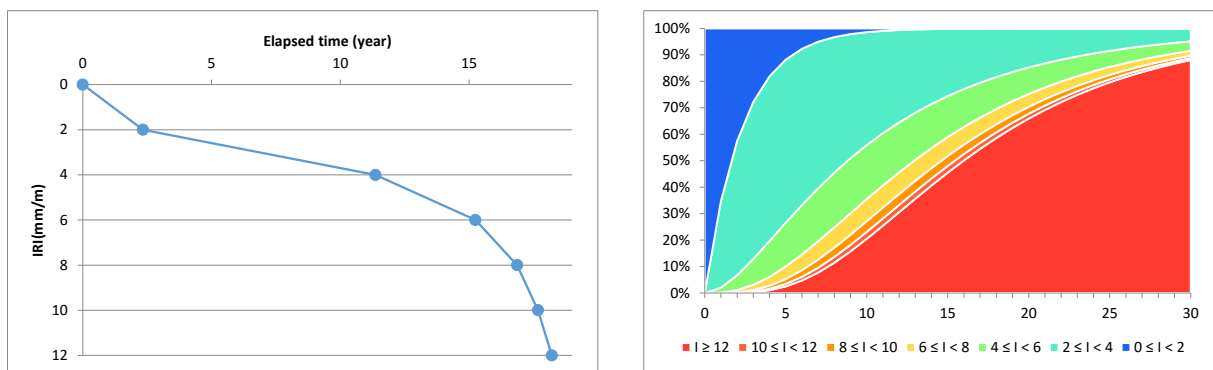
#### Crack



#### Rut



### IRI

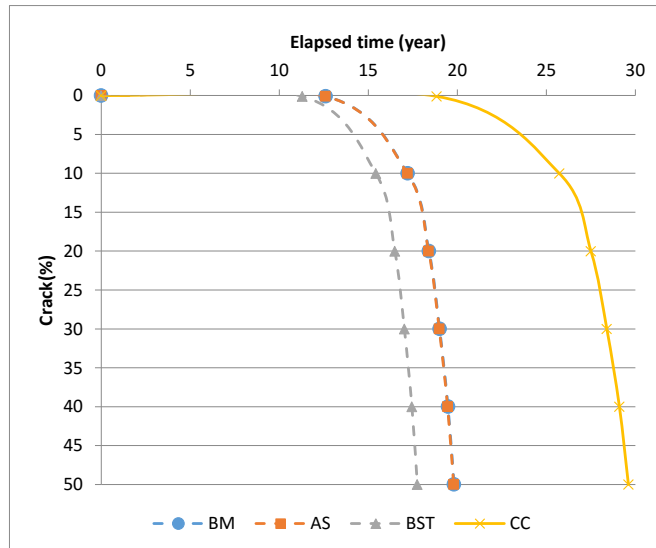


**Figure 5.3.1 Deterioration Performance Curve of Crack, Rut and IRI in RMB I**

The left of above figures show the expected value of deterioration performance of each pavement distress type. The right figures show the deterioration transition probabilities of each pavement distress type.

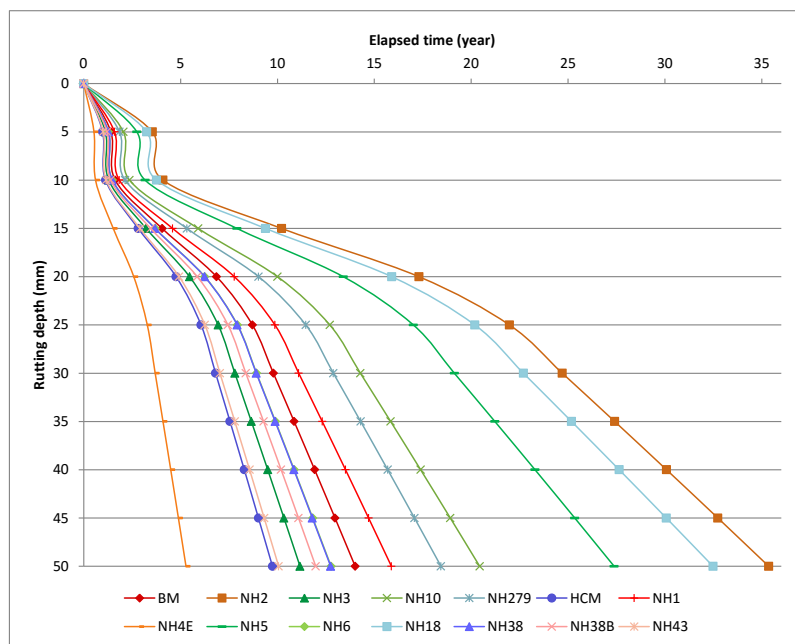
### 5.3.3 Benchmarking Evaluation

Based on the average deterioration performance curve, at the Step2, 3 and 4, the differences of deterioration performance curves have been estimated by Benchmarking Evaluation Module. First, as the results of the Step-2, Error! Reference source not found. indicates the differences of deterioration performance curve by pavement types.



**Figure 5.3.2 Benchmarking Evaluation of pavement types (Crack)in RMB I**

Next as the Step-3, Bench-Marking evaluation for each route has been estimated and the result for RMB I is shown in Error! Reference source not found.. It is clear that there are wide differences on deterioration performance among routes.



**Figure 5.3.3 Benchmarking Evaluation of Rut (AS) on Each Route in RMB I**

At the last step, Bench-Marking evaluation for each 1km section has been estimated. **Figure 5.3.4** shows one part of the results of evaluation for 1km sections. You can see the Heterogeneity value as Epsilon parameters which indicate the relative speed of the deterioration performance. If the value of Epsilon over 1, the deterioration speeds of that section is relatively fast. These outputs for each 1km section are stored into the administration database directly and they are used in the Repair Work Planning module as a parameter of deterioration forecasting.



Target Region	Route	Right/Left	KM	Data number	Epsilon
RMB I	NH2	Right	66	10	0.56908
RMB I	NH2	Right	67	9	0.548493
RMB I	NH3	Left	53	2	0.578596
RMB I	NH3	Left	54	10	1.928603
RMB I	NH3	Left	55	10	1.935499
RMB I	NH3	Left	56	10	1.742714
RMB I	NH3	Left	57	10	1.651287
RMB I	NH3	Left	58	10	1.527243
RMB I	NH3	Left	59	10	1.840078
RMB I	NH3	Left	60	10	1.476375

**Figure 5.3.4 Benchmarking Evaluation of IRI (AC) on each 1km section in RMB I**

### 5.3.4 Strategic Budget Simulation

#### (1) Simulation Scenarios

Strategic budget simulation module can suggest to the decision makers in making investment policy for road maintenance. Strategic budget simulation is performed for the following three scenarios;

Scenario - 0: Non-budget constraint

Scenario - 1: Under Budget Constraint

Scenario - 2: Maintain the Current Pavement Condition Level

Scenario - 3: Maintain the Target Management Level (Without Budget Constraint)

#### 1) Scenario - 0: Non-budget constraint

There is no budget constraint. Repair is carried out based on repair criteria.

#### 2) Scenario - 1: Under Budget Constraint

Repair actions are carried out under budget constraint per year set arbitrarily by a user. If the repair cost exceeds the budget constraint, further repair cannot be done.

#### 3) Scenario - 2: Maintain the Current Pavement Condition Level

Risk level in the initial year of the simulation is calculated, and necessary repair cost to maintain the risk level during the simulation period is estimated.

\*Risk (%) = Length of non-repair work due to budget constraint (km) / Length of full length of road network\*100

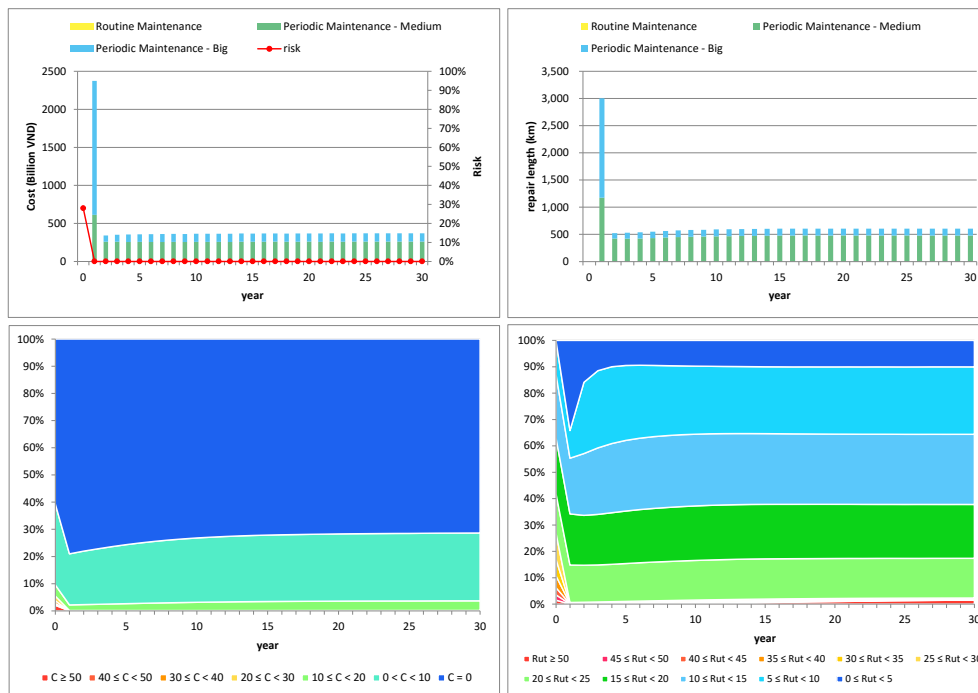
**4) Scenario - 3: Maintain the Target Management Level (Without Budget Constraint)**

Necessary repair cost to maintain the risk level set arbitrarily by a user during the simulation period is calculated.

**(2) Results of Budget Simulation**

The results of simulation based on the four budget scenarios are shown as below. The target of the simulation is whole network of national highway.

First, the simulation result in case of non-budget constraint is shown in **Figure 5.3.7**.



**Figure 5.3.5 Budget Simulation Results (Scenario-0)**

The repair cost for the first year to repair unfinished repair section is much required. After first year, the level of repair cost is at steady-state. In this case, risk is always zero due to not-budget constraint.

Next, the scenario-2 was selected to find the situation in case of maintaining the current risk level.

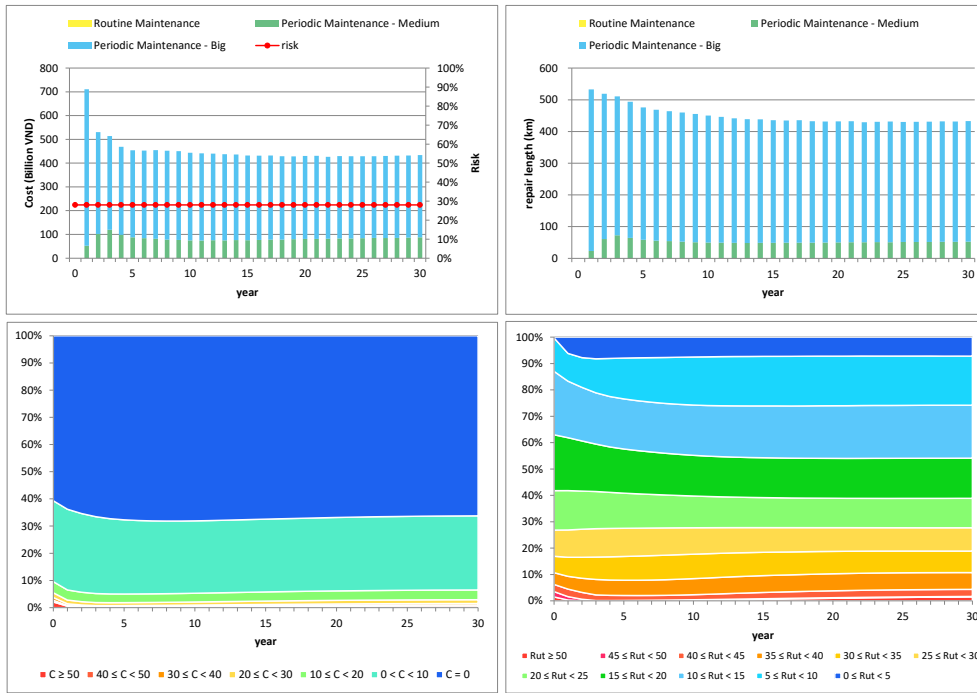
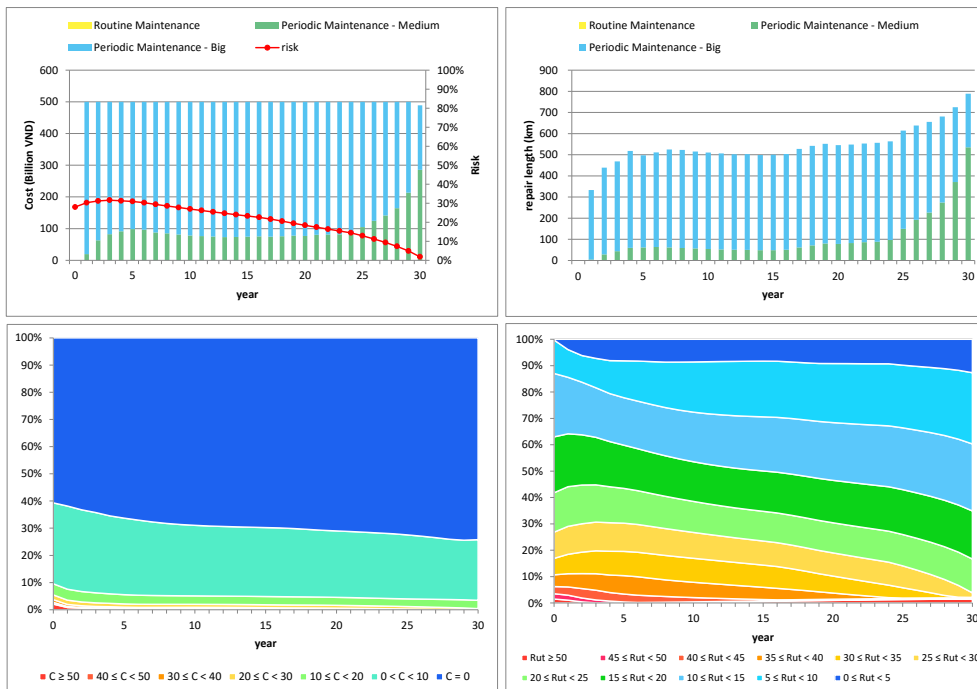


Figure 5.3.6 Budget Simulation Results (Scenario-2)

From this result, we can find approximate level of repair cost as around 400 billion VND per year. But on this scenario current risk level (=28%) is kept for 30 years.

Based on this result of scenario-2, next scenario-1 can be selected.

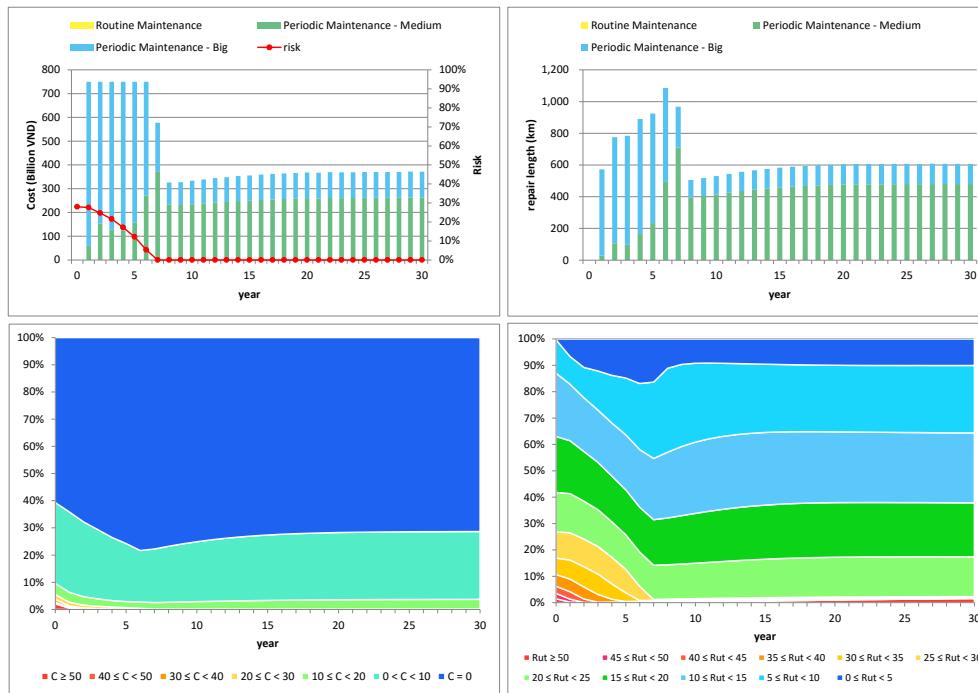
Since the trend level of repair cost on the scenario-2 is around 400 billion VND, as budget constraint in the first trial of scenario-1, 500 billion VND per year is set as budget constraint amount.



**Figure 5.3.7 Budget Simulation Results (Scenario-2, Budget = 500 billion VND)**

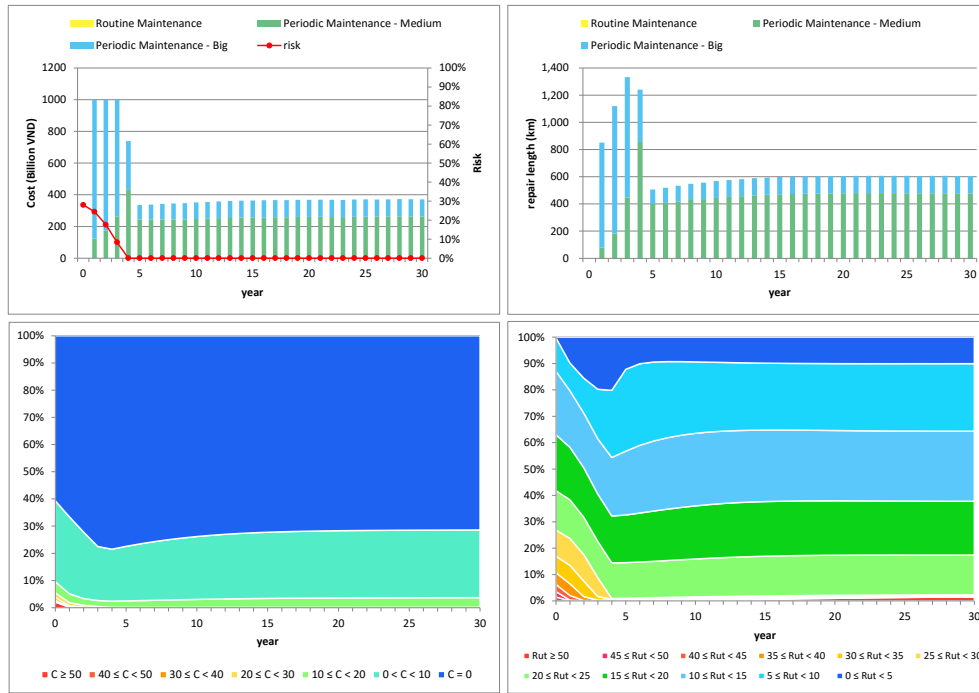
This result shows that the risk level slowly decreases to almost 0% in 30 years. But it takes 30 year to repair all unfinished repair sections.

Next figure is showing the result in the case that the budget constraint is 750 billion VND per year. In this case, you can see that the risk level decreases to 0 % after 8 years and after 8<sup>th</sup> year, the entire constraint budget 750 billion VND is not used.



**Figure 5.3.8 Budget Simulation Results (Scenario-2, Budget = 750 billion VND)**

Furthermore next figure is showing the result in the case that the budget constraint is 1,000 billion VND per year. In this case, you can see that the risk level decreases to 0 % after 4 years and after 4<sup>th</sup> year, the entire constraint budget 1,000 billion VND is not used.



**Figure 5.3.9 Budget Simulation Results (Scenario-2, Budget = 1,000 billion VND)**

In conclusion, we can see that steady –state level of repair cost for entire road network is around 400 billion VND. However due to remaining of u finished repair section, at the initial stage additional repair cost is required. That amount of additional repair cost depends on how many years to be taken for repair of unfinished repair sections.

**5.3.5 Repair Work Plans (Annual and 5-Year)**

**(1) Forecasting of Pavement Deterioration for the Planning Years**

Pavement condition indices are the key information for selection repair methods and timing of repair. Therefore, pavement condition indices collected by field survey are projected to target planning years using result of pavement deterioration evaluation (i.e. the speed of deterioration). The projection model of forecasting of pavement condition indices for each 100m section for the target planning years is incorporated in the repair work planning module. The base planning year is set to 2018 and pavement condition indices are forecasted to the year 2018, 2019, 2020, 2021, and 2022 as shown in **Figure 5.3.10**.

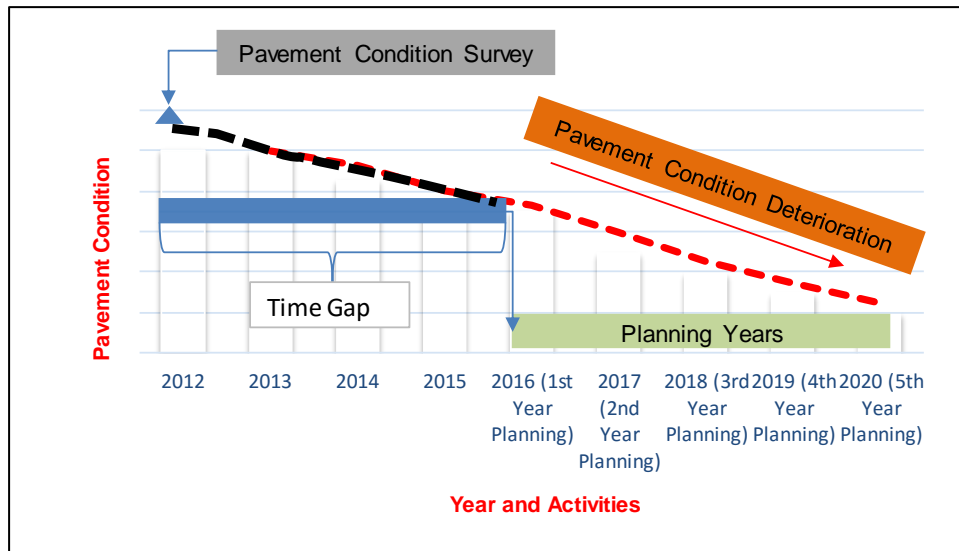


Figure 5.3.10 Pavement Condition Survey and Repair Work Planning Years

(2) Repair Work Selection Matrix

Repair work selections are made based on forecasted/projected pavement condition indices and repair work selection matrix. Repair work selection matrices are set in the system for three types of pavement, namely Asphalt Concrete (AC), Bituminous Surface Treatment (BST) and Cement Concrete (CC). Also, if needed the matrix can further customized to road category (Expressway and National Highways) and road class. Repair work selection matrices shown in **Table 5.3.2**, **Table 5.3.3**, and **Table 5.3.4** are used when formulating the draft repair work plans.

Table 5.3.2 Repair Work Selection Matrix for AC Pavement

	0≤Rut<5	5≤Rut<10	10≤Rut<15	15≤Rut<20	20≤Rut<25	25≤Rut<30	30≤Rut<35	35≤Rut<40	40≤Rut<45	45≤Rut<50	50≤Rut
Crack=0	1000	1000	1000	1000	1000	10101	10402	10403	10501	10501	10502
0<C<10	1000	1000	1000	1000	1000	10102	10403	10405	10501	10502	10502
10≤C<20	1000	1000	1000	1000	1000	10301	10404	10406	10501	10502	10502
20≤C<30	10214	10215	10216	10218	10219	10301	10406	10407	10502	10502	10503
30≤C<40	10402	10403	10404	10405	10406	10407	10407	10408	10502	10503	10503
40≤C<50	10501	10501	10501	10502	10502	10502	10502	10503	10503	10503	10503
50≤C	10501	10501	10502	10502	10502	10503	10503	10503	10503	10503	10503

Legend:

Repair Category ID	Category_Name	Repair_Method ID	Repair_Method	Repair Classification ID	Repair Classification
100	No Repair	1000	No Apply	0	-
101	Minor Repair for Rutting	10101	Hump Milling (<=30mm)	2	Periodic Maint. - Medium Repair
		10102	Hump Milling (<=40mm)	2	Periodic Maint. - Medium Repair
		10103	Hump Milling (<=50mm)	2	Periodic Maint. - Medium Repair
		10104	Hump Cutting and Micro-Surfacing (Type II)	2	Periodic Maint. - Medium Repair
		10105	Hump Cutting and Micro-Surfacing (Type II)	2	Periodic Maint. - Medium Repair
		10106	Hump Cutting and TL2000	2	Periodic Maint. - Medium Repair
102	Minor Repair for Crack	10201	Crack Sealing-L (~ crack ratio 10%)	2	Periodic Maint. - Medium Repair
		10202	Crack Sealing-L (~ crack ratio 20%)	2	Periodic Maint. - Medium Repair
		10203	Crack Sealing-L (~ crack ratio 30%)	2	Periodic Maint. - Medium Repair
		10204	Crack Sealing - A (30%)	2	Periodic Maint. - Medium Repair
		10205	Crack Sealing - A (40%)	2	Periodic Maint. - Medium Repair
		10206	Crack Sealing - A (50%)	2	Periodic Maint. - Medium Repair
		10207	Crack Sealing - A (60%)	2	Periodic Maint. - Medium Repair
		10208	Micro-Surfacing - II	2	Periodic Maint. - Medium Repair
		10209	Micro-Surfacing - III	2	Periodic Maint. - Medium Repair
		10210	TL2000 - Dressing	2	Periodic Maint. - Medium Repair
		10211	Micro-Surfacing (Type II) and Crack Sealing	2	Periodic Maint. - Medium Repair
		10212	Micro-Surfacing (Type III) and Crack Sealing	2	Periodic Maint. - Medium Repair
		10213	TL2000 - Dressing and Crack Sealing	2	Periodic Maint. - Medium Repair
103	Minor Repair for Rut and Crack	10301	Hump Cutting (<30mm) and Crack Sealing	2	Periodic Maint. - Medium Repair
		10302	Hump Milling and Crack Sealing & Micro-Surfacing (Type II)	2	Periodic Maint. - Medium Repair
		10303	Hump Milling and Crack Sealing & Micro-Surfacing (Type II)	2	Periodic Maint. - Medium Repair
		10304	Hump Cutting and Crack Seal and TL2000	2	Periodic Maint. - Medium Repair
104	Overlay and Cut & Overlay	10401	AC Overlaying (3cm)	2	Periodic Maint. - Medium Repair
		10402	AC Overlaying (4cm)	2	Periodic Maint. - Medium Repair
		10403	AC Overlaying (5cm)	2	Periodic Maint. - Medium Repair
		10404	AC Overlaying (6cm)	2	Periodic Maint. - Medium Repair
		10405	AC Overlaying (7cm)	2	Periodic Maint. - Medium Repair
		10406	Cut and AC Overlaying (5cm)	2	Periodic Maint. - Medium Repair
		10407	Cut and AC Overlaying (6cm)	2	Periodic Maint. - Medium Repair
		10408	Cut and AC Overlaying (7cm)	2	Periodic Maint. - Medium Repair
		10409	Cut and AC Overlaying (12cm)	3	Periodic Maint. - Medium Repair
105	Cut and Replacement	10501	Cut Surface Course and Replacement (5cm)	3	Periodic Maintenance - Big Repair
		10502	Cut Surface Course and Replacement (7cm)	3	Periodic Maintenance - Big Repair
		10503	Cut Surface Course and Replacement (12cm)	3	Periodic Maintenance - Big Repair
		10504	Surface Recycling & Overlaying	3	Periodic Maintenance - Big Repair
		10505	Deep Recycling & Overlaying	3	Periodic Maintenance - Big Repair
		10506	Cut & Replacement (Full Structure)	3	Periodic Maintenance - Big Repair

Table 5.3.3 Repair Work Selection Matrix for BST Pavement

	0≤Rut<5	5≤Rut<10	10≤Rut<15	15≤Rut<20	20≤Rut<25	25≤Rut<30	30≤Rut<35	35≤Rut<40	40≤Rut<45	45≤Rut<50	50≤Rut
Crack=0	2000	2000	2000	2000	2000	20101	20101	20201	20201	20201	20301
0<C<10	2000	2000	2000	2000	2000	20101	20101	20201	20201	20201	20302
10≤C<20	2000	2000	2000	2000	2000	20101	20101	20201	20201	20201	20302
20≤C<30	20101	20101	20101	20101	20101	20101	20101	20201	20201	20201	20302
30≤C<40	20201	20201	20201	20201	20201	20201	20201	20201	20201	20201	20303
40≤C<50	20201	20201	20201	20201	20201	20201	20201	20201	20201	20201	20303
50≤C	20301	20301	20301	20301	20301	20302	20303	20303	20303	20303	20303

Legend:

Repair Category ID	Category Name	Repair Method ID	Repair Method	Repair Classification ID	Repair Classification
200	No Repair	2000	No Apply	0	-
201	SBST	20101	SBST	2	Periodic - Medium
202	DBST	20201	DBST	3	Periodic - Big
203	TBST	20301	TBST	3	Periodic - Big
		20302	TBST Macadam (10cm)	3	Periodic - Big
		20303	TBST Macadam (15cm)	3	Periodic - Big

**Table 5.3.4 Repair Work Selection Matrix for CC Pavement**

Crack=C		Repair Category ID	Category Name	Repair Method ID	Repair Method	Repair Classification ID	Repair Classification
Crack=0	3000	300	No Repair	3000	No Apply	0	-
0<C<10	3000	301	Localized Repair (1)	30101	Localized Repair (1)	2	Periodic - Medium
10≤C<20	3000	302	Localized Repair (2)	30201	Localized Repair (2)	2	Periodic - Medium
20≤C<30	3000	303	Replacement of Concrete Slabs	30301	Replacement of Concrete Slabs (22 cm thick)	3	Periodic - Big
30≤C<40	30101						
40≤C<50	30201						
50≤C	30301						

**(3) Formulation of Repair Work Plans (Annual and 5-year Plans)**

Annual and 5-year plans were formulated for target road network as shown Table 5.3.1. Repair work information such as repair section location (From and To), suggested repair method, repair work unit cost used, repair work volume, repair work cost and repair priority are provided in the output. The outputs of repair work planning modules are to be compiled the information in to sixteen MS-Excel worksheets.

The annual budget framework has set based on actual expected budget to be approved for the year 2018 for the periodic repair of pavement. It assumed that approximately 60% of periodic repair budget be allocated for pavement annually. Furthermore, network coverage available PMS dataset was also considered while setting budget framework.

**Table 5.3.5 Budget Framework for Periodic Pavement Repair (Budget in bil. VND)**

Particulars	RMB I	RMB II	RMB III	RMB IV
Expected Periodic-Repair Budget	300	300	300	300
Expected Repair Budget for Pavement (60%)	180	180	180	180
Network Coverage of PMS Dataset	45%	70%	35%	45%
Expected Budget for Pavement Periodic Repair	81	126	63	81

The summary of 5-year repair work plans for RMB I, RMB II, RMB III and RMB IV are presented in **Table 5.3.6**, **Table 5.3.7**, **Table 5.3.8**, and **Table 5.3.9** respectively.



Table 5.3.6 Summary of Repair Work Plans (Annual and 5-Year) for RMB I Target Road Network (approx. 45% of Network)

Manage	Planning year										Total Repair Cost (1000 VND)	Total Length (km)
	2018		2019		2020		2021		2022			
	Repair Cost (1000 VND)	Length (km)	Repair Cost (1000 VND)	Length (km)	Repair Cost (1000 VND)	Length (km)	Repair Cost (1000 VND)	Length (km)	Repair Cost (1000 VND)	Length (km)		
RMB I	80,949,872	47	80,882,063	53	81,041,863	47	81,120,471	46	80,916,823	46	404,911,092	239
SB I.5	52,296,775	23	97,388	0		0		0		0	52,394,163	23
NH1	52,296,775	23		0		0		0		0	52,296,775	23
NH3_N		0	97,388	0		0		0		0	97,388	0
SB I.6	28,653,097	24	14,648,323	12	16,812,555	9	12,101,765	6		0	72,215,740	51
NH1	28,653,097	24	14,648,323	12		0		0		0	43,301,420	36
NH5		0		0	16,812,555	9	12,101,765	6		0	28,914,320	15
SB I.4		0	7,657,160	6		0		0		0	7,657,160	6
NH3		0	7,657,160	6		0		0		0	7,657,160	6
SB I.3		0	58,479,192	35	64,229,308	38		0		0	122,708,500	73
NH4E		0	58,479,192	35	64,229,308	38		0		0	122,708,500	73
SB I.1		0		0		0	69,018,706	40	75,214,946	40	144,233,652	80
NH6		0		0		0	69,018,706	40	75,214,946	40	144,233,652	80
SB I.2		0		0		0		0	5,701,877	6	5,701,877	6
NH6		0		0		0		0	5,701,877	6	5,701,877	6
<b>Grand Total</b>	<b>80,949,872</b>	<b>47</b>	<b>80,882,063</b>	<b>53</b>	<b>81,041,863</b>	<b>47</b>	<b>81,120,471</b>	<b>46</b>	<b>80,916,823</b>	<b>46</b>	<b>404,911,092</b>	<b>239</b>

**Table 5.3.7 Summary of Repair Work Plans (Annual and 5-Year) for RMB II Target Road Network (Approx. 70% of Network)**

Management Range	2018		2019		2020		2021		2022		Total Repair Cost	Total Repair Length (km)
	Repair Cost	Repair Length (km)	Repair Cost	Repair Length (km)	Repair Cost	Repair Length (km)	Repair Cost	Repair Length (km)	Repair Cost	Repair Length (km)		
<b>RMB II</b>	<b>125,878,550</b>	<b>104</b>	<b>126,026,273</b>	<b>127</b>	<b>126,074,383</b>	<b>127</b>	<b>125,993,370</b>	<b>123</b>	<b>126,008,234</b>	<b>118</b>	<b>629,980,810</b>	<b>598</b>
<b>SB II.1</b>	<b>51,315,000</b>	<b>39</b>	<b>39,172,150</b>	<b>36</b>	<b>37,251,416</b>	<b>36</b>	<b>33,293,414</b>	<b>32</b>	<b>29,690,566</b>	<b>28</b>	<b>190,722,546</b>	<b>170</b>
NH1	661,500	1	1,751,321	2	2,161,860	2	3,183,422	3	2,257,097	2	10,015,200	9
NH1 - Old Route (Thanh Hoa)	524,475	1	396,900	0	416,744	0	503,221	0	344,595	0	2,185,935	2
NH10	1,863,000	1	3,846,675	3	3,300,839	3	3,172,244	3	2,900,196	2	15,082,954	13
NH45	31,699,325	24	15,741,476	15	11,540,454	12	9,836,258	11	8,166,783	9	76,984,296	71
HCM	14,154,700	9	15,989,928	14	17,866,853	16	15,191,749	14	14,348,143	12	77,551,373	65
Link (Nghi Son Port - HCM)	2,412,000	3	1,445,850	2	1,964,666	2	1,406,520	2	1,673,752	2	8,902,788	10
<b>SB II.2</b>	<b>40,157,450</b>	<b>29</b>	<b>49,284,017</b>	<b>47</b>	<b>49,163,459</b>	<b>48</b>	<b>46,069,412</b>	<b>44</b>	<b>48,324,575</b>	<b>44</b>	<b>232,998,913</b>	<b>212</b>
NH1	0	0	95,550	0	179,432	0	184,352	0	110,611	0	569,945	1
NH7	26,303,225	19	32,664,666	32	32,083,904	31	27,969,193	27	27,771,671	25	146,792,659	133
NH46	2,089,300	2	4,763,274	4	4,810,044	5	4,574,340	4	5,192,325	5	21,429,283	19
NH46B	2,518,275	3	2,454,323	3	3,800,338	4	3,404,531	4	3,109,256	3	15,286,723	19
HCM	8,655,150	5	7,266,211	6	7,143,695	7	8,097,726	7	9,219,735	8	40,382,517	33
NH48C	283,500	0	1,767,124	2	1,041,860	1	1,203,356	1	1,793,597	2	6,089,437	6
NH7 - Sea Approach	308,000	0	198,450	0	104,186	0	109,396	0	229,730	0	949,762	1
NH1 (Nghe An) - Old route	0	0	74,419	0	0	0	526,518	0	897,650	1	1,498,587	1
<b>SB II.3</b>	<b>22,141,600</b>	<b>25</b>	<b>21,640,713</b>	<b>28</b>	<b>21,234,994</b>	<b>25</b>	<b>23,571,070</b>	<b>26</b>	<b>25,648,978</b>	<b>26</b>	<b>114,237,355</b>	<b>130</b>
NH1	686,000	1	1,190,700	1	2,358,466	2	4,110,445	3	2,478,110	2	10,823,721	9
NH8	11,737,500	17	7,719,627	16	5,120,180	10	3,460,660	8	4,067,107	7	32,105,074	59
NH12C	2,957,500	3	5,199,207	5	4,954,240	5	5,524,900	5	7,759,772	7	26,395,619	24
HCM	6,760,600	4	7,531,179	6	8,802,108	8	10,475,065	10	11,343,989	10	44,912,941	38
<b>SB II.5</b>	<b>2,439,500</b>	<b>2</b>	<b>4,270,534</b>	<b>4</b>	<b>6,202,548</b>	<b>6</b>	<b>6,385,455</b>	<b>6</b>	<b>6,392,245</b>	<b>6</b>	<b>25,690,282</b>	<b>23</b>
QL9 - South By-pass	378,000	0	595,350	1	833,488	1	875,754	1	344,595	0	3,027,187	3
NH9	1,470,000	1	1,804,793	1	839,277	1	1,527,490	1	1,705,748	1	7,347,308	6
HCM - West Branch	591,500	1	1,671,941	2	4,321,411	4	3,763,419	3	3,656,966	3	14,005,237	13
QL9 - North By-pass	0	0	198,450	0	208,372	0	218,792	0	684,936	1	1,310,550	1
<b>SB II.6</b>	<b>2,578,075</b>	<b>3</b>	<b>3,687,048</b>	<b>4</b>	<b>4,381,772</b>	<b>4</b>	<b>5,285,497</b>	<b>5</b>	<b>3,963,148</b>	<b>4</b>	<b>19,895,540</b>	<b>19</b>
NH1	472,500	1	1,474,200	2	1,852,749	2	2,145,087	2	1,694,411	2	7,638,947	7
NH49	1,576,575	2	962,483	1	729,302	1	871,116	1	1,150,778	1	5,290,254	5
HCM - West Branch	529,000	1	1,250,365	1	1,638,976	2	2,106,763	2	1,117,959	1	6,643,063	7
NH1 - Tran Hung Dao St. (Hue)	0	0	160,745	0	160,745	0	162,531	0	0	0	323,276	0
<b>SB II.4</b>	<b>7,246,925</b>	<b>7</b>	<b>7,971,811</b>	<b>8</b>	<b>7,840,194</b>	<b>8</b>	<b>11,388,522</b>	<b>10</b>	<b>11,988,722</b>	<b>10</b>	<b>46,436,174</b>	<b>43</b>
NH1	94,500	0	492,450	1	775,031	1	429,480	0	775,978	1	2,567,439	2
HCM	7,152,425	7	7,479,361	7	7,065,163	7	10,959,042	10	11,212,744	10	43,868,735	41
<b>Grand Total</b>	<b>125,878,550</b>	<b>104</b>	<b>126,026,273</b>	<b>127</b>	<b>126,074,383</b>	<b>127</b>	<b>125,993,370</b>	<b>123</b>	<b>126,008,234</b>	<b>118</b>	<b>629,980,810</b>	<b>598</b>

**Table 5.3.8 Summary of Repair Work Plans (Annual and 5-Year) for RMB III Target Road Network (approx. 35% of Network)**

Management Range	2018		2019		2020		2021		2022		Total Repair Cost (1000 VND)	Total Repair Length (km)
	Repair Cost (1000 VND)	Repair Length (km)	Repair Cost (1000 VND)	Repair Length (km)	Repair Cost (1000 VND)	Repair Length (km)	Repair Cost (1000 VND)	Repair Length (km)	Repair Cost (1000 VND)	Repair Length (km)		
☐ RMB III	62,943,152	36	63,038,705	30	63,012,275	29	62,987,786	29	62,826,700	27	314,808,618	152
☐ SB III.1	22,628,902	19	17,888,257	10	23,404,206	12	24,078,753	12	23,141,251	10	111,141,369	64
NH1	891,100	0	246,225	0	2,403,614	1	6,948,074	3	5,780,944	2	16,269,957	7
NH14G	15,549,802	15	3,960,007	4	4,567,236	4	2,727,185	3	2,178,187	2	28,982,417	29
HCM-East Branch	6,188,000	3	5,361,825	3	9,057,637	4	8,014,240	3	9,092,437	4	37,714,139	16
Hai Van Tunnel - Tuy Loan		0	8,320,200	4	7,254,444	3	6,007,237	2	5,955,977	2	27,537,858	11
HCM - West Branch		0		0	121,275	0	382,017	0	133,706	0	636,998	1
☐ SB III.2	9,554,950	4	2,349,900	1	3,510,359	1	3,142,956	1	3,515,241	1	22,073,406	9
NH1	9,554,950	4	2,349,900	1	3,510,359	1	3,142,956	1	3,515,241	1	22,073,406	9
☐ SB III.3	4,473,500	1	2,783,550	1	13,879,426	5	14,847,145	6	17,496,325	6	53,479,946	20
NH1	4,473,500	1	2,321,550	1	12,169,999	4	12,313,679	5	12,760,166	5	44,038,894	16
NH26		0		0	353,903	0	277,830	0	437,583	0	1,069,316	1
NH27C		0	462,000	0	949,253	0	324,135	0	1,274,823	1	3,010,211	1
NH1D		0		0	406,271	0	1,445,297	1	2,462,189	1	4,313,757	1
NH26B		0		0		0	486,204	0	561,564	0	1,047,768	1
☐ SB III.4	26,285,800	13	39,658,948	18	20,939,384	10	16,935,540	7	14,343,638	6	118,163,310	54
NH19	1,172,500	1	1,477,350	1	3,088,652	2	4,093,364	2	3,794,202	2	13,626,068	6
HCM-East Branch	25,113,300	12	38,181,598	18	17,850,732	8	12,842,176	5	10,549,436	5	104,537,242	48
☐ SB III.5		0	358,050	0	1,278,900	1	3,983,392	3	4,330,245	3	9,950,587	6
NH26		0	358,050	0	1,124,550	1	3,659,256	2	3,704,867	2	8,846,723	6
NH14		0		0	154,350	0	324,136	0	625,378	0	1,103,864	1
<b>Grand Total</b>	<b>62,943,152</b>	<b>36</b>	<b>63,038,705</b>	<b>30</b>	<b>63,012,275</b>	<b>29</b>	<b>62,987,786</b>	<b>29</b>	<b>62,826,700</b>	<b>27</b>	<b>314,808,618</b>	<b>152</b>

**Table 5.3.9 Summary of Repair Work Plans (Annual and 5-Year) for RMB IV Target Road Network (approx. 45% of Network)**

	2018		2019		2020		2021		2022		Total Repair Cost (1000 VND)	Total Repair_Length (km)
Management Range	Repair Cost (1000 VND)	Repair_Le ngth (km)	Repair Cost (1000 VND)	Repair_Le ngth (km)	Repair Cost (1000 VND)	Repair_Le ngth (km)	Repair Cost (1000 VND)	Repair_Le ngth (km)	Repair Cost (1000 VND)	Repair_Le ngth (km)		
<b>RMB IV</b>	<b>80,886,338</b>	<b>69</b>	<b>81,013,020</b>	<b>72</b>	<b>81,073,438</b>	<b>70</b>	<b>80,967,784</b>	<b>71</b>	<b>80,954,705</b>	<b>67</b>	<b>404,895,285</b>	<b>349</b>
<b>SB IV.4</b>	<b>1,321,250</b>	<b>1</b>	<b>7,489,231</b>	<b>6</b>	<b>7,095,109</b>	<b>7</b>	<b>5,612,252</b>	<b>6</b>	<b>9,998,904</b>	<b>8</b>	<b>31,516,746</b>	<b>28</b>
NH1	441,000	0	2,392,425	1	2,775,402	2	1,340,095	1	3,960,733	2	10,909,655	6
NH53	757,750	1	2,176,756	2	2,016,030	3	2,035,046	3	3,775,323	4	10,760,905	13
NH57	122,500	0	2,006,550	1	891,370	1	709,045	1	595,600	0	4,325,065	3
NH60		0	532,875	1	899,091	1	1,434,298	1	1,274,639	2	4,140,903	5
NH54		0	178,500	0	513,216	1	93,768	0	392,609	1	1,178,093	2
NH53 - Stretched Branch		0	202,125	0		0		0		0	202,125	0
<b>SB IV.2</b>	<b>17,618,038</b>	<b>16</b>	<b>17,681,192</b>	<b>17</b>	<b>18,172,184</b>	<b>15</b>	<b>19,949,490</b>	<b>16</b>	<b>16,887,945</b>	<b>13</b>	<b>90,308,849</b>	<b>76</b>
NH1	1,928,500	1	869,139	1	1,583,052	1	2,220,832	1	3,277,920	2	9,879,443	5
NH22B	6,529,688	5	9,111,271	6	10,375,206	7	11,584,268	8	8,968,199	6	46,568,632	31
NH56	79,625	0	231,525	0	243,101	0	141,809	0	289,077	0	985,137	1
NHN2	9,080,225	10	7,469,257	10	5,806,828	7	5,692,627	7	4,352,749	5	32,401,686	39
NH22		0		0	163,997	0	309,954	0		0	473,951	0
<b>SB IV.3</b>	<b>32,992,200</b>	<b>22</b>	<b>31,798,932</b>	<b>23</b>	<b>32,051,362</b>	<b>26</b>	<b>25,213,729</b>	<b>20</b>	<b>25,159,848</b>	<b>20</b>	<b>147,216,071</b>	<b>111</b>
NH1	8,695,400	5	10,837,024	6	12,782,681	8	11,504,964	6	10,121,133	6	53,941,202	32
NH30	17,759,100	11	14,896,320	12	14,433,782	14	7,707,003	9	8,425,752	9	63,221,957	56
NH50	1,770,000	3	1,499,400	2	972,295	2	1,963,044	3	1,669,492	3	7,874,231	13
NH80	4,767,700	2	4,566,188	2	3,862,604	2	4,038,718	2	4,943,471	3	22,178,681	11
<b>SB IV.7</b>	<b>198,450</b>	<b>0</b>	<b>514,500</b>	<b>0</b>	<b>769,820</b>	<b>0</b>	<b>822,492</b>	<b>1</b>	<b>446,700</b>	<b>0</b>	<b>2,751,962</b>	<b>2</b>
NH1	198,450	0	514,500	0	769,820	0	822,492	1	446,700	0	2,751,962	2
<b>SB IV.6</b>	<b>12,849,850</b>	<b>17</b>	<b>11,444,739</b>	<b>15</b>	<b>10,129,492</b>	<b>11</b>	<b>12,412,164</b>	<b>12</b>	<b>11,051,348</b>	<b>11</b>	<b>57,887,593</b>	<b>67</b>
NH1	168,000	0	1,040,025	2	652,128	1	1,045,334	1	909,777	1	3,815,264	5
NH60	1,102,500	1	1,903,650	1	2,370,233	2	3,828,843	3	2,382,400	2	11,587,626	8
Q.Lo - P.Hiep	10,397,800	15	7,017,414	10	4,641,877	6	3,928,510	5	5,486,722	7	31,472,323	43
NH61B	1,181,550	1	1,483,650	2	2,222,153	2	3,056,422	2	2,272,449	2	10,216,224	10
NH63		0		0	243,101	0	553,055	0		0	796,156	0
<b>SB IV.5</b>	<b>15,294,050</b>	<b>12</b>	<b>10,438,026</b>	<b>10</b>	<b>11,531,922</b>	<b>10</b>	<b>15,199,226</b>	<b>15</b>	<b>14,662,757</b>	<b>13</b>	<b>67,125,981</b>	<b>60</b>
NH1		0	128,625	0		0	141,809	0		0	270,434	0
NH61	1,039,500	0	1,293,600	0	3,344,761	2	2,037,998	1	1,884,646	1	9,600,505	4
NH80	220,500	0	966,159	1	1,055,367	1	2,320,609	3	2,233,710	3	6,796,345	9
NH91	12,972,050	9	6,219,387	4	5,026,015	3	8,050,093	5	7,580,273	5	39,847,818	26
South Song Hau Rd	1,062,000	2	1,830,255	4	2,105,779	4	2,648,717	5	2,964,128	4	10,610,879	20
<b>SB IV.1</b>	<b>612,500</b>	<b>1</b>	<b>1,646,400</b>	<b>1</b>	<b>1,323,549</b>	<b>1</b>	<b>1,758,431</b>	<b>1</b>	<b>2,747,203</b>	<b>2</b>	<b>8,088,083</b>	<b>5</b>
NH28	490,000	0	1,029,000	1	810,336	1	283,618	0	893,400	1	3,506,354	3
NH27	122,500	0	617,400	0	513,213	0	1,474,813	1	1,853,803	1	4,581,729	3
<b>Grand Total</b>	<b>80,886,338</b>	<b>69</b>	<b>81,013,020</b>	<b>72</b>	<b>81,073,438</b>	<b>70</b>	<b>80,967,784</b>	<b>71</b>	<b>80,954,705</b>	<b>67</b>	<b>404,895,285</b>	<b>349</b>

## **5.4 ACTIVITY 2-4: DEVELOP WEB-BASED SYSTEM FOR DISPLAYING PAVEMENT CONDITION SURVEY DATA**

### **5.4.1 Introduction**

Pavement condition data are to be collected periodically primarily for formulating pavement maintenance plans. However, such data can be utilized for other secondary purposes also such as monitoring of pavement condition, pavement condition analysis and making various reports. One of the best utilization of pavement condition data might be for pavement condition monitoring purpose in conjunction with Geographic Information System (GIS) map to assist road administrator in pavement management. Under JICA Phase I and Phase II Projects pavement condition surveys are being conducted in all RMBs and it is also anticipated that pavement condition data are to be collected periodically in the interval of 3-5 years.

Considering the availability of such periodic pavement condition data in the database, JICA Project Team in cooperation with DRVN is now developing the web-based pavement condition data display system to display the pavement condition in terms of categorized (i.e. good, fair, bad and poor) pavement indices (crack rate, rutting depth, IRI, etc.), location of corresponding road sections on the GIS map and images of road sections taken during the pavement condition survey.

### **5.4.2 Current Status of Web-based System related to Road Maintenance and Management**

#### **(1) E-document Policy for Road Maintenance System**

On April 10th, 2007, the Prime Minister issued Decree No.64/2007/ND-CP on information technology application in State Agencies' operations (known as Project 64). Project 64 is expected to cooperate with Project 30 to pave the way to the enhancement of administrative procedures by information technology (E-Government).

In light of this policy, DRVN has taken initiatives for computerization of road database and planning system for formulating pavement repair plans by receiving overseas technical assistance since the beginning of 2000s. Until recently, DRVN has developed the web-based Vietnamese Bridge Management System (VBMS) and put it into operation in 2014.

#### **(2) Displaying Pavement Condition System**

Pavement condition database is in particular the key for the successful implementation of Pavement Management System (PMS), in terms of formulating long term maintenance plan in the central level and daily maintenance in the field level. Generally, central level agency (DRVN) can utilize PMS to minimize the life cycle cost of pavement facility in the long course of road maintenance, whereas road operators at the field level agencies (RMBs and SBs) can utilize PMS to the daily maintenance activities. Moreover, sharing actual pavement status upon

uniformly conducted survey between the fields and central levels can facilitate further advanced dialogue within DRVN in formulating appropriate maintenance plans.

To develop web-based system for displaying pavement condition survey data, following issues are considered;

- System development policy,
- Users of the system and its access controls,
- Display pavement condition data on the GIS map and in the table,
- Display items on the GIS map and in tables,
- Display front view images of survey vehicle, and
- Display survey condition data by lanes.

### 5.4.3 System Development

#### (1) Objective

To display pavement condition data stored in the DRVN server in order to make it accessible to all concerned agencies to use the system through internet.

#### (2) Target Users

The primary users of the system are officials of DRVN, RMBs and SBs. The system has developed with different level of access rights. Therefore, DRVN is requested to implement access control to the regional agencies (RMBs, SBs and RTCs) in web-site. The user level, display elements and allowed functions are summarized in **Table 5.4.1**.

**Table 5.4.1 Users, Display Elements and Functions**

Users	Display Elements	Function in Web-based Display System for Pavement Condition Data (M2-4)
1) DRVN Departments	All road data	View pavement condition on map, pavement condition data of selected section, images on the road
2) RMBs and SBs	Regional road data for each RMB and SB road network	View pavement condition on map, pavement condition data of selected section, images on the road
3) RTC-Central	All road data	View pavement condition on map, pavement condition data of selected section, images on the road
4) RTCs	Regional road data for each RMB and SB road network	View pavement condition on map, pavement condition data of selected section, images on the road
5) MOT	All road data	View pavement condition on map, pavement condition data of selected section, images on the road

**(3) System Development Policy**

**1) Collaboration in System Development**

Web-based display system has been developed in collaboration with DRVN (WG1) and JICA Project Team with appropriate responsibility assignment.

**2) Step-by-Step Development**

Firstly, JICA Project Team will develop the web-based display system for RMB I pavement condition data, taking into account of applicability of the same system for other remaining RMBs.

Secondly, when pavement condition survey for RMB II, III and IV road network is completed and data become available, examination will be made on the applicability of RMB II, III and IV data to the system and then system upgrade is to be made, if upgrade is needed.

**3) System Development by Outsourcing**

System development has been outsourced to one of the IT companies in Vietnam, taking account of future system upgrade and maintenance. Outsourcing has been managed by the JICA Project Team and made by competitive bidding, following the JICA policy. In considering the security issues of DRVN information management system, it is preferable to contract out the tasks to the local IT consultant which is familiar with DRVN information system.

DRVN cooperated in selecting the local IT Company for system development and carrying out the trial application of the developed system.

**(4) System Description**

**1) Security**

Login method to the web-based display system follows the existing practices of DRVN. DRVN requested to provide appropriate web security system to prevent from any kind of security threat to this system itself as well as systems who are running in the same web domain. User administration system of VBMS is taken as reference and similar login method for DRVN is adopted.

**2) System Features**

**a. Server**

Database server and application server are to be installed in DRVN to store PMS related data and web applications including pavement condition display system. Necessary IT infrastructure have already provided by JICA Project Team and already installed in DRVN. The maintenance and management of server system is to be done by DRVN IT Center.

**b. Language**

The system can support both English and Vietnamese language. The users can select their preferred language directly on system windows.

**c. Base Map**

GPS data collected during pavement condition survey is fully incorporated in the GIS mapping system. Map API (Application Programming Interface) of Vietbando is used as base map for displaying pavement condition data on the map.

**d. Display Function**

i. Specify Parameter

User can specify the following parameters and display pavement condition data on the maps.

- Area to be displayed
- Road number
- Survey year of pavement condition

ii. Pavement Condition Index

User can select pavement index one by one and view pavement condition route map.

- Crack rates (%)
- Rutting Depth (mm)
- IRI (mm/m)
- MCI

iii. Zoom Function of the Map

User can point out specific location and zoom up/down the information on the route map.

iv. Ranking of Pavement Conditions

Pavement condition data can be classified into four (4) ranks with condition range as shown in **Table 5.4.2** and ranking of pavement condition can be displayed by different color on the map.

**Table 5.4.2 Legend and classification of Pavement Condition**

Rank	Crack (%)	Rut Depth (mm)	IRI (mm)	MCI	Legend
1	0 – 10	0 – 20	0 – 4	$\geq 5$	Good
2	10 – 20	20 – 30	4 – 6	4 – 5	Fair
3	20 – 40	30 – 50	6 – 10	3 – 4	Poor
4	$\geq 40$	$\geq 50$	$\geq 10$	$< 3$	Seriously Damaged



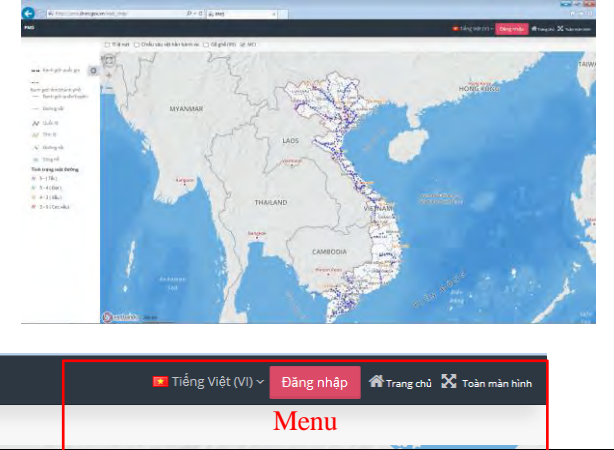
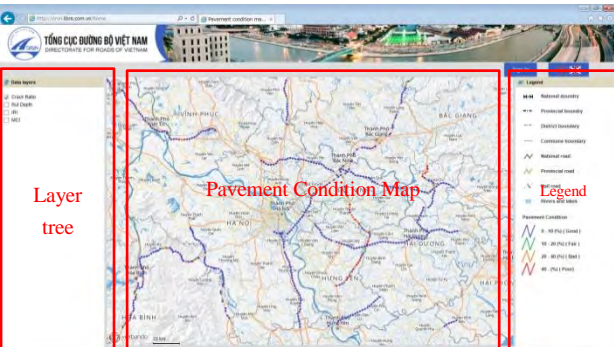
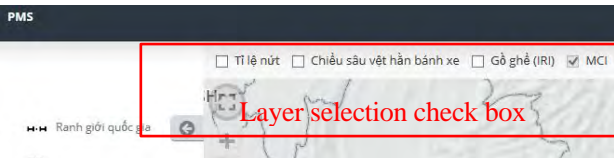
v. Display of Front View Image

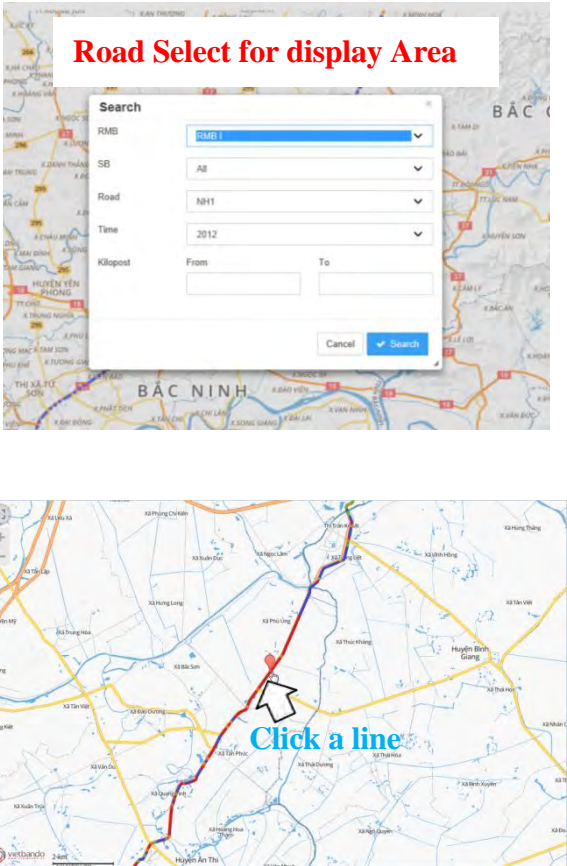
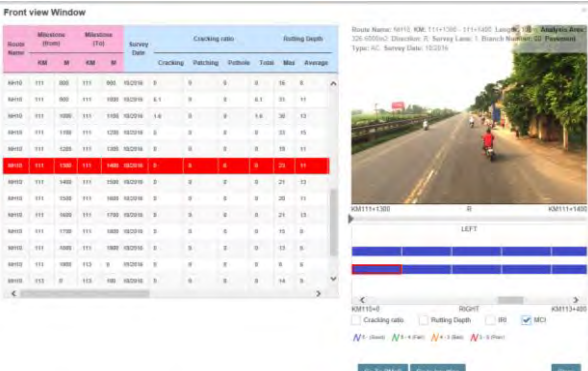
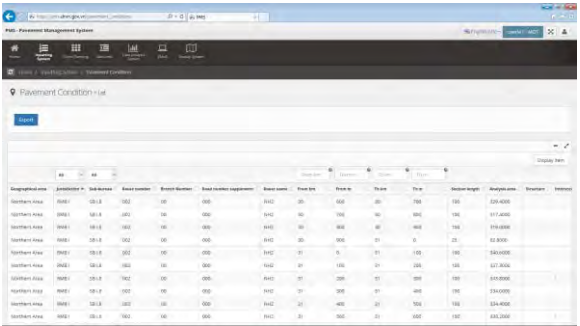
User can refer to the image data, by pointing out a specific location on the route map. When user click a road section on the route map, front view image window appears and user can change images sequentially, even can change lane position taken during corresponding pavement condition surveys.

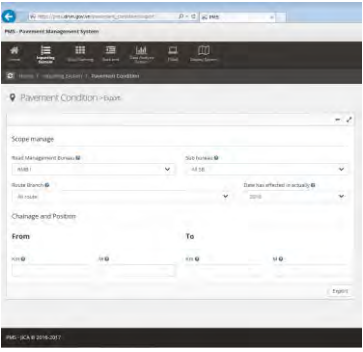
vi. Pavement Condition Data Table

User can refer to the pavement condition data table by pointing out a specific location on the route map. When user click a road section on the route map, pavement condition data table appears concurrently with front view image window. Furthermore, the pavement condition data table can display alone and export that data.

(5) Screen Transition

Screen	Function
<p>1) Main screen (GIS Map)</p> 	<ul style="list-style-type: none"> <li>- User can login to system and access to other system function from this screen.</li> <li>- User can select language (VN&lt;-&gt;EN)</li> <li>- In accordance with the user level, only accessible items are activated.</li> </ul>
<p>2) GIS operation screen</p> 	<ul style="list-style-type: none"> <li>- GIS operation screen consists of three (3) parts, namely “Layer tree”, “Pavement Condition Map” and “Legend”.</li> <li>- Initially, “Pavement Condition Map” shows a road map centered the area of selected jurisdiction.</li> <li>- On Pavement Condition Map, color-coded lines of the latest data are displayed.</li> </ul>
<p>2-1) Layer selection box</p> 	<ul style="list-style-type: none"> <li>- The user can choose only one item from “Layer selection check box” to show in “Pavement Condition Map”.</li> <li>- Each road lane section has pavement condition data. The value of each item is ranked by value and displayed by designed color.</li> </ul>

Screen	Function
<p>2-2) Pavement Condition Map</p>  <p style="text-align: center;">Front View Window</p> 	<ul style="list-style-type: none"> <li>- “Pavement Condition Map” shows each lanes of each direction of the road section. For instance, a road section whose four (4) lanes, has four (4) lines on the map.</li> <li>- Lanes are properly offset in accordance with the scale of “Pavement Condition Map”.</li> <li>- User can select RMB’s, SB’s, Roads, Survey year and KP station for display area.</li> <li>- User can click road sections to see detailed information. When user click a road section line, a “ Pavement Condition and Front View Window” is displayed.</li> <li>- User can change “Pavement Condition and Front View Window” back and forth by clicking button or type left/ right arrow button on key board.</li> <li>- User also can change Pavement Condition and Front View Window to adjoining lane by clicking button or type up/ down button on key board.</li> <li>- Road sections of “Pavement Condition table” can be selected. When a road section is selected, “Pavement Condition Map” and “Front View” are changed to corresponding to selected road section.</li> <li>- Table of record, map and “Front View” are linked to each other and marked up selected road section respectively.</li> </ul>
<p>2-3) Pavement Condition Table</p> 	<ul style="list-style-type: none"> <li>- User can change pavement condition index for display “Pavement Condition table” from pull down list.</li> </ul>

Screen	Function
	<p>- User can export the Pavement Condition Data by specify the Road, RMB's, SB's, Direction, Lane, Distress type, and survey year.</p>

**(6) System User Level and Function**

The user-level and function are shown in **Table 5.4.3**.

**Table 5.4.3 System User Level**

User Level	Organization	Function
Level 1	MOT, DRVN, RTC Central	Access and manage data of whole region
Level 2	RMBs, RTCs	Access and manage data under belonging RMB
Level 3	Sub Bureaus	Access and manage data under belonging Sub Bureau
Public User	Public Users without registration	Access to View GIS Map with condition ranking only
Super Administrator	DRVN (IT Center)	Maintenance

**(7) System Operation and Maintenance**

Enhancement of responsibility assignment including administration procedures relevant to the implementation of this web-based display system for pavement condition data is discussed in **Chapter 7**.

**(8) Development Responsibility Sharing between DRVN and JICA Project Team**

The following shows the responsibility assignment between DRVN and JICA Project Team in system development phase.

**1) DRVN**

- DRVN specifies base geographical maps on which pavement condition data are to be displayed and bears expenses for the use of the base geographical maps.
- DRVN supports the selection of an application server and a database server which can fit to the DRVN information system.
- Upon installing an application server and a database server in DRVN IT Center, DRVN sets system environment to make servers operable in the DRVN information system.

- IT Center is requested to provide information and advices relevant to system development.
- IT Center is requested to actively participate in the discussion with IT Consultant.

**2) JICA Project Team**

- JICA project team bears the expenses for developing a web-based display system for pavement condition data.
- JICA Project Team will provide hardware including one application server and one database server during project term to reinforce the storage capacity of software and database.

**(9) Outputs**

In this system development, the following outputs are available;

- Web-based Display System for Pavement Condition Data
- Operating Manual and Administration Manual in Vietnamese and English
- Training Material
- Training for System Users and Administrators
- System Design Document

**(10) Development Schedule**

**Table 5.4.4** shows the time schedule for system development. It took about 6 months for system development. IT consultant obliged to report the progress of system development every months and final inspection was conducted in April 2016. During trial operation of system, the IT Consultant started developing PMS Data Input System (i.e. second component of the contract).

**Table 5.4.4 Schedule of System Development for Display and Input System**

	'15 Oct	Nov	Dec	'16 Jan	Feb	Mar	Apr	May	Jun	Jul
Development of Web-based System for Displaying Pavement Condition Data (M2-4)										
Development of Web-based PMS Data Input System(M1-3)										
Progress Report	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
System Evaluation										
System Install in DRVN Server										<input type="checkbox"/>

### **(11) Stages of System Development**

The system has been developed by incorporating the suggestions and comments provided by JICA Project Team and DRVN. A number of meetings between IT Company and JICA Project Team and DRVN also have arranged to get feedback on system design document and prototype system. The first version of the system has made available since middle of January 2016 for trial running for all concerned agencies. DRVN has provided the pavement condition data display system to RMBs and SBs since 20<sup>th</sup> January 2016 and asked their feedback on the system and their feedbacks have been incorporated in the system.

Currently, the system is available at [www.pms.dr.vn.gov.vn](http://www.pms.dr.vn.gov.vn); operating at DRVN's server and domain.

### **(12) Technology Transfer**

The Project conducted technology transfer for administrators and system users after completion of the system development.

#### **1) Administrator Training**

Assuming WG1 including IT Center is a group of administrators, administrator training has been made during system development as part of OJTs. IT consultant in charge of system development have provided the training to transfer technology so that IT center can administer the system in the future.

#### **2) System User training**

The JICA Project Team has provide user training through existing facilities including workshops and OJTs.

### **5.4.4 Necessary Data Update to Sustain the System**

The JICA project team built the system first by using data from the Pavement Condition Survey of RMB I surveyed in 2012. Furthermore, pavement condition data of RMB I, RMB II, RMB III and RMB IV surveyed in 2015 have already been uploaded to the DRVN server. However, to sustain the system, it is critical to update the information such as GIS maps, road section data, and pavement condition data in a timely manner. JICA Project Team proposed that DRVN assign those tasks to the capable departments.

The following are required updates for the system.

- Master Data of Road Section / GIS Data of Road Section / Representative Road Section Table
- Pavement Condition Data Table / Image Table / Front View Images
- DB Update Check

**5.5 ACTIVITY 2-5: DEVELOP WEB-BASED PMS OPERATION SYSTEM**

**5.5.1 Summary of System Features and Operational Level**

Web-based PMS operation system functions as a platform that comprehensively manages each PMS module developed under this project. A PMS portal has been developed to integrate all PMS family systems, namely PMS data input system, Pavement condition data display system, PMS planning systems (PMS dataset formulation module, pavement deterioration evaluation module, strategic budget simulation module and repair work planning module), pavement monitoring system and pavement condition data analysis system. PMS planning modules can run independently also provided that module datasets are formulated prior to running of the modules.

User administration module has been developed considering the current responsibility assignment of DRVN/RMB/SB staff. Three level of accounts are considered, namely level 1 (DRVN/MOT), level 2 (RMB) and level 3 (SB). Beside ordinary user, three level of administrative account are also considered to administer the system from the backend. The following access rights are set tentatively.

**Table 5.5.1 System User and Access Rights**

Admin-1	Management of user management, updating master table and other related information from the backend (full access at backend)
Admin-2	Management of user management, updating master table and other related information from the backend (access at RMB level)
Admin-3	Management of user management, updating master table and other related information from the backend (access at SB level)
User Level-1	Access to all PMS systems including system running and exporting
User Level-2	Access to data input system, PC data display system, PC data analysis system, repair work planning module
User Level-3	Access to data input system, PC data display system, PC data analysis system

The system has been developed fully web-based and installed in DRVN server provided by JICA under this project. The functions and features of each module are same as described in Chapter 5.1 of this report. The web-based PMS operation system has been operated online and provided a platform for downloading necessary data to users in MS-Excel format.

Design documents and user manuals are also prepared for future updating and system operation respectively. Figures below show the system windows of all four modules.

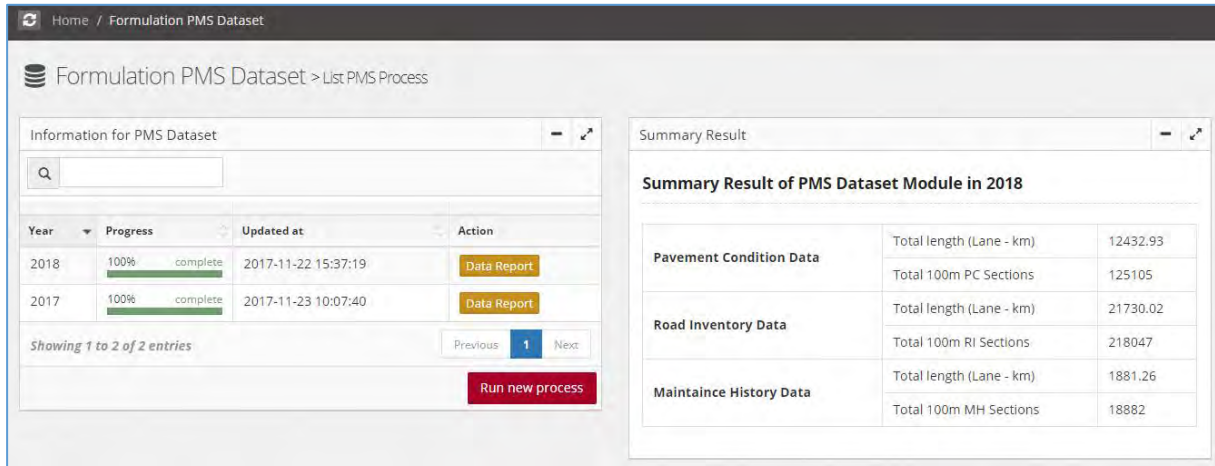


Figure 5.5.1 Web Operation of PMS Dataset Formulation Module

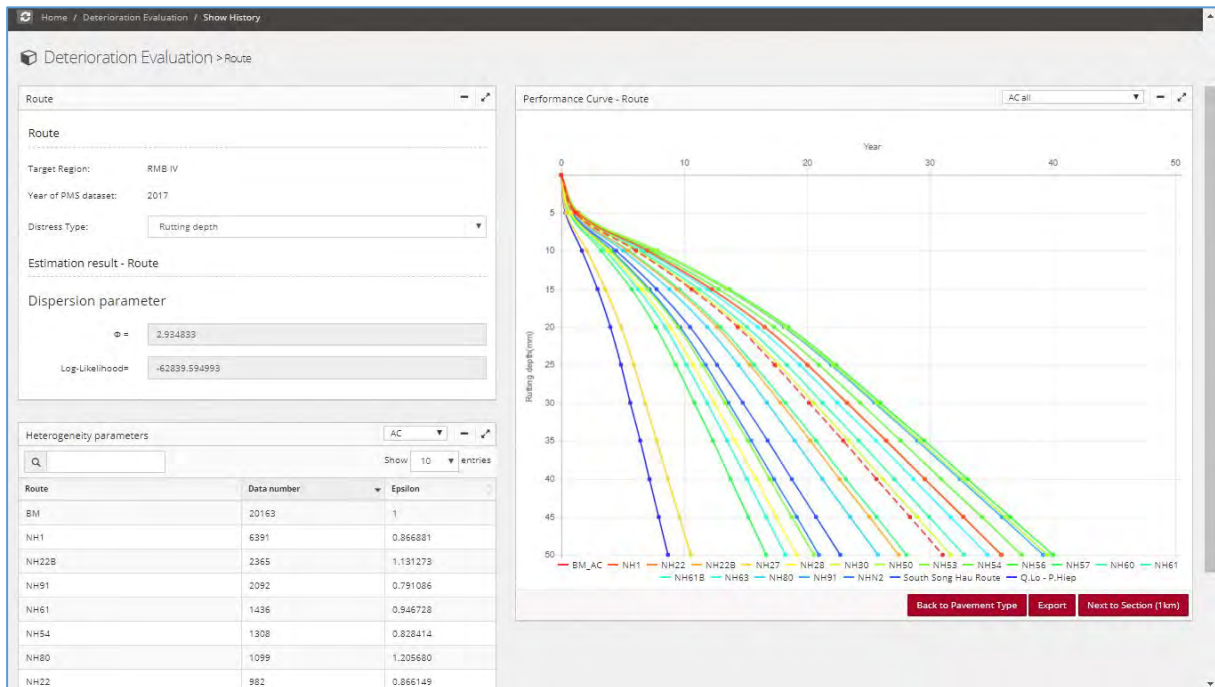


Figure 5.5.2 Web Operation of Pavement Deterioration Evaluation Module

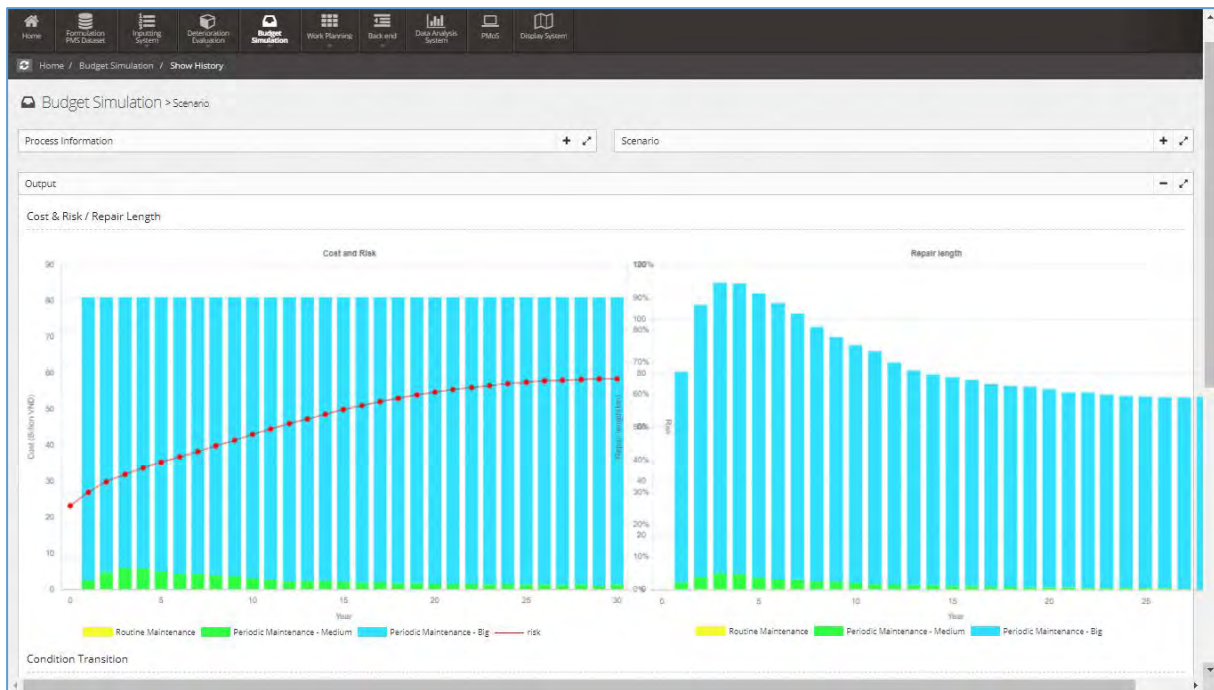


Figure 5.5.3 Web Operation of Strategic Budget Simulation Module

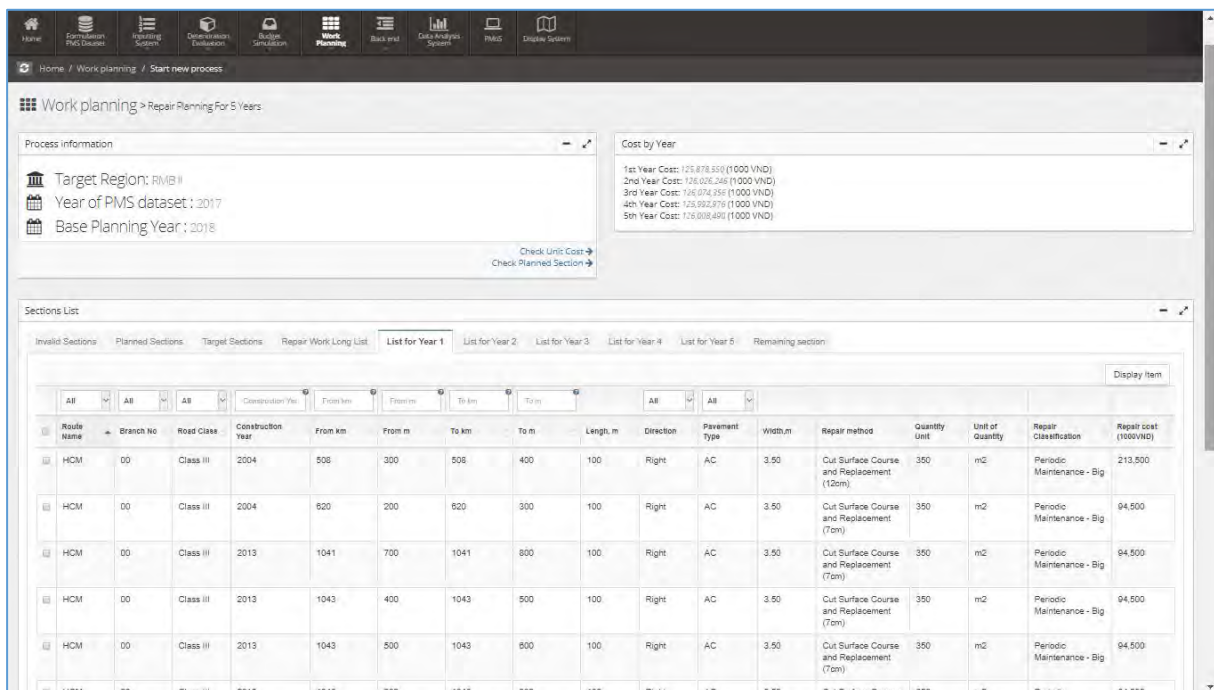


Figure 5.5.4 Web Operation of Repair Work Planning Module

### 5.5.2 Training on Web-based PMS Operation

Training on operation of web-based PMS was conducted in all RMBs in May and October, 2017. Officials from relevant department of DRVN such as DPI and RMMD were also attended the training Hanoi together with RMB I officials. Furthermore, intensive training was provided to DRVN officials specifically for DPI officials.



## **5.6 ACTIVITY 2-6: DEVELOP WEB-BASED ANALYSIS SYSTEM FOR PAVEMENT CONDITION SURVEY DATA**

### **5.6.1 Basic Concept**

The Project had developed analysis system for pavement condition which enables RMB staff throughout the country to analyze pavement condition based on pavement condition survey data. Basic requirement now under consideration includes analytical functions of the following data; 1) Summary of Road Network Statistics and PC Survey Length, 2) Summary of Pavement Condition (PC), 3) Transition of Pavement Condition (PC), 4) Time-series comparison of Pavement Condition (PC), 5) Summary of maintenance record, 6) Summary of passed time from latest repair. The results of analysis can be utilized in various materials including those for annual budgetary request to MOT/MOF, annual report, and public announcement of road maintenance information etc. Tools for the analysis can be downloaded from website and used in each personal computer.

### **5.6.2 Outlines of The Module**

Web-based analysis system for pavement condition survey data aims to provide analysis results according to user needs such as distribution of pavement conditions, statistical values and comparison of pavement performance with previous years based on inputs of pavement condition survey data. There are six sub-modules as below;

#### **1) Summary of Road Network Statistics and PC Survey Length**

- Source Data: RI and PC
- Summarize road network length and Actual PC Survey Length (Latest Survey)
- Breakdown of Latest PC Survey Length by Year

#### **2) Summary of Pavement Condition (PC)**

- Create a graph of pavement condition summary on targeted survey year and regions
- Source data: PC data
- Target data: pavement index (crack, rut(average), rut(max), IRI and MCI)

#### **3) Transition of Pavement Condition (PC)**

- Create a graph of transition of average value of pavement condition
- Source data: PC data
- Target data: pavement index (crack, rut(average), rut(max), and IRI)

#### **4) Time-series Comparison of Pavement Condition (PC)**

- Create a comparison graph of pavement condition on targeted two-times survey year (latest and second latest) and regions
- Source data: PC data
- Target data: pavement index (crack, rut(average), rut(max), and IRI)

**5) Summary of Maintenance Record**

- Create a graph of maintenance record (repair length) for target region and route for past years
- Source data: PMS dataset (archived PMS dataset should be used)
- Target data: maintenance data of each section

**6) Summary of Passed Time from Latest Repair**

- Create a graph of passed time (year) from latest repair year for target RMB
- Source data: PMS dataset (latest)
- Target data: maintenance data of each section (repair year / month)

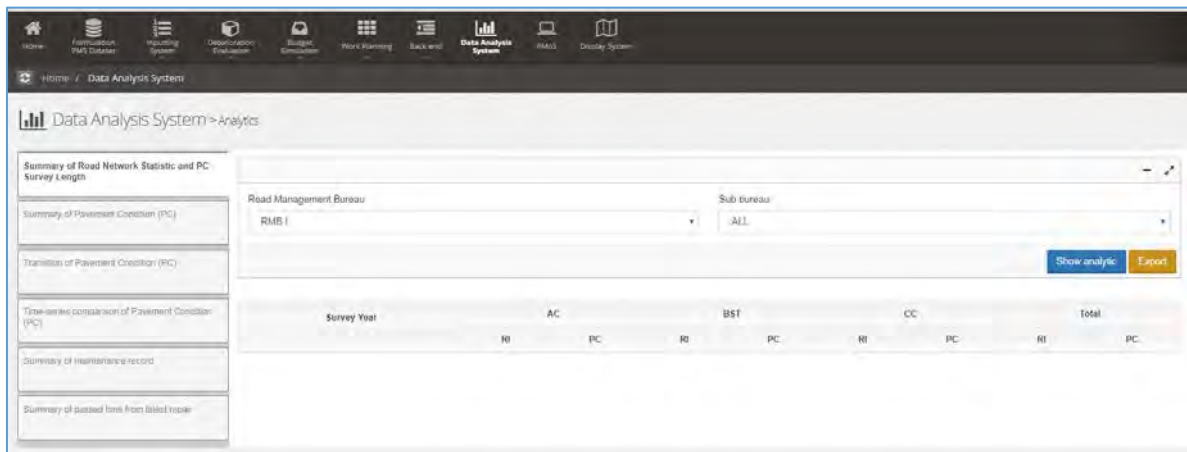


Figure 5.6.1 Portal Window on the Web-System

**5.6.3 Summary of Road Network Statistics and PC Survey Length**

This function is to calculate road network length and actual surveyed length by pavement condition survey in latest year for each RMB and for each pavement type. We can compare between these two length values and find the ratio of surveyed length by pavement condition survey.

Survey Year	AC		BST		CC		Total	
	RI	PC	RI	PC	RI	PC	RI	PC
2016	1,794,100	2,242,145	4,600	58,800	1,700	8,345	1,800,400	2,309,290
2012	0	4,359,665	0	0	0	22,790	0	4,382,455

Figure 5.6.2 Output - Summary of Road Network Statistics and PC Survey Length

**5.6.4 Summary of Pavement Condition (PC)**

This function is to calculate summary of pavement condition based on actual PC data for each surveyed year, for each condition index (Crack, Rut, IRI and MCI). Four kinds of output chart

can be created; 1) 100% stacked bar chart of PC for each route and total, for each RMB, for each pavement index, 2) Pie chart of PC for each route or total, 3) Line graph of PC for each route and average, 4) 100% stacked bar chart of PC of each selected route by comparison between directions and lanes.

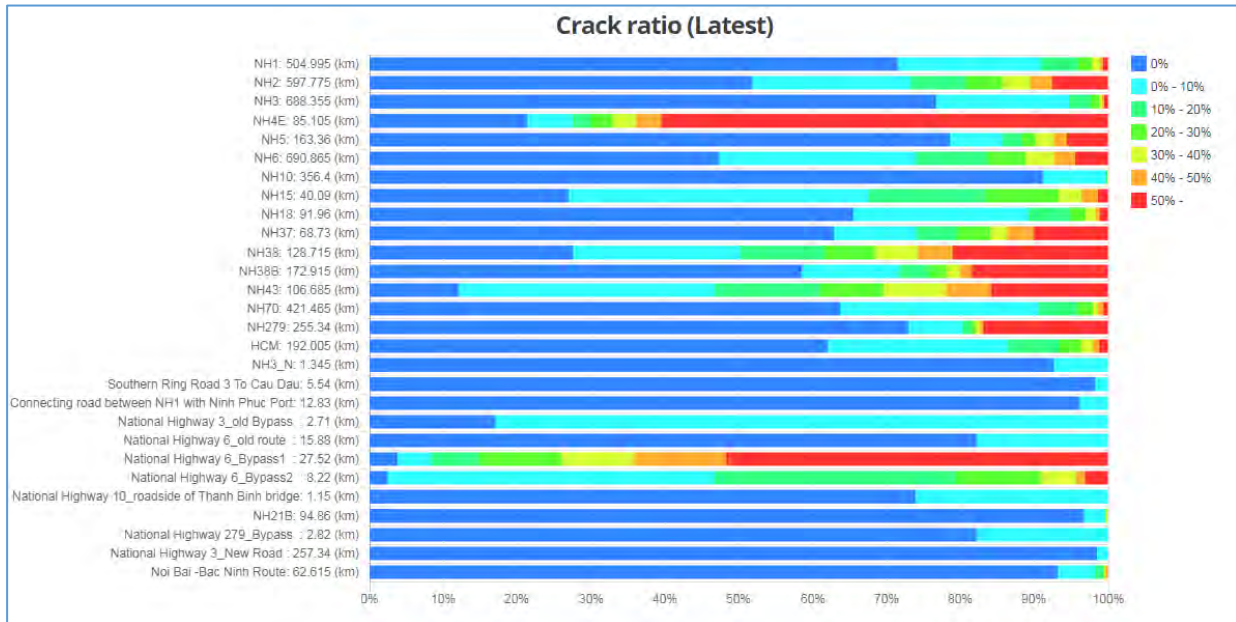


Figure 5.6.3 Output1- Summary of Pavement Condition (PC)

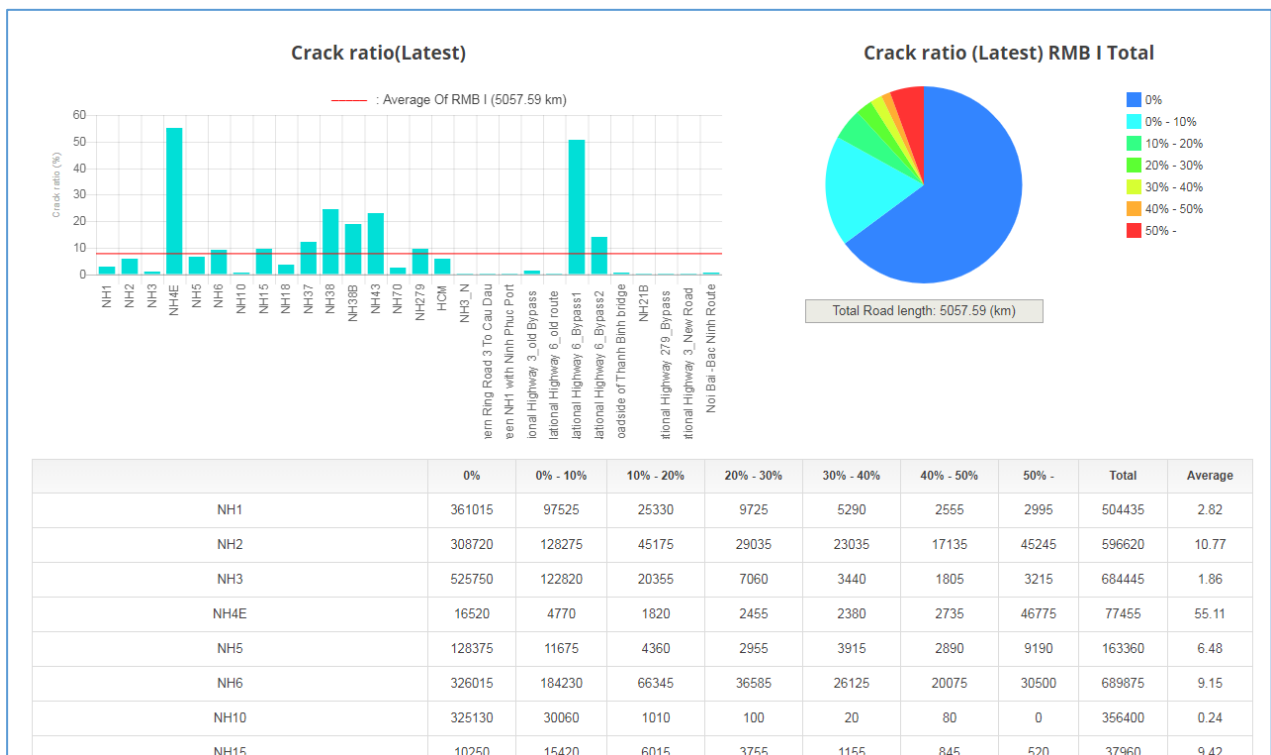


Figure 5.6.4 Output2- Summary of Pavement Condition (PC)

### 5.6.5 Transition of Pavement Condition (PC)

This function is to create a graph of transition of average value of pavement condition for time-series on surveyed years. Users can select a target pavement index, such as Crack, Rut, IRI and MCI).



Figure 5.6.5 Output - Transition of Pavement Condition (PC)

### 5.6.6 Time-series Comparison of Pavement Condition (PC)

This function is to create a comparison graph of pavement condition on targeted tow-times survey year (latest and second latest) and regions, for each pavement index (Crack, Rut, IRI and MCI). As shown on the below figure, two kinds of graph, 1) 100% stacked bar chart of PC for each target survey year, for each RMB, for each pavement index, 2) Doughnut chart of two-times PC survey data for each route or total, are outputted.

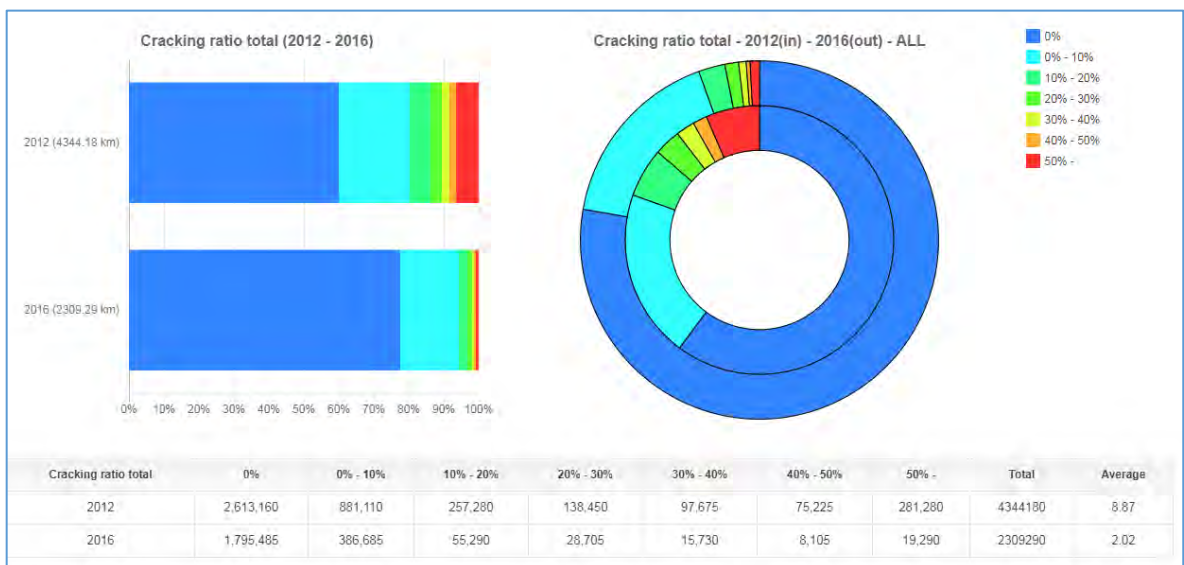


Figure 5.6.6 Output - Time-series Comparison of Pavement Condition (PC)

### 5.6.7 Summary of Maintenance Record

This function focuses on finding the past history of maintenance record. This is to create a summary of maintenance record (repair length) for target region and route for past years. The source data of maintenance record is PMS Dataset. Users can select conditions for summary, such as target region, repair method and repair category.

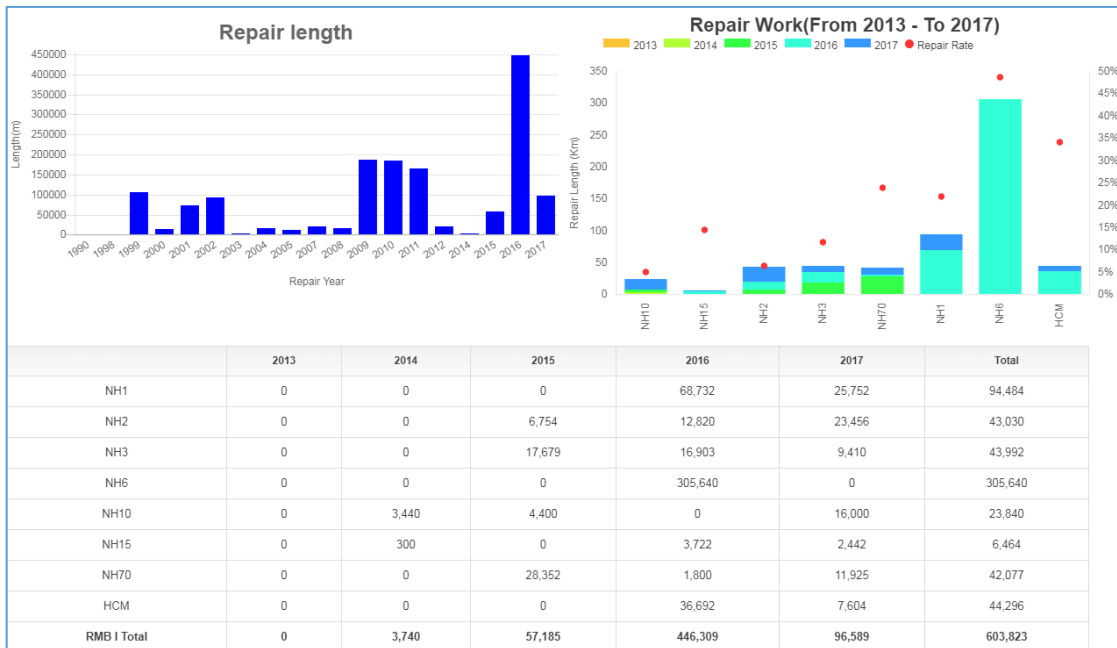


Figure 5.6.7 Output - Summary of Maintenance Record

### 5.6.8 Summary of Passed Time from Latest Repair

This function is to create a graph of passed time (year) from latest repair for each target region (RMB). The definition of passed time is from latest repaired year to present. This output can show the wide differences of pavement repair timing and life cycle.

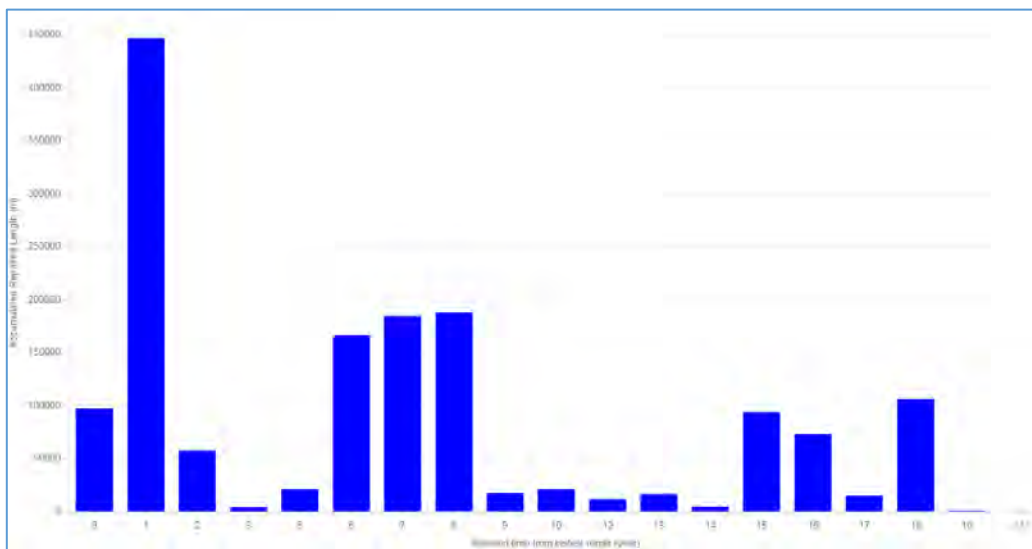


Figure 5.6.8 Output - Summary of Passed Time from Latest Repair

## 5.7 PAVEMENT MONITORING SYSTEM (PMOS)

### (1) Rational

The Pavement Condition Monitoring System (PMoS) is a streamline display system for illustrating road conditions. It was designed to support users of road engineer's working on pavement management and maintenance such as formulating repair work planning in detail and the prioritization of repair works. For that regard, simplified streamline format is applied to take a glance at each road section of present condition and history. The system shows road pavement conditions collected by PC survey of the latest, road inventory and a maintenance history, in line with chainage of kilo post by each lane. The users of PMoS are DRVN Road Maintenance and Management Department and Planning & Investment Department, RMBs and Sub-Bureaus (SBs).

### (2) Outline of PMoS

PMoS is a display system using common database of PMS. It displays simple streamlines with some pavement condition indices, inventory and maintenance history. Besides, the Pavement Condition Data Display System shows exact locations on the map with front view images, and the PMS Data Input System has functions to display detailed information and editing functions. To utilize their advantages, linkage function is facilitated.

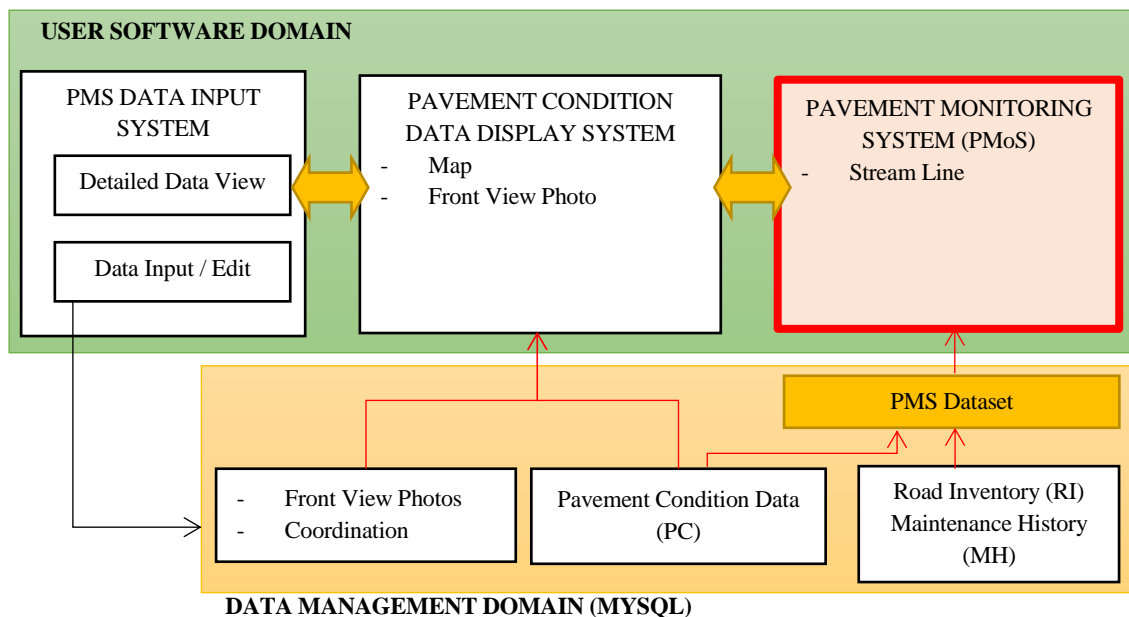


Figure 5.7.1 Structure of PMoS

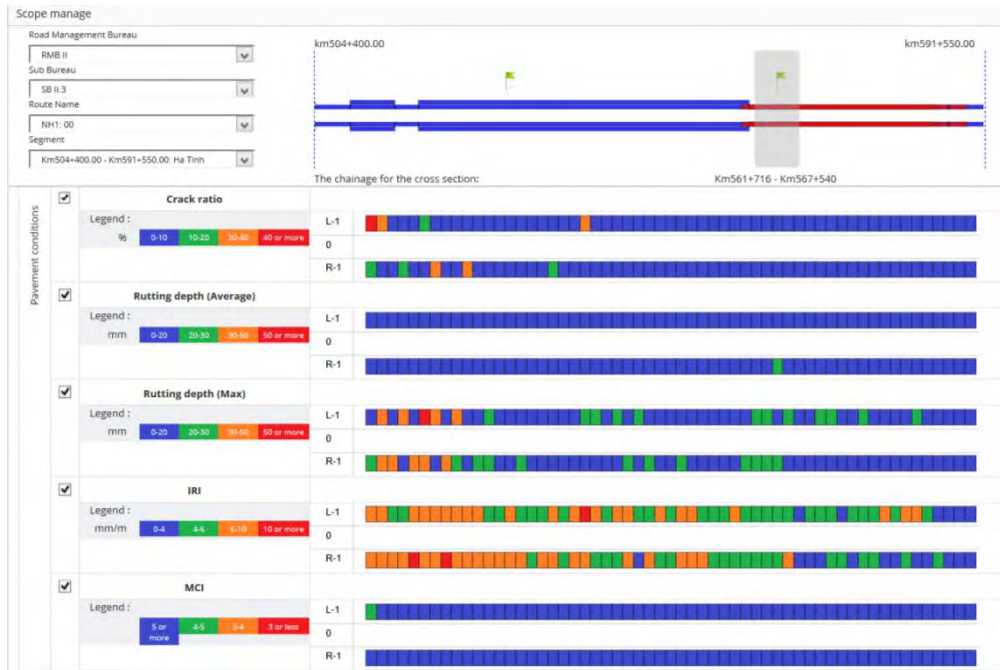
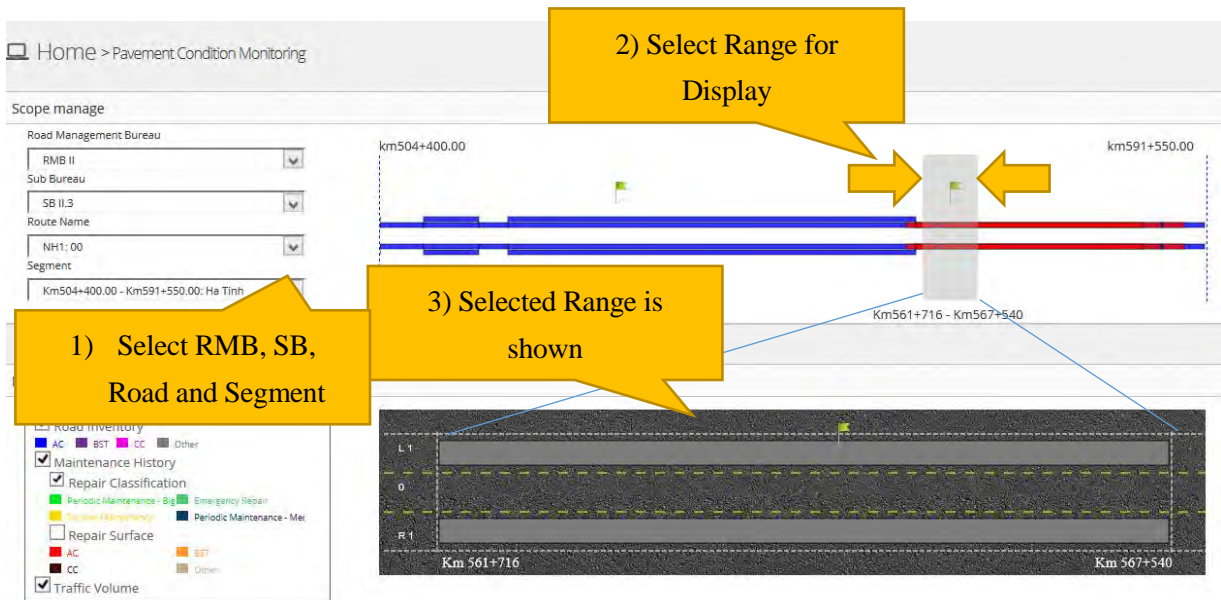


Figure 5.7.2 View of PMoS

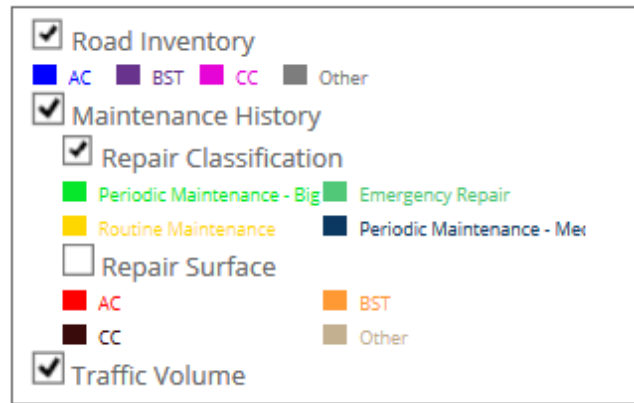
### (3) System Description

- a) Select Jurisdiction and range of display sections at Scope Manage



b) Select display items of surface types and maintenance from check boxes

- Road Inventory of Pavement  
Type: AC/ BST/ CC/ Other
- Maintenance History of Repair  
Classification: Periodic  
Maintenance –Big/ Periodic  
Maintenance –Medium/ Routine  
Maintenance/ Emergency Repair
- Maintenance History of Repair  
Surface: AC/ BST/ CC/ Other



Note) Maintenance History displays one from above two types

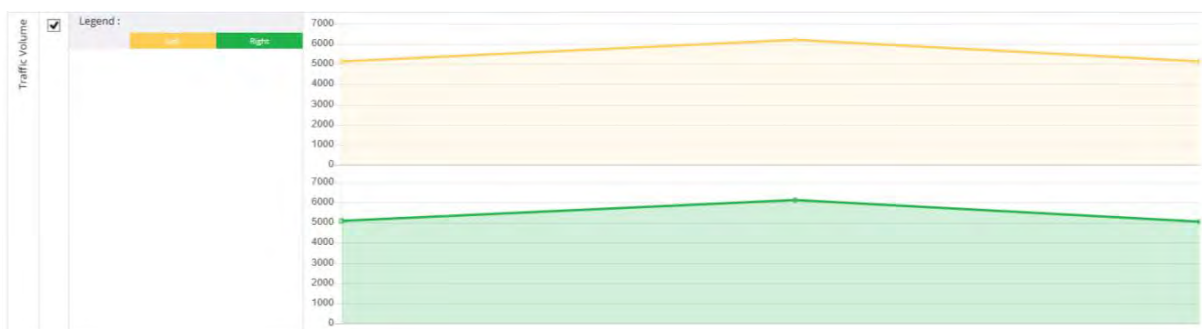
- Traffic Volume: Indicate Traffic Counting Station

c) Select display items of pavement condition indices

- Crack ratio
- Rutting depth (Average)
- Rutting depth (Max)
- IRI
- MCI

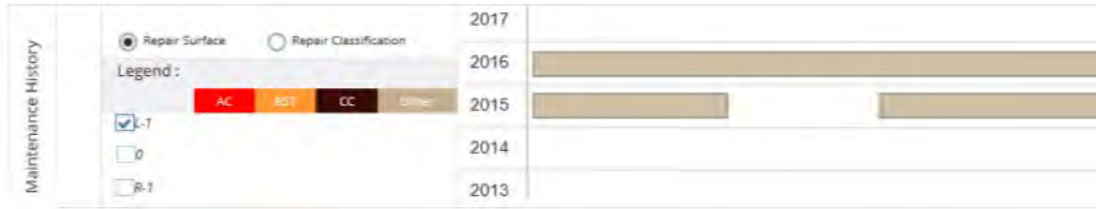


d) Select whether display Traffic Volume shown by sides





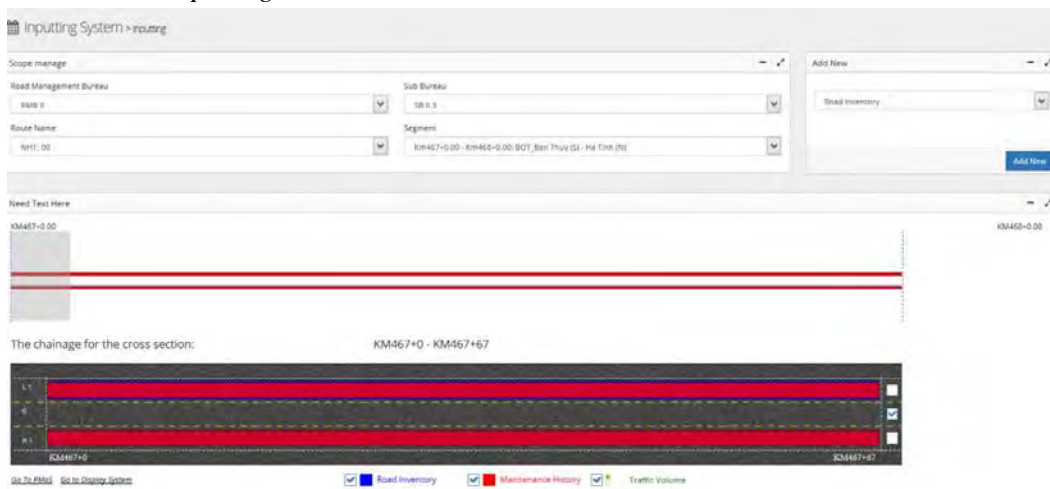
- e) Select types of Maintenance History: Repair Surface or Repair Classification
- f) Select a lane to display Maintenance History of above selected type



- g) Link to Input System and Display System

Link functions to the Input System and the Display System are prepared in PMoS. When users click such links, the system shows linked system in different tab to facilitate users access to directing sections.

Go to Inputting



Go to Display System



## **CHAPTER 6 IMPROVE INSPECTION AND REPAIR WORK SELECTION TECHNOLOGY ON ROAD FACILITY AND DEVELOP TECHNICAL STANDARD (MEASURE 3)**

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### **6.1 ACTIVITY 3-1: IMPLEMENT, MONITOR AND EVALUATE PILOT REPAIR WORKS ON PAVEMENT REPAIR TECHNOLOGY**

#### **6.1.1 Introduction**

Road infrastructure is a national asset to be taken over from generation to generation in sound condition. Proper road maintenance and repair with right work to the right place at the right timing can ensure the best economy over a long period of road maintenance. In order to take proper actions in the course of road maintenance, road administrator should be equipped with a variety of technical standards including road facility inspection standards, design standards and construction standards, that is specifications for maintenance and repair work.

JICA Project for Capacity Enhancement in Road Maintenance supports development of technical standards, focusing on the road facility inspection guideline and the road routine maintenance manual. In conjunction with these activities, the Project will implement pilot projects for routine pavement repair work in collaboration with DRVN, selecting and applying new pavement repair technologies to the national roads under RMB I jurisdiction in accordance with the Record of Discussion (R/D) agreed on September 8th, 2014. Outcomes of this pilot repair work will be incorporated into the road routine maintenance manual.

#### **6.1.2 Objectives**

The objectives of pilot pavement and bridge repair project are as follows;

- a. To apply whole processes including road facility inspection, repair work planning, work implementation in the field for road routine maintenance and periodic repair work to the selected pavement and bridge repair technologies, and to find out key elements for these processes through monitoring on their work performance.
- b. To support the development and the upgrade of technical standards/guideline for road routine maintenance and periodic repair based on the information obtained in the pilot project.

#### **6.1.3 Classification of Road Maintenance and Repair Work**

**Table 6.1.1** shows measures in general taken during the long course of road maintenance. Of these measures, emergency work and periodic repair are those defined in Circular 52 as shown in the table.

Routine maintenance is the measure to maintain road function in initial condition, so that it is sometimes called as reactive road maintenance to be in general taken after defects and deterioration occur on the road facility.

Also, periodic repair is to restore road functions to original loading capacity, so that it is sometimes called as proactive road maintenance which falls into road asset management strategy.

On the other hand, renovation and reconstruction are the measures to upgrade capacity of road facilities including widening to multi lanes and to strengthen pavement structure to be higher standards, which is in general not categorized as road maintenance, but as road investment project in Viet Nam.

**Table 6.1.1 Definition of Maintenance, Repair and Reform**

No.	Activities	Sample Works	Objectives			
			Maintain serviceability	Restore from Aging	Increase strength	Increase capacity
1	Routine Maintenance	<ul style="list-style-type: none"> <li>• Road facility Cleaning</li> <li>• Pothole &amp; bump repair</li> </ul>	X			
2	Emergency Work	<ul style="list-style-type: none"> <li>• Disaster prevention</li> <li>• Disaster restoration</li> </ul>	X			
3	Periodic Repair	<ul style="list-style-type: none"> <li>• Crack seal</li> <li>• Pavement overlay</li> <li>• Cut and overlay, etc.</li> </ul>	X	X		
4	Renovation/ Reconstruction	<ul style="list-style-type: none"> <li>• Pavement design upgrade</li> <li>• Bridge structural reinforcement</li> <li>• Bridge waterproof</li> <li>• Realignment</li> </ul>	X	X	X	
		<ul style="list-style-type: none"> <li>• Increase in lanes (Widening)</li> <li>• Bridge reconstruction</li> </ul>	X	X	X	X

(Note) Roles and objectives for Routine maintenance, Emergency work and Periodic Repair are defined in Circular 52.

#### 6.1.4 Need of Technical Standards

**Table 6.1.2** shows DRVN’s current status of technical standard preparation for road maintenance and repair. The table explains that Specifications of Road Routine Maintenance (TCCS 07-2013-TCDBVN) which was published in 2013 has been applied to the routine maintenance and emergency work for the national roads. Also, MOT design standards for new road construction including work specifications (Construction standards) which are specially set for each project have been applied to the periodic repair and reconstruction of facilities on the national roads.

Pavement repair work applied for routine maintenance is in general so small scale that work specification is more often applied for designing, selecting and executing repair work of road facilities. It is therefore necessary to enhance specifications of Road Routine Maintenance by increasing the variation of technical standards applicable to road routine maintenance.

**Table 6.1.2 Technical Standards Applied for Road Maintenance and Repair**

Measures	Inspection standard	Design standards	Work Specifications
Routine Maintenance	Specifications of Road Routine Maintenance 2013		
Emergency Work	Specifications of Road Routine Maintenance 2013		
Periodic Maintenance	Specifications of Road Routine Maintenance or special inspections (Ex, loading tests)	MOT design standards for new road construction	Work specification for each project
Renovation/ Reconstruction		MOT design standards for new road construction	Work specification for each project

### 6.1.5 Selection of Pilot Repair Work

The Project selected the following pavement and bridge repair technologies as pilot repair work through discussion with WG2. Crack seal and bridge water proof technology have been mainly applied to periodic repair. Pothole technology has been in principle applied to the small repair in the routine road maintenance. Details for each technology is shown in the following section.

- Crack seal technology
- Pothole repair technology for shallow and deep potholes
- Bridge water proof technology

#### 6.1.5.1 Crack Seal Technology

Crack seal technology shall be in principle applied to the periodic repair which is a proactive road maintenance strategy work of road asset management. Road asset management is the management methods which shall implement periodic repair repeatedly to keep maintaining road structural function for the long time to come. Crack seal technology is the measure to prevent water infiltration into cracks arising at the first step of pavement deterioration, thereby prolongs the life cycle of pavement.

However, crack seal can be applied even to the small repair in the routine road maintenance in order to maintain traffic serviceability and safety. It is applied to the small repair as a temporary measure to restore negative effects of pavement damages to vehicle traffic until full repair (Periodic repair) is carried out in the field.

In addition, crack seal can also be applied to fill the gaps arising between cutting face and repair material when pothole repair is implemented.

#### 6.1.5.2 Pothole Repair Technology

Pothole repair technology is considered a reactive repair work conducted by the small repair in the routine road maintenance whose main objective is to restore traffic serviceability and safety from the negative effects given by pavement damages.

For this reason, when damages turn to heavy, independent pothole repair work can no longer be applicable, but periodic repair such as medium or large repair of pavement overlays, cut & overlays and replacement of pavement shall be applied.

However, pothole repair technology shall also be applied to the medium or the heavy pavement damage as temporary repair work until full repair (Periodic repair) is carried out with understanding that the durability of repair material is significantly degraded.

### **6.1.5.3 Bridge Waterproof Technology**

Bridge waterproof technology has been widely applied to prolong pavement life on the bridge concrete deck slab and pavement. Water proof technology is to induce rain water to the drainage and prevent the formulation of water puddle on the bridge deck. It shall be installed when periodic repair like replacement of bridge deck is carried out together with the installation bridge waterproof sheet or paint.

## **6.1.6 Outline of Proposed Pilot Repair Work**

### **6.1.6.1 Crack Seal Technology**

Proposed crack seal technology has the following features;

- Polymer modified asphalt type hot applied crack sealant
- Eliminate penetration of surface water into pavement structure
- Prolong pavement life, thereby reducing repair cost
- High infiltration capacity
- High crack resistance at lower temperature
- High stick resistance at higher temperature



**Photo 6.1-1 Pilot Repair Work (Crack Sealing)**

### **6.1.6.2 Pothole Repair Technology by Cold Asphalt Mix**

Proposed pothole repair technology has the following features;

- Water-proof cold mix pothole repair material
- Can be applied in rain condition, even pothole is full of water
- High scatter resistance
- High water resistance
- High durability



Photo 6.1-2 Pilot Repair Work (Patching)

### 6.1.6.3 Bridge Waterproof Technology

Proposed Bridge Waterproof technology has the following features;

- High water resistance
- High durability
- High drainage capacity



Photo 6.1-3 Pilot Repair Work (Bridge Waterproof)

### 6.1.7 Selection of Pilot Sections

The Project selected candidate sections for the pilot repair works based on the following two steps.

- (1) Preliminary selection by reviewing pavement condition survey data
- (2) Final selection by field surveys

### 6.1.7.1 Selection Criteria

#### (1) Crack Seal

The following criteria for crack seal technology are applied to the selection of pilot sections, which are consistent with the work selection criteria incorporated into Road Facility Inspection Guideline and PMS Model currently under development in this Project.

- 1) Pavement type; Asphalt Concrete Pavement
- 2) Crack level; Medium damages (Crack Total 30% - 40%, if more than 40% large repair is needed).
- 3) Rutting Depth; Less than 20 mm (If more than 20 mm, pavement cutting is needed for repair rutting)
- 4) IRI; Less than 8 mm/m
- 5) MCI;  $3 \leq \text{MCI} < 4$

(Memo)	
MCI; Maintenance Control Index (MLIT Standard in Japan);	
RANK-1;	$5 \leq \text{MCI}$ : Targeted maintenance level
RANK-2;	$4 \leq \text{MCI} < 5$ ; Light damage which need monitoring
RANK-3;	$3 \leq \text{MCI} < 4$ ; Medium damage which need planned repair work
RANK-4;	$\text{MCI} < 3$ ; Heavy Damages which need urgent repair work

(Source) Road Maintenance and Repair WORK Manual, 2007, MLIT

#### (2) Pothole Repair

The following criteria for pothole repair technology are applied for the selection of pilot sections.

- 1) Pavement type; Asphalt Concrete Pavement
- 2) Crack level; Medium damages (Crack (Total) less than 40%, if more than 40% large repair is needed).
- 3) Rutting Depth; Less than 30 mm (If more than 30 mm, pavement cutting will be needed)
- 4) IRI; -----
- 5) MCI; -----

#### (3) Bridge Waterproof work

Selection pilot project for waterproof was carried out base on the result of discussion with DRVN. Bridge repair work plan provided from DRVN to JICA project team. And discussion about target of Waterproof work after site survey was carried out by DRVN and JICA project team. Based on the results of the discussion, three bridges was selected to carry out waterproof work.

Selection result of waterproof work is shown in the following **Table 6.1.3**.

**Table 6.1.3 Selection Pilot Sections for Waterproof**

No	Location (NH18)	Length (m)	Width (m)	Area (m2)	Thickness of Overlay(cm)	Num. of Span	Selected Bridges	Bridge Name
1	<b>Km197+887</b>	<b>21.0</b>	<b>9.5</b>	<b>199.5</b>	<b>6</b>	<b>1</b>	*	<b>Hà Đông 1</b>
2	<b>Km199+350</b>	<b>12.0</b>	<b>10.0</b>	<b>120.0</b>	<b>5</b>	<b>1</b>	*	<b>Hà Đông 2</b>
3	<b>Km212+960</b>	<b>42.0</b>	<b>7.0</b>	<b>294.0</b>	<b>7</b>	<b>2</b>	*	<b>Hà Giàn</b>
4	Km212+750	83.810	7.0	586.67	7	4		
5	Km212+400	315.85	7.0	2,210.95	7	7		
6	Km228+330	63.32	11.0	696.52	5	3		
7	Km219+000	18.0	7.0	126.0	5	1		
8	Km267+350	99.2	14.0	1,388.8	7	3		
9	Km225+650	15.0	8.0	120.0	-	1		
10	Km229+770	21.0	7.0	147.0	7	1		
11	Km274+420	30.3	12.0	363.6	5	2		

(Sauce) Schedule of Bridge repair work of DRVN-Road Maintenance & Management Department (date of acceptance 26.Nov.2015)

### 6.1.7.2 Preliminary Selection

Preliminary selection of candidate sections was made based on the pavement condition survey data in 2012.

### 6.1.7.3 Final Selection

In line with the preliminary selection, the Project went into the final selection, conducting field survey and evaluating the current status of pavement damages, taking account of recommendations issued by RMB I on the candidate locations. The field surveys were conducted on October 23rd on NH6, November 19th on NH6 and Ho Chi Minh Route and November 19th on NH2. Due to improvement project on NH6, site for pavement crack seal had been changed. The final selection was made in February 2017 on NH10 from Thai Binh to Hai Phong.

Based on the results of the field survey, the Project summarized the recommendation on the candidate sections of pilot repair works as shown in **Table 6.1.4**.

**Table 6.1.4 Pilot Repair Work and Candidate National Road Sections**

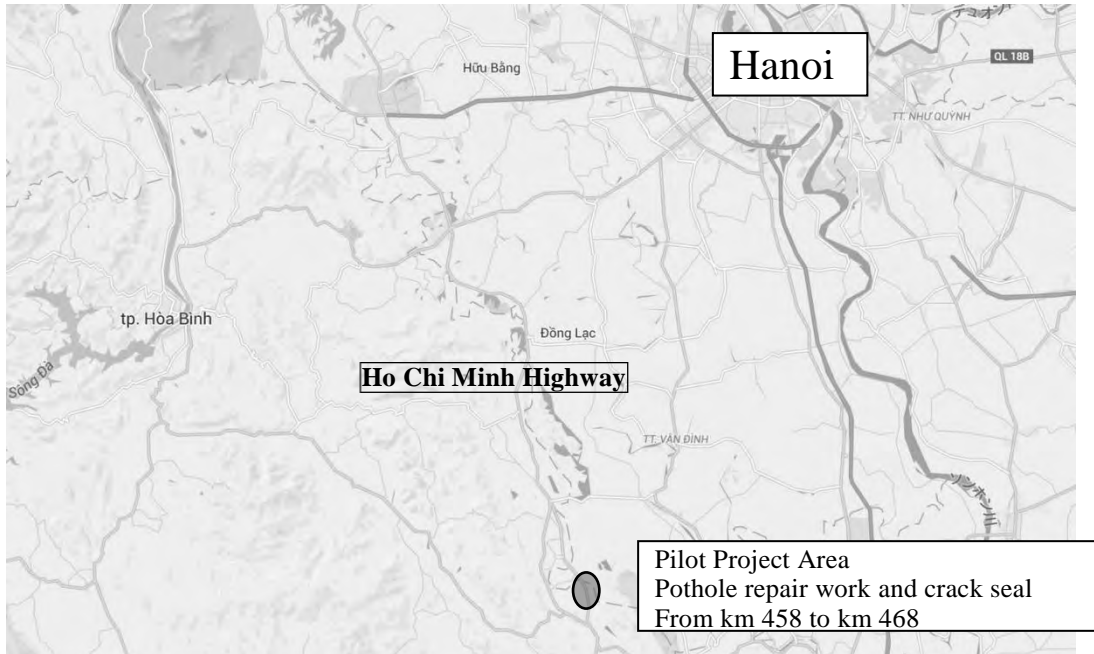
	Repair Work	Specification	Repair Materials	Selected National Road		Maximum Work Volume (total)
a.	Crack seal		CRACK SEAL NX	NH 10	74+000-79+095	1,000 m
				HCM Highway Crack sealing for bottom of potholes before patching	458+000-468+000	
b.	Pothole Repair Work-I	Pothole depth less than 3 cm (Shallow hole)	ROMEN PATCH *1	HCM Highway	458+000-468+000	20 square meters
c.	Pothole Repair Work-II	Pothole depth from 3 cm to 5 cm (Deep hole)	RESCUE PATCH *1	HCM Highway	70+000-78+000	150 square meters
				NH 10 Cut alligator crack areas for patching	74+000-79+095	
d.	Bridge Waterproof Work *2		CATICOAT R BARADRAIN	NH 18	197+887 199+350 212+960	620 square meters

(\*Note1) Shelf Life; Romen Patch; 6 months, Rescue patch; 12 months



(\*Note2) Bridge Waterproof includes drain pipe installation (about 150m).

(\*Note 3) Pavement Potholes on Ho Chi Minh Highway have been mainly occurred at patched areas (by BST or BPM) on alligator cracked pavement. Without treatment of existing cracks before overlaying, cracks on overlay have occurred that caused peeling to form shallow potholes.



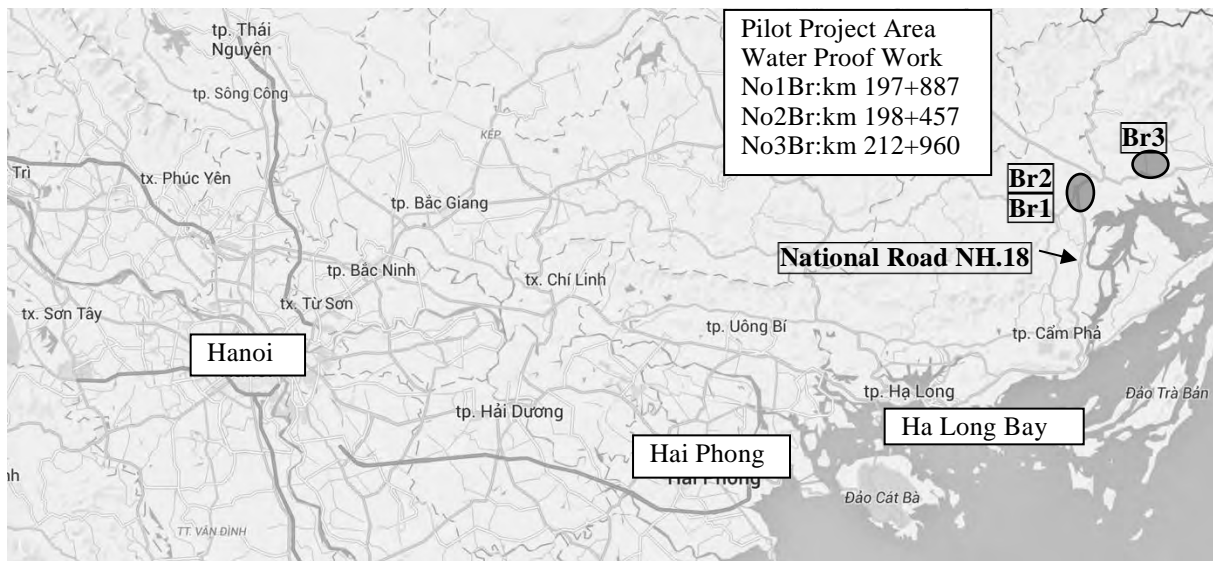


Figure 6.1.1 Location Map of Pilot Project

### 6.1.8 Procurement of Repair Materials

In order to ensure sustainable implementation of pavement routine maintenance, high priority is placed on the use of domestic materials even for the pilot repair work. DRVN including contractors are requested to procure materials and equipment needed for the pilot repair work. However, in case new materials or new equipment need to be applied, but not available in Vietnam, the Project will provide them. In this case, DRVN is requested to support import procedures.

### 6.1.9 Crack Seal

The following crack repair materials had been prepared by JICA project team and supplied to DRVN.

Table 6.1.5 Crack Seal Material

Item	Product Name	Quantity	Unit	Note
Crack Sealant	CRACKSEAL NX	11	Cartons	275 kilograms
Primer	NX PRIMER	1	Bucket	20 liters
Curing Sand	ROMEN SAND	1	Bucket	25 kilograms

### 6.1.10 Pothole Repair Work –I (Shallow Hole)

The following pothole repair materials had been prepared by JICA project team and supplied to DRVN. Other materials needed for the crack repair work had been prepared by the contractor.

Table 6.1.6 Pothole Repair Material (Shallow Hole)

Materials	Product Name	Quantity	Unit	Note
Cold Asphalt Patching Mix	ROMEN PATCH	84	Cartons	1,500 kilograms
Rubber Modified Tack Coat	CATIOZOL GM	1	Bucket	18 liters
Curing Sand	ROMEN SAND	2	Buckets	50 kilograms

### 6.1.11 Pothole Repair Work –II (Deep Hole)

The following pothole repair materials had been prepared by JICA project team and supplied to DRVN. Other materials needed for the crack repair work had been prepared by the contractor.

**Table 6.1.7 Pothole Repair Material (Deep Hole)**

Materials	Product Name	Quantity	Unit	Note
Cold Asphalt Patching Mix	RESCUE PATCH	1,152	Bags	17,280 kilograms
Rubber Modified Tack Coat	CATIOZOL GM	5	Bucket	86 litters
Curing Sand	ROMEN SAND	2	Bucket	50 kilograms

### 6.1.12 Bridge Waterproof

The following waterproof materials had been prepared by JICA project team and supplied to DRVN. Other materials needed for the waterproof work had been prepared by the contractor.

**Table 6.1.8 Bridge Water Proof Material**

Materials	Product Name	Quantity	Unit	Note
Primer	CATICOAT R	16	Buckets	320littes
Waterproof membrane	FRESH COAT	44	Cartons	1,100kilograms
Curing Sand	SILICA SAND #4	23	Bags	690kilograms
Formed Joint Sealant	SEROSEAL SS TAPE (II)	27	Rolls	270meters
Drainage Pipe	BARADRAIN (I)	8	Rolls	200meters

### 6.1.13 Repair Equipment and Manpower

#### 6.1.13.1 Crack Seal Work

##### (1) Equipment Prepared by JICA Project Team

The following equipment had been prepared by JICA project team and supplied to DRVN.

**Table 6.1.9 Crack Seal Work Equipment (JICA)**

Item	Quantity	Unit	Note
Melting Device	1	Unit	To heat and melt the sealant
Cracks Sealer	1	Unit	To pour sealant into cracks
Burner Head	2	Units	To heat and melt the sealant
Dipper	5	Units	To carry melted sealant
Large Scraper	2	Units	To clean the cracks
Small Scraper	3	Units	To clean the cracks
Brush for Primer	5	Units	To apply primer
Curing Tape	1	Carton	To musk the application area

##### (2) Equipment Prepared by Contractors

Other equipment shown below had been prepared by the contractor.

**Table 6.1.10 Crack Seal Work Equipment (Contractor)**

Equipment	Quantity	Unit	Note
Large Steel Bucket	5	Units	To carry melted sealant
Small Bucket for Primer	3	Units	To apply primer

Steel Kettle	3	Units	To pour sealant into cracks
Blower	1	Unit	To clean the cracks
Bloom	3	Units	To clean the cracks
Propane Gas Tank	4/day	Units	To heat and melt the sealant
Regulator for Propane Gas	2	Units	To heat and melt the sealant
Truck	1	Unit	To carry the materials and the equipment
Steel Brush – Large	4	Unit	Crack cleaning

**(3) Manpower Prepared by Contractors**

Six (06) workers had been prepared the contractor. After instruction from Japanese experts, workers of the contractor will handle the work directly. In the case of combination with other repair works, the maximum number of workers is requested.

JICA Project Team had allocated two Japanese experts to provide instruction.

**(4) Remarks:**

The above quantities of materials, equipment, and manpower are requirement for direct implementation of repair work excluding other items and traffic safety work also.

**6.1.13.2 Pothole Repair Work-I (Shallow hole)**

**(1) Equipment Prepared by JICA Project Team**

The following equipment had been prepared by JICA project team and supplied to DRVN.

**Table 6.1.11 Pothole Repair Work-I (Shallow hole) Equipment (JICA)**

Equipment	Quantity	Unit	Note
Trowel	5	Units	To apply the cold mix
Large Scraper	2	Units	To clean the potholes
Small Scraper	3	Units	To clean the potholes
Curing Tape	2	Cartons	To musk the application area

**(2) Equipment Prepared by Contractors**

Other equipment shown below had been prepared by the contractor.

**Table 6.1.12 Pothole Repair Work-I (Shallow hole) Equipment (Contractor)**

Equipment	Quantity	Unit	Note
Small Bucket for Tack Coat	3	Units	To apply tack coat
Brush for Tack Coat	10	Units	To apply tack coat
Large Plastic Bucket	3	Units	To clean the equipment
Water Tank and Water	2	Units	To clean the equipment
Cutter	3	Units	To prepare the application
Blower	1	Unit	To clean the potholes
Bloom	3	Units	To clean the potholes
Truck	1	Unit	To carry the materials and the equipment
Steel Brush – Large	4	Unit	Crack cleaning
Mandrel	2	Unit	Cutting edge and excavating pothole

**(3) Manpower Prepared by Contractors**

Six (06) workers had been prepared the contractor. After instruction from Japanese experts, workers of the contractor will handle the work directly. In the case of combination with other repair works, the maximum number of workers is requested.

JICA Project Team had allocated two Japanese experts to provide instruction.

**(4) Remarks:**

The above quantities of materials, equipment, and manpower are requirement for direct implementation of repair work excluding other items and traffic safety work also.

**6.1.13.3 Pothole Repair Work-II (Deep hole)**

**(1) Equipment Prepared by JICA Project Team**

The following equipment had been prepared by JICA project team and supplied to DRVN.

**Table 6.1.13 Pothole Repair Work-II (Deep hole) Equipment (JICA)**

Equipment	Quantity	Unit	Note
Manual Tamper	1	Unit	To compact the mixture
Large Scraper	2	Units	To clean the potholes
Small Scraper	3	Units	To clean the potholes
Curing Tape	1	Carton	To musk the application area

**(2) Equipment Prepared by Contractors**

Other equipment shown below had been prepared by the contractor.

**Table 6.1.14 Pothole Repair work-II (Deep hole) Material Equipment (Contractor)**

Equipment	Quantity	Unit	Note
Small Bucket for Tack Coat	3	Units	To apply tack coat
Brush for Tack Coat	10	Units	To apply tack coat
Large Plastic Bucket	1	Unit	To clean the equipment
Water Tank and Water	2	Units	To clean the equipment
Cutter	3	Units	To prepare the application
Blower	1	Unit	To clean the potholes
Bloom	3	Units	To clean the potholes
Shovel	2	Units	To apply the cold mix
Plate Compactor	1	Unit	To compact the cold mix
Truck	1	Unit	To carry the materials and the equipment
Steel Brush – Large	4	Unit	Crack cleaning
Mandrel	2	Unit	Cutting edge and excavating pothole

**(3) Manpower Prepared by Contractors**

Six (06) workers had been prepared the contractor. After instruction from Japanese experts, workers of the contractor will handle the work directly. In the case of combination with other repair works, the maximum number of workers is requested.

JICA Project Team had allocated two Japanese experts to provide instruction.

**(4) Remarks:**

The above quantities of materials, equipment, and manpower are requirement for direct implementation of repair work excluding other items and traffic safety work also.

**6.1.13.4 Bridge Waterproof Work**

**(1) Equipment Prepared by JICA Project Team**

The following equipment had been prepared by JICA project team and supplied to DRVN.

**Table 6.1.15 Bridge Waterproof Work Equipment (JICA)**

Equipment	Quantity	Unit	Note
Dipper	5	Units	To carry melted waterproof
Small Scraper	3	Units	To clean the bridge deck
Brush for Primer	3	Units	To apply primer
Curing Tape	3	Boxes	To musk the application area
Waterproof Brush(L)	2	Units	To apply waterproof
Waterproof Brush(M)	2	Units	To apply waterproof
Waterproof Brush(S)	3	Units	To apply waterproof
High Frequency Water Content Meter	1	Unit	To check the water content on bridge deck
Fireproof Sheet	2	Sheets	To avoid from fire

Note; \*Melting device and burner head for crack sealing repair work is used for melt the waterproof material.

**(2) Equipment Prepared by Contractors**

Other equipment shown below had been prepared by the contractor.

**Table 6.1.16 Bridge Waterproof Work Equipment (Contractor)**

Equipment	Quantity	Unit	Note
Large Steel Bucket	5	Units	To carry melted waterproof
Shovel	1	Unit	To spray the curing sand
Cutter	3	Units	To prepare the application
Handle for roller brush	3	Units	To apply primer
Roller Brush	10	Units	To apply primer
Trash Bag	1	Dozen	To clean the site
Cotton Glove	3	Dozen	To protect hands from waterproof
Rubber Glove	1	Dozen	To protect hands from primer
Wheel Barrow	1	Unit	To spray the curing sand

**(3) Manpower Prepared by Contractors**

Eight (08) to ten (10) workers had been prepared the contractor. After instruction from Japanese experts, workers of the contractor will handle the work directly. In the case of combination with other repair works, the maximum number of workers is requested.

JICA Project Team had allocated two Japanese experts to provide instruction.

#### **(4) Remarks**

The above quantities of materials, equipment, and manpower are requirement for direct implementation of repair work excluding other items and traffic safety work also.

#### **6.1.14 Preparation of Techno-economic Report for Public Investment**

DRVN was requested to prepare the following materials for the approval of the pilot project. JICA Project Team cooperated on this preparation.

- 1) Shop drawings, processing designs (if any)
- 2) Construction cost estimates
- 3) Other contents of the techno-economic report.

#### **6.1.15 Responsibility Sharing Between DRVN and Project Team**

Pilot repair was carried out, making use of regular maintenance and repair projects of RMB I and changing material and work specification of conventional repair technologies to the proposed technologies, so that DRVN is requested to take an initiative in implementing pilot repair works. Responsibility sharing between DRVN and JICA Project Team is shown below.

##### **6.1.15.1 DRVN**

In accordance with R/D, DRVN was requested to take responsibility for the following issues;

- Budget preparation for pilot repair work
- Selection of project area
- Selection of contractors
- Procurement of domestic equipment and materials
- Implementation of repair work, supervision, work quality and safety assurance of the work
- Monitoring and evaluation of work performance.

##### **6.1.15.2 JICA Project Team**

JICA Project done the following;

- Technical assistance to the selection of repair work technologies, construction technologies, work quality and safety management, and monitoring and evaluation methods
- Procurement of special materials and equipment in Japan, while DRVN is requested to cooperate with the acceleration of import procedures.

#### **6.1.16 Implementation Schedule**

The following is a tentative time schedule for the implementation of pilot repair work. It was expected that it take a long time for the processing of export and import procedures, so

that DRVN was kindly requested to cooperate on the acceleration of export/import procedures.

- April to September 2015 Planning of pilot repair work implementation plan
- September to November 2015; Selection of pilot section
- January to March 2017: Material and equipment procurement and export/import procedures
- April 2017 Work execution
- May to December 2017; Monitoring and evaluation of pilot work performance
- January 2018 - ; Legal procedure on Standardization

### 6.1.17 Implementation of Pilot Repair Work on the Sites

Following the implementation plan described above, pilot repair works were implemented on the sites by the contractor selected by DRVN. Field work for the pilot project were all completed from April 14 to April 28, 2017 without any accidents on the sites, thanks to the effort of DRVN, PMU3, ITST and Contractor.

The following is the summary of pilot repair work on the sites.

#### 6.1.17.1 Work Volume

##### (1) Overall Work Volume

Overall work volumes including crack seal, pothole repair and bridge waterproof are all summarized in the following **Table 6.1.17**.

**Table 6.1.17 Work Volumes for Pilot Repair Project (Summary)**

No.	Technologies	Units	Work Volume for Actual Execution			Remarks
			NH.10	HCM Highway	NH.18	
1	Crack Seal Work	place	70			
2	Pothole Repair Work-I (Shallow hole)	place	1	10		
3	Pothole Repair Work-II (Deep hole)	place	19	26		
4	Bridge Waterproof Work	Bridge			4	

##### (2) Work Volume for Crack Seal Work

Work volumes for crack seal implemented on NH.10 are summarize in the following

.



**Table 6.1.18 Work Volumes for Crack Seal (National Road No.10)**

NO	STARTING STATION	CRACK	WIDTH	DEPTH	REMARKS
		L (m)	B (mm)	H (mm)	
1	Km74+805	3	5	5	right
2	Km74+805	3	5	10	right
3	Km74+806	10	6	7	right
4	Km74+810	3	4	6	right
5	Km74+815	3	5	7	right
6	Km74+825	10.2	5	5	right
7	Km74+845	13.2	6	5	right
8	Km74+850	1	6	7	right
9	Km74+855	1	5	6	right
10	Km75+050	1	5	7	right
11	Km75+150	2	6	7	right
12	Km75+155	1	6	7	right
13	Km75+152	10.5	6	7	right
14	Km75+158	10	6	7	right
15	Km75+170	5	4	6	right
16	Km75+220	2	5	10	left
17	Km75+430	19	3	4	right
18	Km75+432	2	3	5	right
19	Km75+440	2	5	7	right
20	Km75+450	15	4	6	right
21	Km75+460	12	5	7	right
22	Km75+465	1	3	5	right
23	Km75+500	12	5	7	center
24	Km75+550	3	5	7	right
25	Km75+570	3	6	8	right
26	Km75+580	2	4	6	right
27	Km75+590	15	7	11	right
28	Km75+610	2	5	7	center
29	Km75+613	3	4	7	left
30	Km75+615	9	7	11	right
31	Km75+700	8	6	8	left
32	Km75+740	55	6	7	left
33	Km75+750	8	5	7	left
34	Km75+850	10	6	10	right
35	Km75+870	6	4	6	right
36	Km75+950	34	6	8	right
37	Km75+970	8	6	9	right
38	Km75+975	25.5	6	8	right
39	Km76+000	30	6	6	left
40	Km76+050	9.3	5	6	right
41	Km76+065	28.8	6	7	right
42	Km76+070	6	5	6	left
43	Km76+130	5	3	6	right
44	Km76+140	34	5	6	right
45	Km76+160	10.1	5	8	right
46	Km76+185	2	6	8	right
47	Km76+210	15	3	7	right
48	Km76+250	20	7	10	both sides
49	Km76+340	9.8	4	6	right
50	Km76+370	54.5	5	8	right
51	Km76+390	29.6	6	7	right
52	Km76+510	3	3	6	right
53	Km76+515	3	3	6	left
54	Km76+545	16.3	4	7	right
55	Km76+580	46.6	5	6	right
56	Km76+670	30	6	9	left
57	Km76+755	20	7	10	left
58	Km76+690	8	5	7	right
59	Km76+710	20	6	10	right
60	Km77+215	35	5	8	right
61	Km77+220	25.9	6	7	right
62	Km77+225	45.5	5	8	right
63	Km77+250	56.5	6	8	right

NO	STARTING STATION	CRACK	WIDTH	DEPTH	REMARKS
		L (m)	B (mm)	H (mm)	
64	Km77+380	9.5	7	9	right
65	Km77+550	110.5	6	7	right
66	Km77+570	10	3	6	right
67	Km77+590	30	6	7	right
68	Km77+620	12	5	8	right
69	Km77+700	15	7	8	right
70	Km77+780	20	5	7	right
TOTAL		1091.1			

**(3) Work Volume for Pothole Repair Work-I (Shallow hole)**

Work volumes for pothole repair work-I (Shallow hole) are summarized in the following **Table 6.1.19**.

**Table 6.1.19 Work Volumes for Pothole repair (Shallow hole)**

(1) National Road NO.10

NO	STATION	DIMENSION (M)		TYPE of POTHOLE	POTHOLE CONDITION	REMARKS
		WIDTH	LENGTH			
1	KM 74+803 - 74+804	0.68	1	shallow	Water leakage	left

(2) HCM road

NO	STATION	DIMENSION (M)		TYPE of POTHOLE	POTHOLE CONDITION	REMARKS
		WIDTH	LENGTH			
18	KM460+120 - 460+122	1.5	2	shallow	dry	left
21	KM460+130 - 460+134	1.2	3.9	shallow	dry	left
23	KM460+580 - 460+581	0.6	1.6	shallow	dry	right
24	KM460+590 - 460+592	0.8	2.3	shallow	dry	right
25	KM460+595 - 460+596	1.1	1.5	shallow	dry	right
32	KM461+740 - 461+741	1.6	1	shallow	dry, Km461+745 dimension of 1x2 as designed	left
33	KM461+760 - 461+761			shallow	dry, patching in many types of geometric dimension, dimension of 1x1m as designed	left
34	KM461+775 - 461+776	0.6	1.4	shallow	dry	left
35	KM461+780 - 461+788	0.8	3.1	shallow	dry	left
36	KM461+790 - 461+793	1.3	3.5	shallow	dry	left

**(4) Work Volume for Pothole Repair Work-II (Deep hole)**

Work volumes for pothole repair Work-II (Deep hole) are summarized in the following **Table 6.1.20**.

**Table 6.1.20 Work Volumes for Pothole Repair (Deep hole)**

(1) National Road NO.10

NO	STATION	DIMENSION (M)		TYPE of POTHOLE	POTHOLE CONDITION	REMARKS
		WIDTH	LENGTH			
2	KM 74+810 - 74+811	0.9	1	deep	<b>Damp, WET</b>	right
3	KM74+811 - 74+812	0.5	0.5	deep	<b>FLOODED</b>	right

NO	STATION	DIMENSION (M)		TYPE of POTHOLE	POTHOLE CONDITION	REMARKS
		WIDTH	LENGTH			
4	KM74+830 - 74+831	0.7	1.3	deep	dry	right
5	KM74+845 - 74+846	0.6	0.7	deep	dry, crack around, length=14m	right
6	KM74+870 - 74+871	0.6	0.8	deep	dry	right
7	KM74+871 - 74+872	1	1.2	deep	dry	right
8	KM74+874 - 74+875	0.6	0.7	deep	dry, crack around, length=22m	right
9	KM75+145 - 75+146	1	1	deep	dry	right
10	KM75+150 - 75+151	0.15	0.5	deep		right
11	KM75+155 - 75+157	1.2	2.2	deep	dry, crack around, length=3,4m	right
12	KM75+170 - 75+171	0.9	1.1	deep	dry	left
13	KM75+450 - 75+452	0.6	1.5	deep	dry, crack around, length=2m	left
14	KM75+740 - 75+742	0.6	1.7	deep	dry	left
15	KM75+770 - 75+772	1.1	1.8	deep	dry	left
16	KM76+020 - 76+021	0.8	0.8	deep	dry	left
17	KM76+150 - 76+152	1.3	2.2	deep	dry, crack around, length=6m	right
18	KM76+670 - 76+671	0.7	0.9	deep	dry, crack around, length=3m	right
19	KM76+685 - 76+686	1.2	1.4	deep	dry	right
20	KM77+560 - 77+561	0.6	1	deep	dry, crack around, length=5m	right

(2) HCM road

NO	STATION	DIMENSION (M)		TYPE of POTHOLE	POTHOLE CONDITION	REMARKS
		WIDTH	LENGTH			
1	KM459+540 - 459+541	0.75	0.98	deep	dry	left
2	KM459+595 - 459+596	1.96	1.27	deep	dry	left
3	KM459+670 - 459+671	0.58	1.27	deep	dry	left
4	KM459+690 - 459+691	0.75	0.92	deep	dry	left
5	KM459+710 - 459+712	2.07	2.53	deep	dry	left
6	KM459+850 - 459+853	1.96	3.8	deep	dry	right
7	KM459+990 - 459+992	1.73	2.07	deep	dry	left
8	KM459+930 - 459+934	1.61	4.49	deep	dry	left
9	KM459+920 - 459+925	1.61	6.1	deep	dry	left
10	KM459+890 - 459+894	2.1	4.1	deep	dry	left
11	KM459+990 - 459+992	1.73	2.07	deep	dry	left
12	KM460+020 - 460+023	3.11	4.14	deep	dry	left
13	KM460+025 - 460+028	2.5	2.7	deep	dry	left
14	KM460+035 - 460+037	2.99	4.72	deep	dry	left
15	KM460+050 - 460+052	2.76	2.88	deep	dry	left
16	KM460+080 - 460+084	1.73	4.95	deep	dry	left
17	KM460+105 - 460+106			deep	dry, patching in many types of geometric dimension	left
19	KM460+122 - 460+124	1.27	1.61	deep	dry	left
20	KM460+125 - 460+127	0.92	2.07	deep	dry	left
22	KM460+170 - 460+173	2.53	3.34	deep	dry	left
26	KM460+650 - 460+652	1.73	2.65	deep	dry	left

NO	STATION	DIMENSION (M)		TYPE of POTHOLE	POTHOLE CONDITION	REMARKS
		WIDTH	LENGTH			
27	KM460+660 - 460+664	3	4.6	deep	dry	left
28	KM460+805 - 460+808	1.84	4.14	deep	dry	right
29	KM460+890 - 460+894	1.5	4.26	deep	dry	left
30	KM460+700 - 460+702	1.61	2.76	deep	dry	left
31	KM460+770 - 460+772	1.73	2.76	deep	<b>Heavy Rain, Flooded</b>	left

**(5) Work Volumes for Bridge Waterproof Work**

Work volumes for bridge water proof work are summarized in the following **Table 6.1.21**.

**Table 6.1.21 Work Volume for Bridge Water Proof Works**

No	Location (NH18)	Length (m)	Width (m)	Area (m2)	Thickness of Overlay(cm)	Num. of Span	Bridge Name
1	Km197+887	21.0	9.5	199.5	6	1	Hà Đông 1
2	Km199+350	12.0	10.0	120.0	5	1	Hà Đông 2
3	Km212+960	42.0	7.0	294.0	7	2	Hà Giàn

**6.1.17.2 Implementation Schedule for Pilot Repair Work Project**

Implementation schedule for pilot repair work project is shown in the following **Table 6.1.22**.

**Table 6.1.22 Implementation Schedule for Pilot Repair Work Project**

Date	Repair Work	Crack Sealing (Mainly) and Pothole Patching	Pothole Repair (Mainly) and Crack Sealing	Bridge Waterproof
	Main Material	Crack seal NX Rescue Patch	Romen Patch Crack seal NX	Fresh Coat
	Road (Station)	NH-10 (K74-K79+095)	HCM Highway (K458-K468)	NH-18 (K197+887, K198+457, K212+960)
	Location	Thai Binh City	Hoa Binh Province	Quang Ninh Province
14-Apr	Mobilization			
15-Apr		Site Preparation		
16-Apr		Day-1		
17-Apr		Day-2		
18-Apr		Day-3		
19-Apr		Day-4	Site Preparation	
20-Apr			Day-1	
21-Apr			Day-2	
22-Apr			Day-3	Site Preparation
23-Apr				Day-1
24-Apr				Day-2
25-Apr				Day-3
26-Apr				Day-4
27-Apr				Day-5
28-Apr	Demobilization			

6.1.17.3 Photos

(1) National Roads No.10 (NH.10)

1) Crack repair work



Cleaning



Cleaning



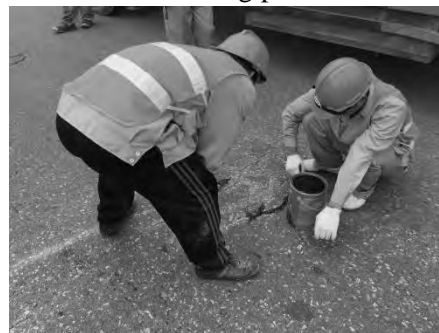
Cleaning



Melting pot



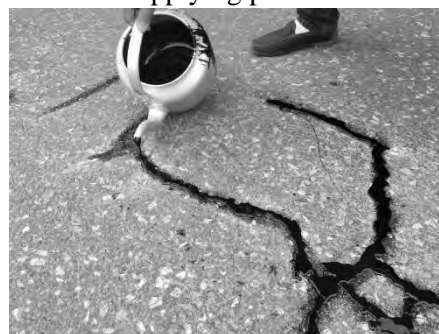
Sealing device



Applying primer



Sealing



Sealing

Photo 6.1-4 Crack Repair Work

2) Pothole repair work



Remove existing surface



Remove existing surface



Cleaning



Mend of crack on top of basement layer



Prime coating on basement layer



First layer



First layer compaction



First layer compaction



Second layer



Finished

**Photo 6.1-5 Pothole Repair Work**

**(2) HCM Highway**

**1) Pothole Repair Work**



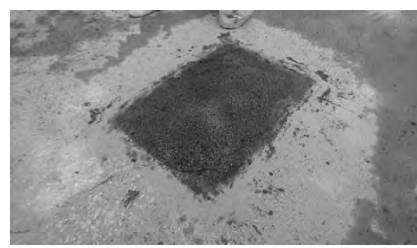
Remove existing Surface



Cleaning



Prime coating on basement Layer



Finished

**Photo 6.1-6 Pothole Repair Work**

**(3) NH.18**

**1) Bridge Waterproof**



Applying primer



Waterproof



Waterproof



Waterproof



Drain pipe



Drain pipe

**Photo 6.1-7 Bridge Waterproof Work**

## 6.1.18 Monitoring of Pilot Repair Work Performance

### 6.1.18.1 Outline of Monitoring Survey

Monitoring on the pilot work performance will be conducted according to the time schedule shown in **Table 6.1.23**. Monitoring will be in principle accomplished by JICA Project Team together with counterpart members. Competent agencies (ITST, UTC) are sometimes invited to the monitoring of the pilot repair work.

**Table 6.1.23 Monitoring Schedule**

Time elapse	Survey
Day of work implementation	
few days after the work	1 <sup>st</sup> survey
1 month after the work	2 <sup>nd</sup> survey
2 months after the work	3 <sup>rd</sup> survey
3 months after the work	4 <sup>th</sup> survey
Hereafter every 2 weeks until the end of one year	Regular periodic survey

Site monitoring survey was carried out by JICA project team as shown in the following **Table 6.1.24**.



**Table 6.1.24 Implementation Schedule of Site Monitoring Survey**

No	Date	Scope of monitoring	Site	Remark
1	17-May-2017	Waterproof	NH-18	First monitoring by JICA project team
2	18-May-2017	Pothole Repair and Crack Sealing	HCM Highway	First monitoring by JICA project team
3	25-May-2017	Crack Sealing and Pothole Patching	NH-10	Monitoring JICA project team after 1 month
4	03-Jun-2017	Crack Sealing and Pothole Patching	NH-10	Monitoring with staff of MOT, DRVN, ITST, Contractor
5	12-Jun-2017	Crack Sealing and Pothole Patching	NH-10	Monitoring after reconstruction JICA project team
6	05-Jul-2017	Crack Sealing and Pothole Patching	NH-10	Monitoring JICA project team after 2 months
		Pothole Repair and Crack Sealing	HCM Highway	Monitoring JICA project team after 2 months
7	07-Jul-2017	Waterproof	NH-18	Monitoring JICA project team after 2 months
8	01-Sep-2017	Crack Sealing and Pothole Patching	NH-10	Monitoring JICA project team after 3 months
		Pothole Repair and Crack Sealing	HCM Highway	Monitoring JICA project team after 3 months
9	23-Dec-2017	Crack Sealing and Pothole Patching	NH-10	Monitoring JICA project team after 4 months
		Pothole Repair and Crack Sealing	HCM Highway	Monitoring JICA project team after 4 months

### 6.1.18.2 Problems Identified in the Monitoring Survey and Their Expected Solutions

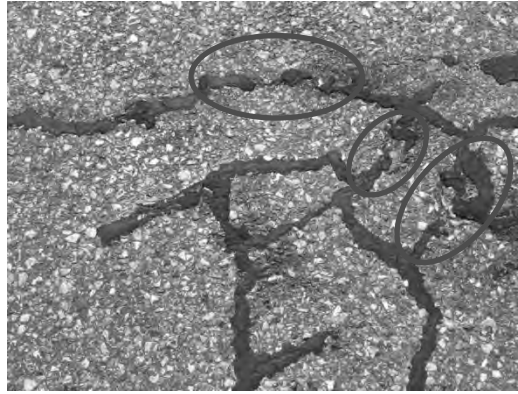
Monitoring survey has reported that many of the repaired pavements on the sites show good performance even when 4 months have elapsed after the implementation of pavement repair work. However, there observed some problems for some repair work in the field. The following shows problem outline, cause analysis and expected solutions against these problems with some photos.

#### (1) Crack Seal Work

##### 1) Case-1: Effect of rainwater or underground water

###### ■ Problem Identification;

- Rainwater or underground water rose to the pavement surface through cracks from subgrade or from pavement base course, pushed up crack seal materials and caused peeling of crack seal materials.



**Photo 6.1-8 Damage condition on site 01**

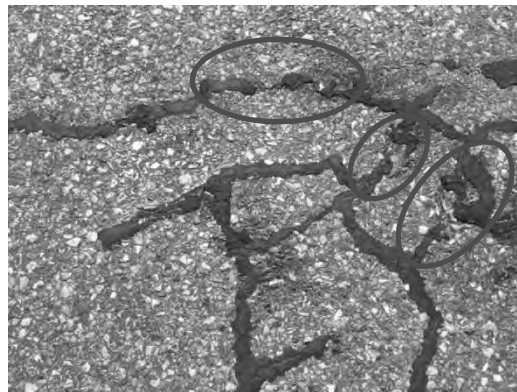
■ Expected solutions

- At the place where cracks penetrated into pavement base course or subgrade, it is recommended to apply cut and replacement of road pavement instead of crack sealing.
- Crack seal can be applied as a temporary measure until full repair work implementation with understanding that the durability of repair work become fairly degraded than expected.

**2) Case-2: Improper under-crack-seal treatment**

■ Problem identification

- Peeling occurred due to insufficient adhesion of the sealing material at places where cleaning and drying of the applied part was insufficient. In addition, similar peeling occurred even at the site where the sealant was injected without proper volume control of primer and confirmation of the dry state.



**Photo 6.1-9 Damage condition on site 02**

■ Expected solutions

- It is important to conduct cleaning and drying on the inside and around affected area of crack sealing thoroughly as a preparatory work before crack sealing.

- Primer should be brushed inside and around cracks with an appropriate amount (0.2 l / m<sup>2</sup>) to the entire affected range, and after the primer has dried sufficiently, the injection of sealing material is started.

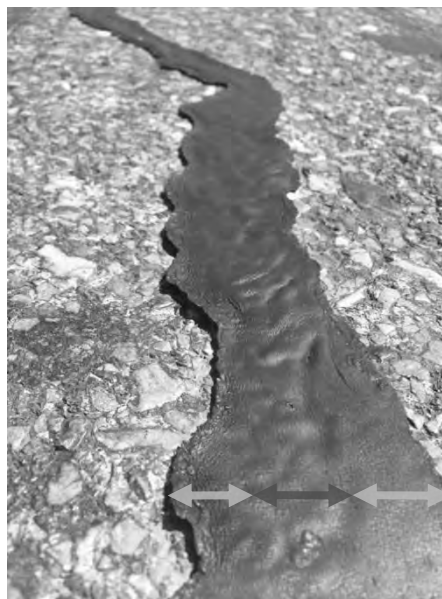
### **3) Case-3; Decrease in temperature for sealing material injection**

#### ■ Problem identification

- Peeling and swelling of the sealing material occurred due to improper temperature management (low temperature) of sealing material during repair work.

#### ■ Expected solutions

- It is important to maintain injection material temperature specified in the work specification and to return the material to the asphalt melting pot immediately when temperature goes down.
- When the sealing material is injected more than necessary, it is important to flatten with a scraper or the like and correct the mounted seal material.



**Photo 6.1-10 Damage condition on site 03**

### **4) Case-4; Repeated heating or overheating of sealing material**

#### ■ Problem identification

- This is not the case identified in the pilot repair work, but sealing material deterioration becomes accelerated due to improper heat management including repeated heating and overheating. Heating of sealing material should be strictly controlled.

#### ■ Expected solutions

- It is important to use the melting pot specialized for the asphalt material and use up the material once dissolved on the sites.

- Surplus sealing material which was not used up in the previous sites shall be applied to the place not appearing to the surface such as crack sealing on the existing pavement base course whose cracks are also found after cutting the damage.
- Special operation staff shall be assigned to manage the melting pod to control material temperature and to prevent fire accident or overheating.

#### **5) Case-5 Water puddle and infiltration**

##### ■ Problem identification

- There observed peeling and softening of repair materials due to the effects of water stagnant on the rut portion and rain water infiltration into pavement through cracks and construction cold joints.

##### ■ Expected solutions

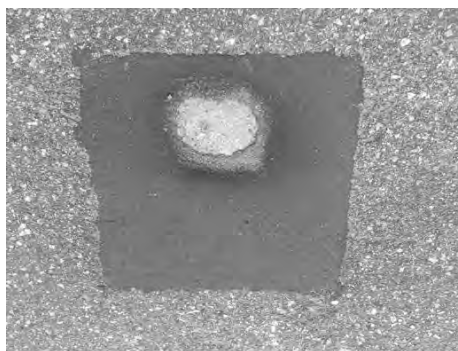
- At dented place or rut on the pavement surface, patching material shall be raised up extra to cope with the settlement of the repaired portion.
- When water infiltration is expected to occur through cold joint or cracks on the pavement surface, crack seal shall be applied to prevent rain water infiltration into pavement.

#### **(2) Pothole Repair Work (Deep Pothole Case)**

##### **1) Case-1: Damages on subgrade and pavement base course**

##### ■ Problem identification

- When repair work was carried out at the place where pavement damages were originated from subgrade or base course damages, there observed fluidization and peeling of repair materials due to insufficient bearing capacity right after the opening of traffic.



**Photo 6.1-11 Damage condition on site 04**

##### ■ Expected solutions

- At the place where crocodile cracks occurred and potential damages on the road subgrade or pavement base course are expected, periodic repair, which includes the full replacement of subgrade and base course, shall be applied instead of the small repair in the routine maintenance.

- If cold asphalt mixture is applied as an emergency work before full periodic repair is implemented, it should be done with understanding that the durability of repair material shall be significantly degraded.

**2) Case-2: Insufficient compaction due to emergency repair work**

■ Problem identification

- At the pavement damage where repair material was placed directly on the damage without square cutting, uniformity in material thickness was impaired which caused uneven compaction during repair work and there observed fluidization, uneven settlement and peeling of asphalt mixture due to repeated traffic loads on the sites.

■ Expected solutions

- Repair work with square cutting of damage area shall be in principle applied to the repair work including small repair in the routine maintenance and periodic repair.
- However, repair work without square cutting of damage area can be applied to the small repair work which is to be implemented as an emergency work to ensure traffic safety in particular under heavy traffic condition.



**Photo 6.1-12 Damage condition on site 05**

**3) Case-3: Excessive depth of repair work**

■ Problem identification

- At the place where damage area of more than 5 cm in depth was repaired by cold asphalt mixture, there observed fluidization and peeling of repair materials due to the settlement caused by insufficient compaction or by repeated traffic loads before repair materials get initial strength.



**Photo 6.1-13 Damage condition on site 06**

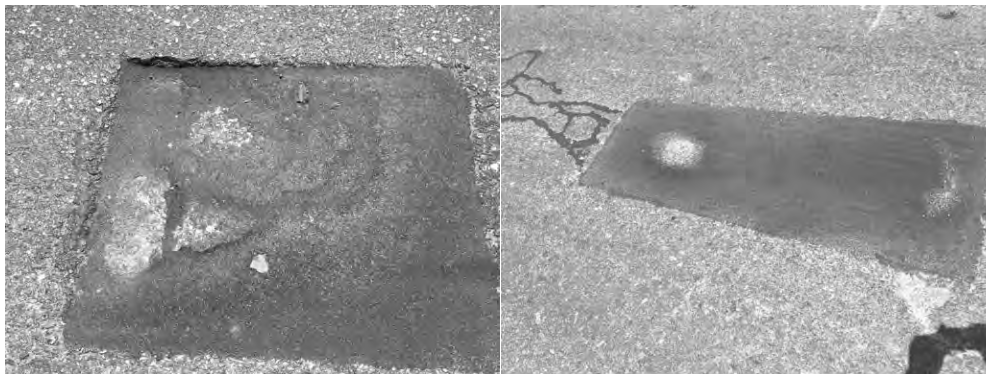
■ Expected solutions

- In case cold asphalt mixture is applied to the deep pothole damage less than 5 cm in depth, a layer shall be divided into several and compaction shall be applied to each layer. Also, surplus material shall be placed on the surface (About 20% surplus of design repair thickness).
- On the other hand, pothole depth is more than 5 cm, hot asphalt mixture shall be applied in principle. This is because small aggregate size of about less than 5 mm is in general used for the cold asphalt mixture and large size of about 13 mm is used for the hot asphalt mixture, so that hot asphalt mixture has more durability than cold asphalt mixture in this case.
- However, if cold asphalt mixture is applied as an emergency work before full periodic repair is implemented, it should be done with understanding that the durability of repair material shall be significantly degraded.

**4) Case-4: Softening and separation of repair material due to water bleeding**

■ Problem identification

- At the place where there is no drainage system on the road and ground water level is high, when repair work is done for the damages on the subgrade and on the pavement base course, there observed damages caused by water bleeding which include the softening of repair materials and the floating up of separated asphalt component.



**Photo 6.1-14 Damage condition on site 07 and 08**

■ Expected solutions

- For the repair work at the place where underground water is anytime breeding, periodic repair of cut and replacement from road subgrade shall be in principle applied instead of small repair in the routine maintenance.
- If cold asphalt mixture is applied as an emergency work before full periodic repair is implemented, it should be done with understanding that the durability of repair material shall be significantly degraded.

**5) Case-5: Water puddle and infiltration**

■ Problem identification

- There observed peeling and softening of repair materials caused by water puddle at rut portion and rain water infiltration through cold joints and pavement cracks.



**Photo 6.1-15 Damage condition on site 09**

■ Expected solutions

- For the rut repair on the pavement surface, sufficient surplus of repair material shall be applied to the rut in order to prevent settlement arising soon after the work (About 20% surplus of design repair thick ness).
- At the place where rain water is expected to infiltrate into repaired portion, crack seal work shall be applied in order to prevent water infiltration.

**6) Case-6: Excessive repair area**

■ Problem identification

- At the place where wide damage area more than 1.0 m x 1.0 m is repaired by cold asphalt mixture, there observed fluidization and peeling of repair materials caused by traffic loads before repair materials get initial strength after work execution. Cold asphalt mixture needs more time to get initial strength than hot asphalt mixture needs.



**Photo 6.1-16 Damage condition on site 10**

■ Expected solution

- In case repair area is wider than 1.0 m x 1.0 m, cold asphalt mixture shall not be applied, but hot asphalt mixture shall be used.
- However, if cold asphalt mixture is applied as an emergency work before full periodic repair is implemented, it should be done with understanding that the durability of repair material shall be significantly degraded.

**(3) Summary of Damage Patters Arising after Pilot Repair Work**

Based on the monitoring survey report, the Project conducted a pattern analysis for the damages arising after the pilot repair work. **Table 6.1.25** shows the problem patterns analyzed for pothole repair work. The analysis is intended to find out key points of attention in designing pavement repair plans in the field.

**Table 6.1.25 Problem Pattern Classification (Pothole Repair)**

Damage Patters	Analysis of Problems	Key Points of Attention		
		Repair Material Selection	Repair Place Selection	Repair Work Selection
P-1	At a place where repair work was implemented on the wide range more than 1.0 m x 1.0 m by cold asphalt mixture, there observed fluidization of cold asphalt mixture (Rescue Patch) leading to the peeling of repair material due to compaction load during repair work or traffic load, since cold asphalt mixture takes time to get initial strength after the execution of repair work.		X	
P-2	At the pavement damage where repair material was placed directly on the damage without square cutting, uniformity in material thickness was impaired which caused uneven compaction during repair work and there observed fluidization, uneven settlement and peeling of asphalt mixture due to repeated traffic loads on the sites.		X	
P-3	At a place where repair work was done by cold asphalt mixture (Rescue Patch) to deep potholes, 3 to 5 cm in depth, there observed fluidization and peeling of asphalt material due to insufficient compaction caused by improper selection of compaction equipment.			X
P-4	At a repair place or next to the place where crack rate is high, lack of bearing capacity might have frequently occurred at subgrade. When repair work was done to this place by cold asphalt mixture, the durability of repair material was significantly impaired and there observed cracks or uneven settlement on the repair material which came out early after repair work.	X	X	
P-5	At a place where there is no drainage system or where rain water runs into road surface, subgrade bearing capacity is often impaired by water bleeding or infiltration. When repair work was done by cold asphalt mixture, there observed phenome in which the durability of repair material was impaired or only the asphalt component floated up and softened on the surface due to repeated traffic loading. The softening point is expected to peel off in the near future.	X	X	
P-6	When repair was done where pavement surface was recessed, surface water concentrated and infiltrated into the gap between cutting surface and repair material and created water pool. With this phenomenon, asphalt component floated up and softened on the surface due to repeated traffic loading. The softening point is expected to peel off in the near future.	X		X



Damage Patters	Analysis of Problems	Key Points of Attention		
		Repair Material Selection	Repair Place Selection	Repair Work Selection
P-7	At a place where pavement construction joint opens and a gap is observed (At road center or at the boundary between lane and shoulder), water infiltration into pavement layers occurred, gave significant damages to the road subgrade and impaired the durability of repair material.	X		X

### 6.1.19 Feed Back of the Results of Pilot Repair Work to the Planning of Pavement Repair Plans

Based on the results of monitoring survey and the analysis on the key points in planning, the Project has reviewed all processes needed for the planning of road maintenance and repair plans and clarified key points in planning as follows.

#### 6.1.19.1 Maintenance and Repair Activities and Their Objectives

There are mainly four types of activities implemented in the long period of road maintenance with different objectives. As shown in

**Table 6.1.26**, they are (1) Routine Maintenance including small scale of repair work, (2) Emergency Restoration. (3) Periodic Repair and (4) Renovation or reconstruction of road facilities. Planner of road maintenance and repair plans is requested to fully understand the differences of these works and objectives.

##### (1) Routine Maintenance and Small Repair

Routine Maintenance is the measure implemented to prevent and promptly fix deficiency or minor damages of road facilities in order to mitigate negative effects of pavement damages to road traffic and safety, thereby to maintain traffic service level of the road facility. These operations are typically small scale or simple, but widely dispersed, and require skilled or un-skilled manpower. With this, it is important to take a quick action to the pavement damages.

##### (2) Emergency Restoration

Emergency restoration is the measure implemented when road facilities are damaged by sudden incidents such as typhoons, floods, earthquakes, crashes, fires and other unexpected incidents or when there are signs of sudden damages which affect the usage safety and require prompt repair in order to ensure the smooth and safe traffic.

##### (3) Periodic Repair

Periodic repair is the measure aiming to recover road functions to the original loading capacity against damages and deterioration of road facilities, which cannot be assured by road routine maintenance. For this reason, it is often called as proactive road maintenance or rehabilitation which falls into the road asset management strategy. Periodic repair is sometimes called as medium and large repair in Viet Nam.

**(4) Renovation and Reconstruction of Road Facilities**

Renovation and reconstruction of road facilities are the measures to improve the technical condition of road transport infrastructure assets and to replace old or aged facilities. Renovation includes upgrade of pavement design, reinforcement of bridge structures against disasters, road realignment, increase in lane (Widening) and so forth. Reconstruction includes the replacement of old road facilities. These renovation and reconstruction project are in general categorized as investment project by the regulations in Viet Nam.

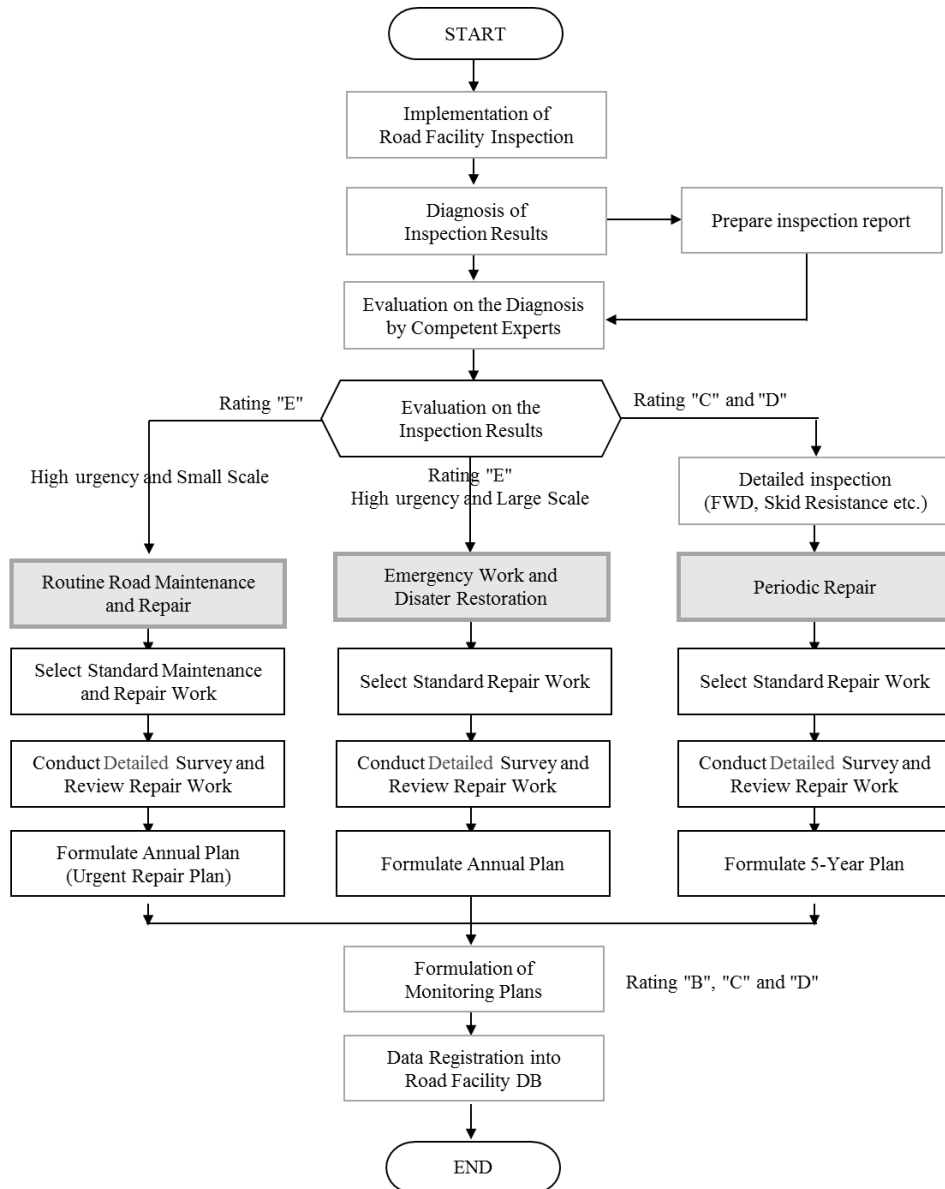
**Table 6.1.26 Maintenance and Repair Plans for Road Pavement**

No.	Maintenance and Repair Activities	Sample Works	Objectives			
			Maintain traffic serviceability/safety	Restore from Aging (Deterioration)	Increase strength	Increase capacity
1	Routine Maintenance and small Repair	<ul style="list-style-type: none"> <li>• Road facility cleaning</li> <li>• Pothole &amp; bump repair</li> </ul>	X			
2	Emergency Work	<ul style="list-style-type: none"> <li>• Disaster prevention</li> <li>• Disaster restoration</li> <li>• Urgent repair work</li> </ul>	X			
3	Periodic Repair (Medium and Large Repair)	<ul style="list-style-type: none"> <li>• Crack seal</li> <li>• Pavement overlay</li> <li>• Cut and overlay, etc.</li> <li>• Bridge waterproof</li> </ul>	X	X		
4	Renovation/ Reconstruction (Investment Project)	<ul style="list-style-type: none"> <li>• Pavement design upgrade</li> <li>• Bridge structural reinforcement</li> <li>• Road realignment</li> </ul>	X	X	X	
		<ul style="list-style-type: none"> <li>• Increase in lanes (Widening)</li> <li>• Bridge reconstruction</li> </ul>	X	X	X	X

(Note) Roles and objectives for Routine maintenance, Emergency work and Periodic Repair are defined in Circular 52.

**6.1.19.2 Key Points of Planning Procedures for Pavement Maintenance and Repair Plans**

Figure 6.1.2 shows the general procedures for the formulation of road maintenance and repair plans. As seen in the figure, road asset management shall begin with the implementation of Road Facility Inspection. Diagnosis on the results of inspection data and repair work selection shall follow successively before formulating road maintenance and repair plans. The flowchart has explained that diagnosis plays an important role as the base of formulating road routine maintenance plans and periodic repair plans.



**Figure 6.1.2 Planning Procedures of Pavement Maintenance and Repair**

**6.1.19.3 Key Points of Road Facility Inspection**

The following are the description of the types and the methods of road facility inspection. Of these inspection methods, users are in particular requested to conduct Routine Inspection and Periodic Inspection, and then conduct diagnosis on the inspection results, following the inspection and the evaluation methods shown after the inspection types.

**(1) Inspection Types**

Road facility inspection for the national roads shall fall into the following five categories; (1) initial inspection; (2) routine inspection; (3) periodic inspection, (4) emergency inspection and (5) detailed inspection. The following is the brief description for each inspection method.

**1) Initial Inspection**

Initial inspection is to survey the initial status of road facilities that are taken over from construction stage to maintenance stage. It is in general implemented before opening road facility to the public.

**2) Routine Inspection**

Routine inspection is a daily inspection done by traffic patrol staff aiming to quickly find unusual incidents and defects which may provide negative effects on the road and traffic function, thereby maintain the service level of the road.

**3) Periodic Inspection**

Periodic inspection is to regularly survey defects and deterioration of road facilities, to evaluate them in comparison with predetermined judgment criteria, to select the most suitable repair methods for the damages and to preserve data in relevant databases. Periodic inspection provides base information to the road asset management which aims to find out the most appropriate mid-term/long-term investment scenarios for road maintenance and repair works.

**4) Emergency Inspection**

Emergency inspection is generally carried out in order to supplement the above inspections and to cope with emergencies, such as unusual weather, traffic accidents and natural disasters.

**5) Detail Inspection**

Detail inspection shall be implemented aiming to further study the details of structural defects and deterioration of road facilities after periodic inspection and to specify the causes of structural defects and deterioration. It shall be also implemented to provide detail information to the designs of road repair works, including F/S, basic designs and technical designs needed for repair works.

**(2) Inspection Method**

Inspection methods are shown in the following **Table 6.1.27**.

**Table 6.1.27 Inspection Methods**

Inspection Type	Inspection Methods
Initial Inspection	<ul style="list-style-type: none"> <li>• Short-distance visual inspection</li> <li>• Hammering tests</li> <li>• Pavement condition survey vehicle</li> </ul>
Routine Inspection	<ul style="list-style-type: none"> <li>• Vehicle on-board visual inspection</li> <li>• Short-distance visual inspections</li> </ul>
Periodic Inspection	<ul style="list-style-type: none"> <li>• Pavement condition survey vehicle</li> <li>• Short-distance visual inspection</li> <li>• Hammering inspection, Crack gage, measuring tape</li> <li>• Photos</li> </ul>
Emergency Inspection	<ul style="list-style-type: none"> <li>• Short-distance visual inspection</li> <li>• Hammering inspection, Crack gage, measuring tape</li> <li>• Photos</li> </ul>

Detailed Inspection	<ul style="list-style-type: none"> <li>• Short-distance visual inspection</li> <li>• Hammering inspection, Crack gage, measuring tape</li> <li>• Photos</li> <li>• Non-destructive test equipment</li> </ul>
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(Source) Project for capacity enhancement in Road Maintenance Phase-II

### (3) Evaluation Method by ABC Rating

Pavement maintenance and repair plans is in general developed based on the evaluation data of road facility inspection conducted preliminary. In this Project, ABCDE rating shall be applied to evaluate inspection data, following the evaluation criteria shown in **Table 6.1.28**. For further details, users are requested to refer to the “Road Facility Inspection Guideline” developed in this Project.

**Table 6.1.28 ABCDE Evaluation for Inspection Data**

Rating	Evaluation Criteria	Effects on road structural function	Effects on traffic and environment	Need of further study	Measures to be taken
A	<ul style="list-style-type: none"> <li>• No damage or minor structural damages</li> </ul>	Small	-----	-----	<ul style="list-style-type: none"> <li>• No repair work</li> </ul>
B	<ul style="list-style-type: none"> <li>• Medium structural damages</li> <li>• Progress of damages is not expected within coming 5 years.</li> <li>• Repair works will be needed, but not urgent.</li> </ul>	Medium	-----	-----	<ul style="list-style-type: none"> <li>• Monitoring</li> </ul>
C	<ul style="list-style-type: none"> <li>• Medium to Heavy structural damages</li> <li>• Progress of damages is expected within coming 5 years.</li> <li>• Repair works will be needed within 5 years.</li> </ul>	Medium-large	-----	Detailed inspection	<ul style="list-style-type: none"> <li>• Periodic repair (Planned works)</li> <li>• Monitoring</li> </ul>
D	<ul style="list-style-type: none"> <li>• Heavy structural damages</li> <li>• Urgent repair work is needed.</li> </ul>	Large	-----	Detailed inspection	<ul style="list-style-type: none"> <li>• Periodic repair</li> <li>• Urgent repair</li> <li>• Monitoring</li> </ul>
E	<ul style="list-style-type: none"> <li>• Large effects on road traffic and safety and road environment are expected.</li> </ul>	-----	Large	-----	<ul style="list-style-type: none"> <li>• Routine maintenance and repair</li> </ul>

#### 6.1.19.4 Key Points of Work Selection for Pavement Maintenance and Repair Plans

Formulation of pavement maintenance and repair plans shall be done based on the results of road facility inspection as shown in **Figure 6.1.2**. Damages and deterioration evaluated as “E” shall be repaired by small repair in the routine maintenance or in the emergency work as early as possible in order to mitigate the negative effects given to the road traffic and safety. On the other hand, damages and deterioration which are evaluated as “C” or “D” shall be repaired by Periodic Repair, which is planned repair over 5 years with preferential treatment depending upon ABC rating.

In the selection of repair work, the following two-step approach is recommended in this project and shall be applied to the repair work selection. Users are therefore requested to select standard repair work first, and then to review selected repair work after conducting

detail surveys on the sites. Each of these approaches will be further discussed in the following sections.

- (1) Select standard pavement maintenance and repair work based on inspection results.
- (2) Conduct detail surveys including field observation and additional equipment surveys such as FWD, Skid Resistance Survey and so forth.

### **(1) Selection of Standard Work for Small Repair in the Routine Road Maintenance**

As discussed in the previous section, small repair in the pavement routine maintenance is the measure aiming to quickly repair damages and restore traffic serviceability and safety when damage is detected, so that priority is placed on the speed of repair. For this reason, damage area for this repair work shall be fairly limited to the spot or to the narrow range not more than 1.0m x 1.0m, whose scale is manageable by maintenance patrol staff. **Figure 6.1.3** shows standard repair work the small repair included in the routine road maintenance. ,

On the other hand, in case that damage area is larger than 1.0m x 1.0m and widespread, but is rated as “E” in the diagnosis, repair work shall be incorporated into an annual repair plan and implemented together with other repair work. In case that damage area is larger than 1.0m x 1.0m and widespread, but is rated as “C” or “D” in the diagnosis, repair work shall be incorporated into Periodic Repair Plan and implemented over 5 years with preferential treatment depending upon ABC rating.

Road asset management has explained that there are two types of pavement repair works; (1) Functional damage and (2) Structural damage as shown below. Pothole repair and bump repair which are the typical repair work for the small repair shall be functional damage which is manageable by the small repair in the routine maintenance. Functional damage is fairly light and stays at surface and binder layers.

#### **1) Functional Damage (Refer to Figure 6.1.3)**

Functional damage, which includes rutting and cracking, is not caused by the reduction of pavement strength. The damage stays at the surface layer in most of the cases. Unless appropriate repair is made immediately, the damage gradually progresses into lower layers including binder, subbase course and base course. Major functional damages include rutting, cracking and the deterioration of skid resistance. Progress of these damages often causes the deterioration of travel performance in terms of safety and driving comfort.

#### **2) Structural Damage**

Structural damage is caused by the reduction of pavement bearing capacity of base course or sub grade, so that it is necessary to consider the repair even of the base and sub grade. Damage related to, pavement structure is caused by strength deterioration under repeated loading, insufficient pavement thickness and material strength, strength deterioration in the base or sub grade due to frost heave, etc. Rutting and cracking, which are deemed as the initial stage of functional damages, may also lead to structural damage if they are left unrepaired for a long time. Structural damage is frequently induced by strength reduction in lower layers such as the base and sub grade and by the penetration of damage to lower

layers. It is necessary to select the optimal repair method based on the results of structural surveys of pavements.

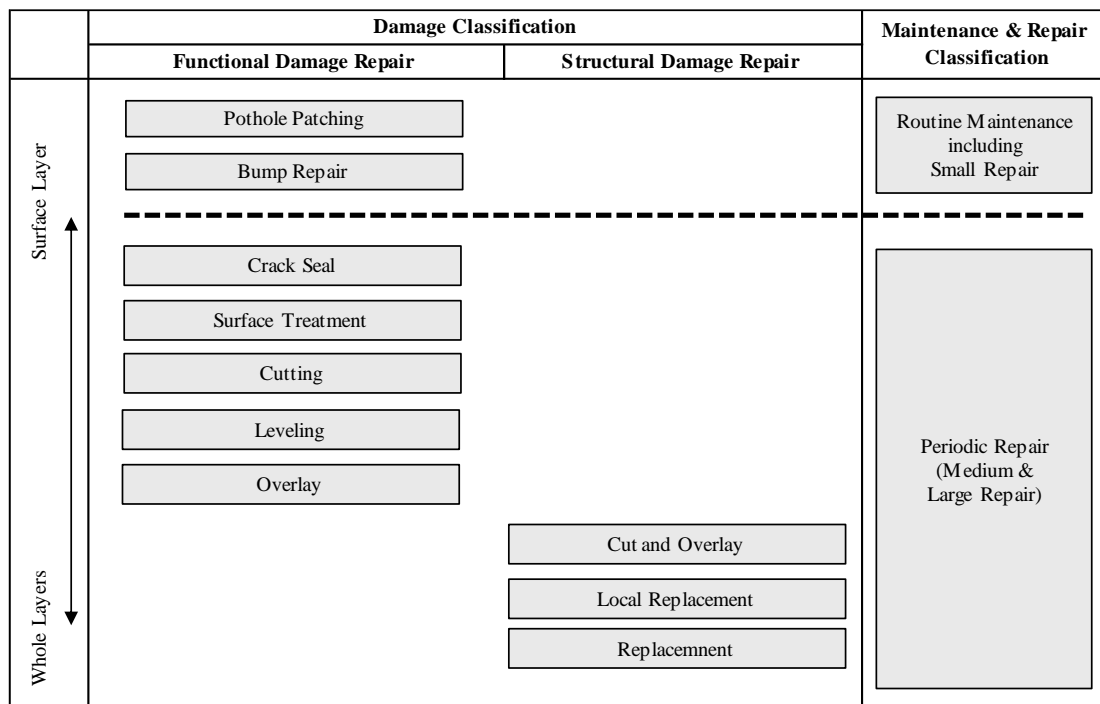


Figure 6.1.3 Pavement Repair Work Selection

(2) Selection of Standard Repair Work for Periodic Repair

Periodic repair is the measure aiming to restore damages or deterioration of road functions to the original state of loading capacity. For this reason, it is often called as proactive road maintenance or rehabilitation which falls into the road asset management strategy. (Refer to **Table 6.1.26**.)

Pavement Management System (PMS) which can formulate pavement budget plan and repair plans was developed as an activity of this Project, which is applicable to all national road systems under DRVN jurisdiction. PMS systematically forecasts future pavement deterioration based on pavement condition survey data, selects appropriate repair work to cope with future deterioration and finally formulates a 5-year pavement repair plan as a mid-term plan in the system. **Table 6.1.29** shows repair work selection criteria for AC Pavement which was developed in the PMS development in cooperation with DRVN. PMS selects repair work based on the criteria in its computation processes based on the forecasted two deterioration indexes, rut depth (mm) and crack ratio (%). In addition, **Table 6.1.30** and **Table 6.1.31** show those for BST Pavement and Concrete Pavement.

Users are requested to take either one the following ways in selecting standard repair work; (1) to refer to the pavement repair work computed and shown in the pavement repair plans formulated by PMS, or to manually apply repair work selection criteria shown below to the evaluation results of pavement damages and deterioration.

**Table 6.1.29 Repair Work Selection Criteria for AC Pavement**

Rutting Depth (mm) Crack Ratio (%)			Light defects	Medium defects		Heavy defects	
			A	B	C		D
			[0; 10)	[10; 25)	[25; 30)	[30; 40)	≥ 40
Light defects	A	[0; 10)	No Treatment Exclusive of Emergency Works	Minor Rut Repair (e.g. Hump Milling)	Overlay and Cut & Overlay	Cut Surface Course and Replacement	
Medium defects	B	[10; 20)		Minor Repair for Crack and Rut (e.g. Hump Milling + Crack Seal)		Cut Surface Course and Replacement	
		[20; 30)	Minor Crack Repair (e.g. Crack Seal, MS, TL-2000)	Cut Surface Course and Replacement			
	C	[30; 40)	Overlay and Cut & Overlay		Cut Surface Course and Replacement		
Heavy defects	D	≥ 40	Cut Surface Course and Replacement		Cut Surface Course and Replacement	Cut Surface Course and Replacement	

**Notes:**

- (1) The system support maintenance planning for pavement in terms of periodical repair.
- (2) Routine or emergency work shall be handled separately. The budget for routine maintenance shall be decided based on lump sum (ad-hoc basis).
- (3) Regarding heavily deteriorated pavements, it shall be handled as the scheme of rehabilitation or improvement. Repair works for heavy defects (Rank D) regarding RUTTING and CRACKING shown in the above table are tentatively selected for pavement repair work planning for specifying candidate repair sections. Repair works shall be designed based on the results of detailed inspection and further site verification.
- (4) Given the maintenance plans prepared by the systems, road operators are requested to finalize including site verification, further investigation (such as pavement load bearing testing) for actual implementation maintenance plans.



**Table 6.1.30 Repair Work Selection Criteria for BST Pavement**

Rutting Depth (mm)			Light defects	Medium defects		Heavy defects
			A	B	C	D
Crack Rate (%)			[0; 25)	[25; 40)	[40; 50)	≥ 50
Light defects	A	[0; 10)	No Treatment Exclusive of Emergency Works	SBST	DBST	Surface Reconstruction (TBST)
	Medium defects	B				
C		[20; 30)	SBST			
		[30; 50)	DBST			
Heavy defects	D	≥ 50	Surface Reconstruction (TBST)			

**Notes:**

- (1) The system support maintenance planning for pavement in terms of periodical repair.
- (2) Routine or emergency work shall be handled separately. The budget for routine maintenance shall be decided based on lump sum (ad-hoc basis).
- (3) Regarding heavily deteriorated pavements, it shall be handled as the scheme of rehabilitation or improvement. Repair works for heavy defects (Rank D) regarding RUTTING and CRACKING shown in the above table are tentatively selected for pavement repair work planning for specifying candidate repair sections. Repair works shall be designed based on the results of detailed inspection and further site verification. Given the maintenance plans prepared by the systems, road operators are requested to finalize including site verification, further investigation (such as pavement load bearing testing) for actual implementation maintenance plans.

**Table 6.1.31 Repair Work Selection Criteria for Concrete Pavement**

Pavement Deterioration Index				Measures
Crack Index (cm/m <sup>2</sup> )	Light defects	A	[0;30) (TBD)	No Treatment Exclusive of Emergency Works
	Medium defects	B	[30;40) (TBD)	Localized Repairs (1)
		C	[40;50) (TBD)	Localized Repairs (2)
	Heavy defects	D	≥ 50 (TBD)	Full Repair Replacement of concrete slabs

Note) TBD: setting the proper value is under discussion.

- (1) The system support maintenance planning for pavement in terms of periodical repair.
- (2) Routine or emergency work shall be handled separately. The budget for routine maintenance shall be decided based on lump sum (ad-hoc basis).
- (3) Regarding heavily deteriorated pavements (Ranking D), the system supports to identify the targeted sections with the repair work of replacement of concrete slabs. Decision on whether or not to treat foundation or subgrade shall be made based on the results of detailed inspection and further site verification.

- (4) Given the maintenance plans prepared by the systems, road operators are requested to finalize including site verification, further investigation (such as pavement load bearing testing) for actual implementation maintenance plans.
- (5) Localized repairs consisting of variety of methods such as crack sealing, patching and partial replacement that shall be decided by site verification.

#### **6.1.19.5 Key Points of Detail Survey**

Following the selection of standard repair work discussed above, users are requested to conduct detail site surveys to get local conditions for the design and the implementation of pavement repair on the sites. Detail survey may include field visual observation conducted to the damage and deterioration identified in the pavement inspection. Detail survey shall be done by competent engineers. In addition, further survey, such as FWD, skid resistance survey shall be implemented to get numerical data for designing repair work. The following are the key points of detail survey.

##### **(1) Damage Area**

The detail survey on the damage area aims to measure the scale of pavement damage spread, which shall be the base of repair work selection. If damaged area is isolated to the spots or the narrow area of less than 1.0m x 1.0m, small repair in the routine maintenance shall be basically applied. However, if damages spread wider than 1.0m x 1.0m, periodic repair with hot mixture shall be the best selection. Small repair in the routine maintenance should not be applied for this case in principle.

##### **(2) Damage Depth**

The detail survey is to know the depth of pavement damage. If damage stays within surface or binder layer (Functional damage), small repair in the routine maintenance shall be basically applied to repair damages. However, if the damage depth reaches to the road bed, small repair in the routine maintenance is no longer effective to this damage, but periodic repair shall be applied.

##### **(3) Damage Type**

The detail survey on the damage type is also an important element. If a pothole or a bump is observed on the sites, small repair in the routine maintenance can be basically applicable, but if cracks or rutting is observed, small repair is no longer effective and periodic repair shall be the best selection for this case.

##### **(4) Possibility of water bleeding from road bed**

Detail survey on the potential of water bleeding from road bed is important element. If there observed water bleeding from road subgrade, it often causes serious damages to the pavements such as Crocodile Cracks etc. and gives serious negative impacts on the lifecycle of the pavement due to insufficient bearing capacity of subgrade, base course or subbase course. If water bleeding is observed, periodic repair shall be basically applied to the damages and replacement of damages with hot mix shall be the best solution for this case including subgrade, base course or subbase of pavement. Implementation of FWD survey is recommended to design the depth of replacement.

**(5) Possibility of Surface Water infiltration**

Water infiltration into pavement cracks and pavement construction joints often gives serious damages to road subgrade, base course and subbase course and shortens pavement lifecycle. Water infiltration also occurs when pavement damaged area is depressed in height, causing water concentration to the repair section. To cope with this, it is important to apply water sealing by asphalt emulsion to any cracks created by the small repair in the routine maintenance and by periodic repair.

**(6) Traffic Volume**

Detail survey on the traffic volume is also an important element to select pavement repair materials, in particular for the small repair in the routine maintenance. Cold mix is in principle applied to the small repair. Cold mix which in general takes time to get initial strength is subjective to traffic load which often causes the fluidization of asphalt material and the separation of asphalt component. Best solution for the pavement repair work under heavy traffic condition is to apply hot mix, or to apply cold mix to the limited area less than 1.0 square meters (1.0 meter X 1.0 meter).

**(7) Emergency Repair until Full Repair**

There are special cases in which road operator should implement emergency repair with cold mix until full recovery by periodic repair. This may often occur when traffic serviceability or safety is degraded due to pavement damages and thus urgent repair is needed in particular under the heavy traffic condition in the urban area. However, it should be noted that temporary treatment by cold mix becomes feasible with understanding that performance of this measure becomes fairly degraded and temporal until periodic repair. For this reason, it is not appropriate to apply performance acceptance criteria (such as IRI) to this case. As an alternative measurement for the payment, dimension measurement of the completed shape is in general applied.

**(8) Repair Work Method**

When doing periodic repair work on the sites, square-cut of damaged area by pavement cutting machine shall be done first in order to ensure uniformity of repair thickness and of compaction effect. However, damage repair without square-cutting shall be also applicable to shorten traffic control time in particular for the small repair in the routine road maintenance. For this case, it is important to understand that degradation of performance may occur as already discussed in the previous section.

**6.1.19.6 Flow Chart for Repair Work Selection**

Based on the key points identifies in the pavement pilot project implementation, the Project finally developed flow chart shown in **Figure 6.1.4** for the selection of pavement repair work. Users can apply this flow chart to select small repair work in the routine maintenance and periodic repair.

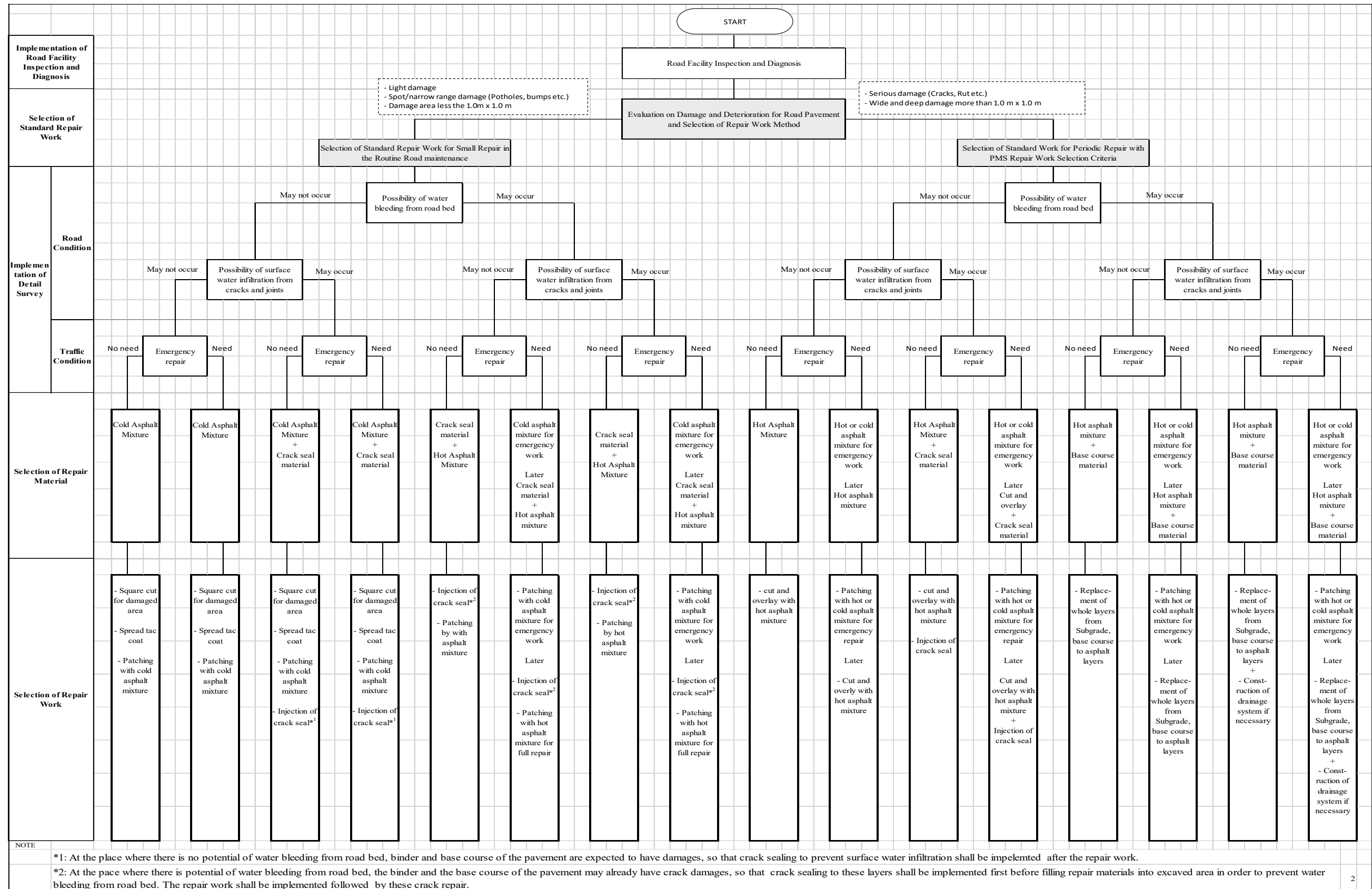


Figure 6.1.4 Repair Work Selection Flowchart

#### **6.1.20 Standardization of Pavement and Bridge Repair Work**

Based on the results of pilot pavement and bridge repair project, the Project has developed recommendations on the implementation of road facility inspection, work selection, material selection and work selection for the pavement and bridge repair in road routine maintenance and periodic repair including a flowchart for repair work selection. These recommendations can provide important information to the development and upgrading of technical standards, manuals, guidelines for routine maintenance and periodic repair.

Also, the Project has developed work specification for crack seal technology, pothole repair technology and bridge water proof technology for the implementation of routine maintenance and periodic repair work. Work specification can also be incorporated into contract documents to give the implementation guidelines on these technologies to the maintenance and repair work contractors.

#### **6.1.21 Conclusion and Recommendation**

As one of the Major-3 activities, the Project conducted a pilot pavement and bridge repair project in cooperation with DRVN WG2, setting two objectives. The first objective is to examine all procedures from inspection, repair material selection, repair work selection, repair method selection, monitoring and the evaluation of work performance for road pavement and bridge repair work. The second objective is to support the development of technical standards for pavement and bridge repair technology based on the results of this pilot project.

In the Project, JICA Project Team developed a pilot project implementation plan which selected three repair technologies including a crack seal, a pothole repair and a bridge waterproof technology and purchased pavement and bridge repair materials, which include cold asphalt mixture and bridge waterproof material, and imported them to Viet Nam from Japan. On the other hand, DRVN conducted design and repair work in the field in April 2017 by applying work contracts with private companies.

This Report is the Draft Final Report which summarized the findings obtained in the pilot project based on the monitoring survey conducted for the past 5 months after the implementation of pilot project. The Report also developed recommendations on the key elements in planning pavement and bridge facility inspection, repair material selection, repair work selection, repair method selection, monitoring and the evaluation of work performance for road pavement and bridge repair work. At the last end, the Project has also developed a flowchart that can be used in the planning of pavement repair work.

DRVN is recommended to fully utilize this Report and recommendations in the planning of pilot pavement and bridge repair projects and in developing and upgrading technical standards.

## **6.2 ROAD FACILITY INSPECTION GUIDELINE**

### **6.2.1 Introduction**

The Project has developed the Road Facility Inspection Guideline for the national road maintenance and management under the jurisdiction of DRVN. The details of the Guideline are shown in “Volume-2: Technical Manuals and Guideline of Final Report”.

### **6.2.2 Scope of Applications**

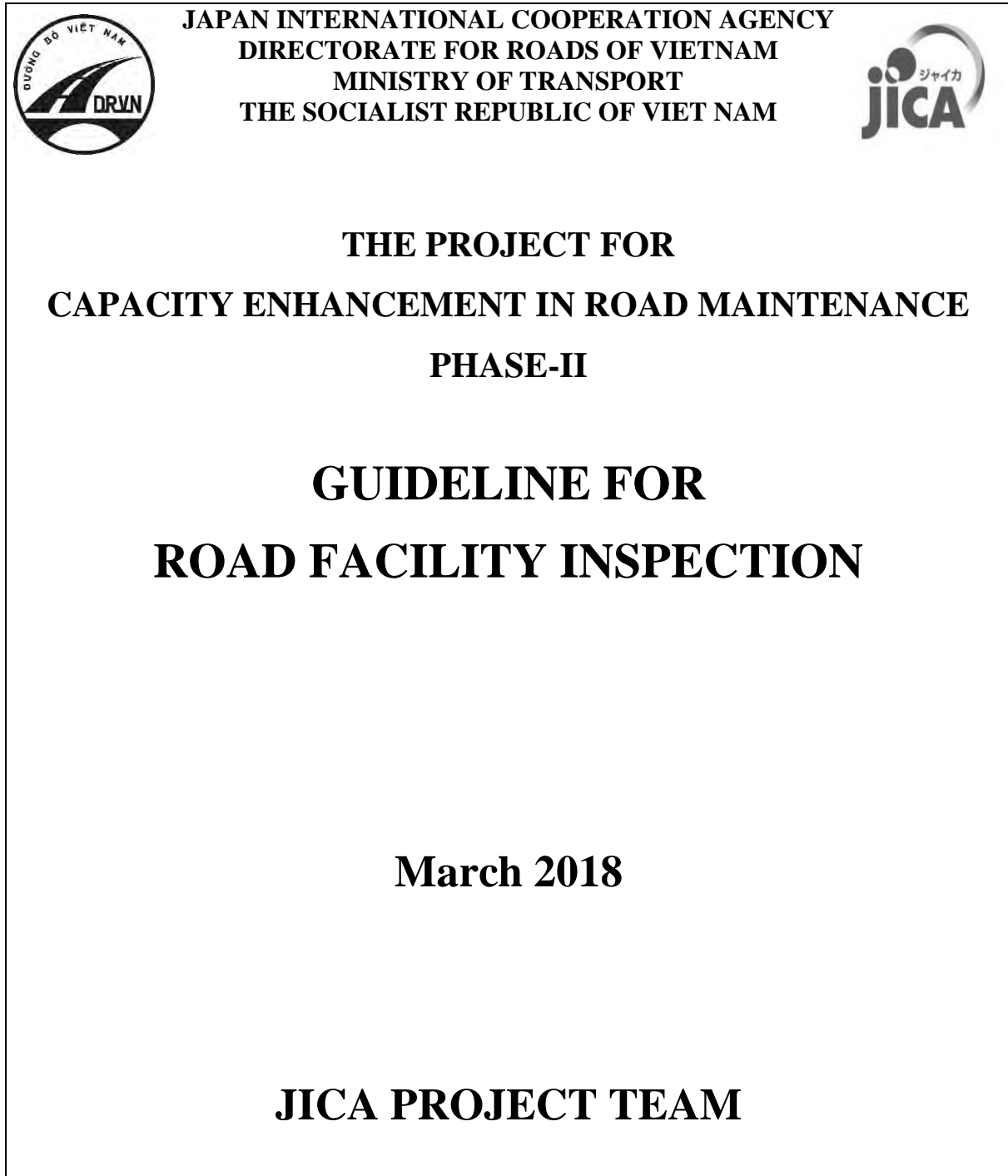
- (1) Guideline for Road Facility Inspection is a reference material aiming to provide information on the inspection procedures to the DRVN, RMBs and SBs staff currently involved in the road maintenance and management activities in the field.
- (2) The Guideline can also be referred to the revision of the Standards of Road Routine Maintenance (TCCS, 2012/TCDBVN) currently applied to the routine maintenance of the national roads.
- (3) This Guideline regulates road facility inspection procedures for the national roads under the jurisdiction of DRVN and Provincial People’s Committees.
- (4) This Guideline does not apply to the facility inspection for expressways, local roads from provincial level and below, and roads managed by BOT scheme.
- (5) The Guideline stipulates information on road facility inspection which includes inspection facilities, classification, devices, frequencies, schedule, safety assurance during inspection, evaluation on the inspection results and recording of inspection results and reporting.
- (6) In formulating maintenance and repair plans based on the evaluation results of road facility inspection, users can also refer to the Road Maintenance Manual which was also developed in this JICA Project. .
- (7) Responsibility assignment for management, supervision and implementation of road facility inspection shall be regulated by DRVN decisions separately.
- (8) This Guideline covers road facility inspections including those for Road Slopes, Drainage Systems, Retaining Walls, Road Pavements, Tunnels, Box Culverts, Pipe Culverts, Traffic Safety Facilities and Traffic Management Facilities.
- (9) This Guideline can also be applied as a reference material to the Bridge Inspection Guideline (VBMS) developed in conjunction with VBMS development and promulgated by DRVN separately. This Road Facility Inspection Guideline can supplement the Bridge Inspection Guideline (VBMS), in particular to the points not clearly defined in the Bridge Inspection Guideline (VBMS).
- (10) For road facilities whose inspection guidelines are not stipulated in this Guideline, managing agencies for road facility inspection shall develop Inspection Guidelines from those for the

similar facilities regulated in this Guideline.

- (11) The articles of this Guideline is to be applied prior to those in the Standards of Road Routine Maintenance (TCCS, 2012/TCDBVN), if there is any overlap in information relevant to road facility inspection.

### **6.2.3 Cover Sheet**

The following shows the cover sheet for the Road Facility Inspection Guideline.



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## **6.3 ROAD ROUTINE MAINTENANCE MANUAL**

### **6.3.1 Introduction**

The Project has developed the Road Routine Maintenance Manual for the national road maintenance and management under the jurisdiction of DRVN. The details of the Manual are shown in “Volume-2: Technical Manuals and Guideline of Final Report”.

### **6.3.2 Scope of Applications**

- (1) This manual regulates technical requirements and provides some guidelines on management and implementation of routine maintenance of roads managed by Central and Local agencies.
- (2) This manual does not target all types of roads nationwide. Its main content represents technology of road routine maintenance for ordinary road networks (except for expressways) which is under the management of central and local authorities.

### **6.3.3 Cover Sheet**

The following shows the cover sheet for the Road Routine Maintenance Manual.



**JAPAN INTERNATIONAL COOPERATION AGENCY  
DIRECTORATE FOR ROADS OF VIETNAM  
MINISTRY OF TRANSPORT (MOT)  
THE SOCIALIST REPUBLIC OF VIETNAM**



**THE PROJECT  
FOR CAPACITY ENHANCEMENT IN ROAD  
MAINTENANCE IN THE  
SOCIALIST REPUBLIC  
OF VIETNAM**

**ROAD ROUTINE MAINTENANCE  
MANUAL**

**March 2018**

**JICA Project Team**

### 6.3.4 Contents List

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## 6.4 EXPRESSWAY MAINTENANCE MANUAL

### 6.4.1 Introduction

The Project has developed the Expressway Maintenance Manual for the expressway maintenance and management under the jurisdiction of DRVN. The details of the Manual are shown in “Volume-2: Technical Manuals and Guideline of Final Report”.

### 6.4.2 Scope of Applications

(12) Guideline for Road Facility Inspection is a reference material aiming to provide information on

the inspection procedures to the DRVN, RMBs and SBs staff currently involved in the road maintenance and management activities in the field.

- (13) The Guideline can also be referred to the revision of the Standards of Road Routine Maintenance (TCCS, 2012/TCDBVN) currently applied to the routine maintenance of the national roads.
- (14) This Guideline regulates road facility inspection procedures for the national roads under the jurisdiction of DRVN and Provincial People's Committees.
- (15) This Guideline does not apply to the facility inspection for expressways, local roads from provincial level and below, and roads managed by BOT scheme.
- (16) The Guideline stipulates information on road facility inspection which includes inspection facilities, classification, devices, frequencies, schedule, safety assurance during inspection, evaluation on the inspection results and recording of inspection results and reporting.
- (17) In formulating maintenance and repair plans based on the evaluation results of road facility inspection, users can also refer to the Road Maintenance Manual which was also developed in this JICA Project. .
- (18) Responsibility assignment for management, supervision and implementation of road facility inspection shall be regulated by DRVN decisions separately.
- (19) This Guideline covers road facility inspections including those for Road Slopes, Drainage Systems, Retaining Walls, Road Pavements, Tunnels, Box Culverts, Pipe Culverts, Traffic Safety Facilities and Traffic Management Facilities.
- (20) This Guideline can also be applied as a reference material to the Bridge Inspection Guideline (VBMS) developed in conjunction with VBMS development and promulgated by DRVN separately. This Road Facility Inspection Guideline can supplement the Bridge Inspection Guideline (VBMS), in particular to the points not clearly defined in the Bridge Inspection Guideline (VBMS).
- (21) For road facilities whose inspection guidelines are not stipulated in this Guideline, managing agencies for road facility inspection shall develop Inspection Guidelines from those for the similar facilities regulated in this Guideline.
- (22) The articles of this Guideline is to be applied prior to those in the Standards of Road Routine Maintenance (TCCS, 2012/TCDBVN), if there is any overlap in information relevant to road facility inspection.

### **6.4.3 Cover Sheet**

The following shows the cover sheet for the Expressway maintenance Manual.



**JAPAN INTERNATIONAL COOPERATION AGENCY  
DIRECTORATE FOR ROADS OF VIETNAM  
MINISTRY OF TRANSPORT  
THE SOCIALIST REPUBLIC OF VIET NAM**



**THE PROJECT FOR  
CAPACITY ENHANCEMENT IN ROAD MAINTENANCE  
PHASE-II**

**EXPRESSWAY MAINTENANCE MANUAL**

March 2018

**JICA PROJECT TEAM**

#### 6.4.4 Contents List

The following shows the table of contents for the Expressway Maintenance Manual.

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**6.5 TECHNICAL SPECIFICATIONS FOR PAVEMENT AND BRIDGE REPAIR WORK**

**6.5.1 Technical Specifications for Crack Repair Work**

**6.5.1.1 Definition**

To be specified by DRVN

Crack repair work by crack sealant shall be carried out, following the specifications shown below.

**6.5.1.2 Reference Standards**

The following quoted documents are necessary for the application of this specification.

- Specifications of Road Routine Maintenance, TCCS 2012

This specification shall be preferentially applied to the articles from 5.4.3.3 to 5.4.3.6 of the above Specifications of Road Routine Maintenance, TCCS 2012.

**6.5.1.3 Scope of Application**

This specification should be applied for routine maintenance/periodic maintenance work on National road in Vietnam which is falling under the jurisdiction of DRVN/MOT.

**6.5.1.4 Materials**

The crack sealant is specified as hot applied asphalt type material.

The working temperature, such as heating temperature and pouring temperature shall be followed by supplier’s instruction

Primer shall be used if the chosen sealant required these material for preparation

Item	Unit
Crack Sealant	Cartons
Primer	Bucket
Curing Sand	Bucket

**Specification for Crack sealing material**

Item	Specifications	Test Method
Penetration@25°C(Cone needle)	mm	6 or less
Softening Point	°C	100 and more
Viscosity@200°C	mPa·s	Report
Density@15°C	%	Report
Bending Workload	kPa	700 and more
Bending Stiffness	MPa	30 or less
Stickiness@60°C	wt%	5 or less
		*1



### 6.5.1.5 Test method for stickiness@60°C

- (1) Apply primer on the deck slab
- (2) After applied primer become completely dried, apply crack sealant on the primer with size of 40mm\*60mm\*3mm, cure it in the 60°C
- (3) Spray lime stone powder with heated at 60°C on the applied sealant, and take off excess
- (4) Set Flat rubber seat which has 1mm thick with 60°C on the testing material, then set waved shaped rubber seat which has 10mm thick with 60°C on the flat rubber seat
- (5) Using wheel tracking test machine, track on the test sample with traverse with the condition as per listed;
  - Test time: 15 minutes
  - Test temperature: 60degree Celsius
  - Test weight: 700N
  - Test speed (Tracking speed): 21 reciprocating motion/minutes
  - Test speed (Traverse speed): 10cm/minutes
- (6) After test is finished, check the weight of testing material stick to the flat rubber sheet [Stickiness (%) = material weight which stick to the flat sheet / (volume of testing material\*density)\*100]

### 6.5.1.6 Equipment

The following equipment shall be prepared by the contractor.

Item	Unit	Note
Melting Equipment	Unit	To heat and melt the sealant
Crack Sealer	Unit	To pour sealant into cracks
Burner Head	Units	To heat and melt the sealant
Dipper	Units	To carry melted sealant
Large Scraper	Units	To clean the cracks
Small Scraper	Units	To clean the cracks
Brush for Primer	Units	To apply primer
Large Steel Bucket	Units	To carry melted sealant
Small Bucket for Primer	Units	To apply primer
Steel Kettle	Units	To pour sealant into cracks
Propane Gas Tank	Units	To heat and melt the sealant
Regulator for Propane Gas	Units	To heat and melt the sealant

### 6.5.1.7 Construction Requirements

#### (1) Weather Condition

Work implementation of crack repair work shall be applied to dried condition of pavement. When rain falls during the work, the work shall stop immediately

**(2) Cleaning**

- Repair work area shall be completely dried along with inside cracks.
- Clean dirt and waste inside the cracks and surroundings

**(3) Application of primer**

- Brush or spray primer uniformly on the pavement surface, inside the cracks and 2 cm around the cracks.
- Apply primer with the volume of 0.2 L/m<sup>2</sup>
- Primer must apply uniformly, be careful with not apply too thick or too thin
- Primer is flammable, so that fire is not allowed near the primer
- After confirmed that applied primer is completely dried, application for crack sealing can be done.

**(4) Applying crack sealant**

- Crack sealant shall be heated indirectly by means of melting device
- Clean inside melting device and avoid mixing with other materials
- Maximum heating temperature shall be not more than 240 degree C
- Stir well during heating and partial heating is not allowed
- Use up heated crack sealant in a day. Repeated heating of crack sealant which may deteriorate material quality is not allowed.
- The remained material which heated and used at last site can be used for the crack sealing for basement, such as sealing for base course and binder course, not for surface course

**(5) Crack Sealing**

- Clean the device and do not mix with other material
- Pouring temperature shall be 180 degree C or over.
- Once temperature of pouring sealant become lower than ideal temperature, stop pouring and take the sealant back to the melting device. Then, seal hot sealant into the crack
- Crack sealing is carried out with about 2 mm in thickness.

**(6) Curing**

- Spray curing sand on the sealant with 0.4 kilograms per square meters.

**(7) Open traffic**

Repair sections with crack sealant shall be opened to traffic, after temperature of the sealed material goes down under 60 degrees in Centigrade.

**(8) Storage**

Crack sealant material which is flammable and poisonous shall be stored with care in a dry room.

### 6.5.1.8 Measurement and Payment

#### (1) Measurement

Measurement of the crack repair work shall be the length of cracks (m) repaired and accepted in accordance with the contract documents.

However, Crack width which will be implemented by Crack Sealant based on this specification should be less than and equal to 2cm. Contractor should propose alternative measurement and payment if crack width is more than 2cm.

#### (2) Payment

Payment of the crack repair work shall be made, applying a contracted unit price to the measured length of the crack repair work. The contracted unit price shall include all necessary costs for the implementation of crack repair works.

Pay Item	Description	Unit
	Crack Repair Work	m

### 6.5.2 Technical Specifications for Pothole Repair Work-I (Shallow hole)

#### 6.5.2.1 Definition

To be specified by DRVN

Pothole repair work-I (Shallow hole) by cold asphalt patching mix shall be carried out, following the specifications shown below.

#### 6.5.2.2 Reference Standards

The following quoted documents are necessary for the application of this specifications.

- Specifications of Road Routine Maintenance, TCCS 2012

This specification shall be preferentially applied to the articles from 5.4.3.3 to 5.4.3.6 of the above Specifications of Road Routine Maintenance, TCCS 2012.

#### 6.5.2.3 Scope of Application

This specification should be applied for routine maintenance/periodic maintenance work on National road in Vietnam which is falling under the jurisdiction of DRVN/MOT.

#### 6.5.2.4 Repair Materials

Repair material for shallow pot hole shall be used cold asphalt bump repair mixture which is composed asphalt related binding material and fine aggregate

Rubber modified asphalt emulsion shall be use for tack coat for tighter binding between base and patching material.

Materials	Unit
Cold Asphalt Bump Repair Mix	Cartons
Rubber Modified Tack Coat	Bucket
Curing Sand	Buckets

**Specifications for Pothole pair (shallow hole) material**

Item		Specifications		Test Method
Properties Before Hardening	Setting Time	@10°C	min	2 and more
		@20°C	min	2 and more
	Curing Time	@10°C	min	30 or less
		@20°C	min	30 or less
				ASTM D 217

Item		Specifications	Test Method
Properties After Hardening	Marshall Stability	kN	2.5 and more
	Flow value	1/100cm	30 – 60
	Adhesion with Concrete deck	MPa	0.6 and more
	Adhesion with Asphalt deck	MPa	0.6 and more
			Guideline for Simple Pavement
			Testing Method for former Ministry of Construction

		Passing Sieve WT%				Test Method
Sieve Size	2.36mm	600 μ m	300 μ m	150 μ m	75 μ m	Handbook for pavement survey and test method (Japan Road Association)
Specification	100	50 - 70	35 - 55	25 - 40	5 - 15	

**6.5.2.5 Repair Equipment**

The following equipment shall be prepared by contractor.

Equipment	Unit	Note
Trowel	Units	To apply the cold mix
Large Scraper	Units	To clean the application area
Small Scraper	Units	To clean the application area
Small Bucket for tack Coat	Units	To apply tack coat
Brush for Tack Coat	Units	To apply tack coat
Large Plastic Bucket	Units	To clean the equipment
Water Tank and Water	Units	To clean the equipment

**6.5.2.6 Construction Requirements**

**(1) Weather Condition**

Work implementation of Pothole repair work-I (Shallow hole) shall be preferably applied to dried condition of pavement, but can also be applied to wet condition of pavement.

**(2) Digging**

Dig till the bottom of damaged area in cutting area.

**(3) Cleaning**

Clean dirt and waste inside the pothole and surroundings

**(4) Application of tack coat**

- Brush tack coat uniformly on the pavement surface.
- Apply tack coat with the volume of 0.4 L/m<sup>2</sup>

**(5) Mixing of materials**

- Place dry, cool and shade place for better workability at application site
- Preliminary mix both aggregate and emulsion separately
- Add water into emulsion up to 100cc/set if the workability is not good
- Mix aggregate and emulsion in the aggregate bag quickly about 10-15sec.

**(6) Filling and compaction**

- Fill mixed materials into repair area.
- Level mixed material promptly by trowel
- Use coarse graded material on the basement for deeper bump more than 3cm

**(7) Curing**

- Spray curing sand on the application area framed by curing tape with 0.4 kilograms per square meters.
- Tear off curing tape before the material completely hardened

**(8) Open traffic**

Repair sections shall be opened to traffic, after confirming that emulsion has broken and the color faded into black

**(9) Storage**

Pothole repair material shall be stored in a cool and dry room.

**6.5.2.7 Measurement and Payment**

**(1) Measurement**

Measurement of Pothole repair work-I (Shallow hole) shall be the number of area (square meters) of bump repaired and accepted in accordance with contract documents.

**(2) Payment**

Payment of Pothole repair work-I (Shallow hole) shall be made, applying a contracted unit price to the measured area of Pothole repair work-I (Shallow hole). The contracted unit price shall include all necessary costs for the implementation of bump repair work including traffic control during Pothole repair work-I (Shallow hole).

Pay Item	Description	Unit
	Pothole repair work-I (Shallow hole)	m <sup>2</sup>

**6.5.3 Technical Specifications for Pothole Repair Work-II (Deep Hole)**

**6.5.3.1 Definition**

To be specified by DRVN

Pothole repair work-II (Deep Hole) by cold asphalt patching mix shall be carried out, following the specifications shown below.

**6.5.3.2 Reference Standards**

The following quoted documents are necessary for the application of this specifications.

- Specifications of Road Routine Maintenance, TCCS 2012

This specification shall be preferentially applied to the articles from 5.4.3.3 to 5.4.3.6 of the above Specifications of Road Routine Maintenance, TCCS 2012.

**6.5.3.3 Scope of Application**

This specification should be applied for routine maintenance/periodic maintenance work on National road in Vietnam which is falling under the jurisdiction of DRVN/MOT.

**6.5.3.4 Repair Materials**

Repair material for deep pot hole shall be used cold asphalt patching mixture which is composed asphalt related binding material, coarse aggregate, fine aggregate

Rubber modified asphalt emulsion shall be use for tack coat for tighter binding between base and patching material.

Materials	Unit
Cold Asphalt Patching Mix	Bags
Rubber Modified Tack Coat	Bucket
Curing Sand	Bucket

**Specifications for Pothole repair (Deep hole) material**

Item	Specifications	Test Method
Density Mm	Report	Handbook for pavement survey and test method (Japan Road Association)
Marshall Stability@20°C °C	1.0 and more	
Cantabro Ross@5°C mPa·s	5.0 or less	

Sieve Size	Passing Sieve WT%							Test Method
	13.2mm	4.75mm	2.36mm	600 μ m	300 μ m	150 μ m	75 μ m	
Specification	100	87 - 100	18 - 35	10 - 21	6 - 14	3 - 10	1 - 8	Handbook for pavement survey and test method (Japan Road Association)

**6.5.3.5 Repair Equipment**

The following equipment shall be prepared by contractor.

Equipment	Unit	Note
Manual Tamper	Unit	To compact the mixture
Large Scraper	Units	To clean the potholes
Small Scraper	Units	To clean the potholes
Small Bucket for Tack Coat	Units	To apply tack coat
Brush for Tack Coat	Units	To apply tack coat
Large Plastic Bucket	Unit	To clean the equipment
Water Tank and Water	Units	To clean the equipment
Shovel	Units	To apply the cold mix
Plate Compactor	Unit	To compact the cold mix

**6.5.3.6 Construction Requirements**

**(1) Weather Condition**

Work implementation of Pothole repair work-II (Deep hole) shall be preferably applied to the dried condition of pavement. Pothole repair work-II is applicable under rainy weather and wet pavement condition for emergency cases.

**(2) Cutting**

Cut in square shape by cutting machine on damaged area.

**(3) Digging**

Dig till the bottom of damaged area in cutting area.

**(4) Cleaning**

Clean dirt and waste inside the pothole and surroundings

**(5) Application of tack coat**

- Brush tack coat uniformly on the pavement surface.
- Apply tack coat with the volume of 0.4 liters per square meters

**(6) Filling and compaction**

- Fill patching materials into pothole using scraper, dividing into few layers with 3 cm in maximum thickness each layer.
- Compact pothole materials for each layer
- Fill and compact the pothole, heaping up the volume equivalent to about 20 percent of the depth.
- Use of oil should not be applied to get workability, but spray water at compaction.
- Cold asphalt patching mix contains flammable material, so that fire is not allowed near the material.

**(7) Curing**

Spray curing sand on the application area with 0.4 kilograms per square meters.

**(8) Open traffic**

Open traffic after confirmed well compaction.

Repair sections shall be opened to traffic, after confirming that the material is well compacted.

**(9) Storage**

Pothole repair material shall be stored with care in a dry room, piling up less than 10 bags on the material. Pothole repair material shall be used up immediately, when opening the bag.

**6.5.3.7 Measurement and Payment**

**(1) Measurement**

Measurement of Pothole repair work-II (Deep hole) shall be the number of square meters of potholes repaired and accepted in accordance with contract documents.

**(2) Payment**

Payment of Pothole repair work-II (Deep hole) shall be made, applying a contracted unit price to the measured area of pothole repair work. The contracted unit price shall include all necessary costs for the implementation of pothole repair work including traffic control during pothole repair work.

Pay Item	Description	Unit
	Pothole repair work-II (Deep hole)	m <sup>2</sup>



## 6.5.4 Technical Specifications for Bridge waterproof work

### 6.5.4.1 Description

To be specified by DRVN

### 6.5.4.2 Reference Standards

The following quoted documents are necessary for the application of this specifications.

- Specifications of Road Routine Maintenance, TCCS 2012

This specification shall be preferentially applied to the articles from 5.4.3.3 to 5.4.3.6 of the above Specifications of Road Routine Maintenance, TCCS 2012.

### 6.5.4.3 Scope of Application

This specification should be applied for routine maintenance/periodic maintenance work on National road in Vietnam which is falling under the jurisdiction of DRVN/MOT.

### 6.5.4.4 Waterproof Material

- Waterproof materials composed Primer, Waterproof membrane, Silica sand, Formed joint sealant, and Drainage pipe.
- Primer is solvent based asphalt liquid. It penetrates into deck slab and has well adhesion with both deck slab and waterproof membrane
- Waterproof membrane is hot applied asphalt type membrane. Apply with heat and has well adhesion with both primer and paving hot mixture
- Silica sand for curing requires dried well graded sand which is not too fine, not too course
- Formed joint sealant requires not only the property of joint sealant but also formed shape for well workability
- Drainage pipe requires both flexibility to follow the deck surface, and rigidity to hold the paving.

Materials	Unit
Primer	Bucket
Waterproof Membrane	Carton
Curing Sand	Bag
Formed Joint Sealant	Roll
Drainage Pipe	Roll

Specification for primer for waterproof (Concrete deck)

Item	Specifications	Test Method
Set to Touch@20°C	min 60 and more	JIS K 5600-1-1
Evaporation residue	% 20 and more	JIS K 6833
Workability	Pass	JIS K 5600-1-1
Durability for water	Pass	JIS K 5600-6-1

Specification for primer for waterproof (Steel deck)

Item	Specifications	Test Method
Set to Touch@20°C min	60 and more	JIS K 5600-1-1
Evaporation residue %	50 and more	JIS K 6833
Workability	Pass	JIS K 5600-1-1
Durability for water	Pass	JIS K 5600-6-1

Specification for waterproof membrane

Item	Specifications	Test Method
Penetration@25°C mm	1 – 5	Handbook for pavement survey and test method (Japan Road Association)
Softening Point °C	80 and more	JIS K 2207
Tensile Strength@23°C N/mm <sup>2</sup>	0.35 and more	JIS A 6021
Elongation rate at breaking %	300 and more	
Durability at alkalinity@23°C mm	No trouble	JIS K 5600-6-1
Durability at salt water@23°C mm	No trouble	
Anti-stickiness@60°C	Not stick	Manual for waterproof on road bridge (Japan Road Association)

Specification for Formed Joint Sealant

Item	Specifications	Test Method
Penetration@25°C (Cone needle) mm	6 or less	Handbook for pavement survey and test method (Japan Road Association)
Flow@60°C, 75degree, 5hrs mm	5 or less	
Tensile Value@-10°C mm	3 and more	

6.5.4.5 Waterproof Equipment

The following equipment shall be prepared by contractor

Item	Unit	Note
Melting device	Unit	To heat and melt waterproof material
Dipper	Unit	To carry melted waterproof
Scraper	Unit	To clean the deck slab
Brush for primer	Unit	To apply primer
Waterproof brush(L)	Unit	To apply waterproof
Waterproof brush(M)	Unit	To apply waterproof
Waterproof brush(S)	Unit	To apply waterproof
Water content meter	Unit	To check water content on deck slab
Large steel bucket	Unit	To carry heated waterproof
Roller brush	Unit	To apply primer
Glove	Unit	To protect hands from heat
Wheel barrow	Unit	To spray curing sand

6.5.4.6 Construction Requirements

The objectives of pilot pavement and bridge repair project are as follows;

(1) Weather condition

- Work implementation of waterproof work shall be applied to dried condition.

- When rain falls during the work, the work shall stop immediately.

**(2) Milling**

Eliminate existing asphalt pavement and waterproof completely.

**(3) Digging drainage hole**

If the application deck slab does not have any drainage hole, drill the slab and make drainage hole for water drainage

**(4) Cleaning**

Clean dirt and waste inside the application area.

**(5) Dust blow out**

Blow out dust and waste inside the application area.

**(6) Drying**

Dry application area and surroundings completely

**(7) Heating waterproof membrane**

- Start heating waterproof membrane.
- Waterproof membrane shall be heated indirectly by proper melting device
- Clean inside melting device and avoid mixing with other material
- Maximum heating temperature shall be not more than 270degree Celsius
- Stir well during heating, and partial heating is not allowed
- Use up heated waterproof membrane in a day. Repeated heating of waterproof membrane which may deteriorates material quality is not allowed

**(8) Checking water content**

- Check the water content of bridge deck slab by high frequency water content meter
- Waterproof application shall be done while the water content of the bridge deck slab is below 10%
- If the water content is more than 10%, dry the bridge deck slab by burner or other materials until the content become less than 10%

**(9) Application of primer**

- Brush primer uniformly on the application area which is bridge deck slab surface and balustrade
- Apply primer which volume is 0.4liter/m<sup>2</sup>
- Primer is flammable, so that fire is not allowed near the material
- After apply on the deck slab, wait until the primer id completely dried

**(10) Application of waterproof membrane**

- After confirmation the primer is completely dried, apply waterproof membrane
- Confirm the temperature of waterproof material is 270degree Celsius
- Using steel bucket, carry hot melt material from the melting device to application spot
- Apply waterproof material with the volume of 1.5kilogram/m<sup>2</sup> for repaired concrete deck slab, 1.2kilogram/m<sup>2</sup> for new construction concrete deck slab, 1.0kilogram/m<sup>2</sup> for steel deck.
- Spread hot melt material on the bridge deck surface by dipper and pull it by waterproof brush uniformly while it is hot
- Apply waterproof material not only on the surface but also the edge
- Apply waterproof membrane uniformly and seamless

**(11) Application of curing sand**

- Spray curing sand uniformly by shovel or hand on surface of waterproof membrane
- Apply curing sand with the volume of 0.7kilogram/m<sup>2</sup>

**(12) Application of formed joint sealant**

- Stick formed joint sealant on the balustrade
- Stick the same height with the design height of asphalt pavement

**(13) Application of drainage pipe**

- Place drainage pipe on the edge of deck slab and balustrade
- Connect to drainage holes, catch basin and expansion joint, and make sure that the water runs into the pipe and drain out from drainage hole, catch basin and expansion joint

**(14) Pave hot asphalt mixture**

- No need to apply tack coat on the waterproof membrane
- Mixture design for the paving material shall be dense graded
- Construction vehicles which run on the waterproof membrane must clean their tire. Tire stick with asphalt material shall cause of deterioration of waterproof membrane
- Paver shall be the wheel type or rubber crawler type, and avoid steel crawler type to protect waterproof membrane
- Asphalt carrying truck must not stay on the waterproof membrane. Once the truck dumps Construction vehicles must not turn their steering wheel on the waterproof membrane
- Paving with care the formed joint sealant and drainage pipe placed on the edge

**(15) Open traffic**

Application section with bridge deck waterproof shall be opened to traffic, after paving is done and its temperature goes down below 60°C

**(16) Storage**

Some of waterproof materials are flammable and poisonous shall be stored with care in a dry room

**6.5.4.7 Measurement and Payment**

**(1) Measurement**

Measurement of the Bridge Waterproof work shall be the area of bridge deck and accepted in accordance with the contract document

**(2) Payment**

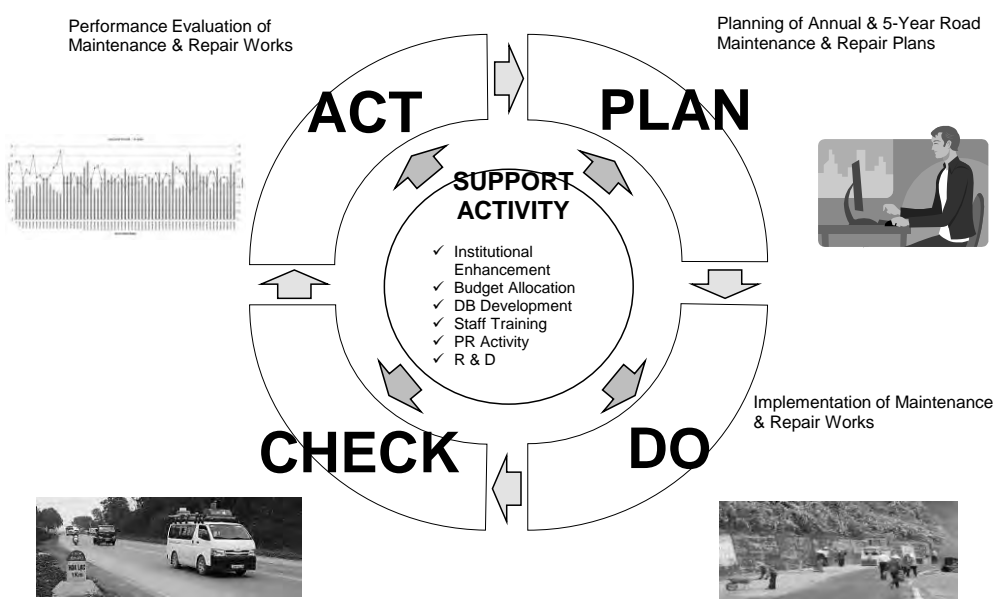
Payment of the Bridge Waterproof work shall be made, applying a contracted unit price to the measured area of the waterproof application work. The contracted unit price shall include all necessary costs for the implementation of Bridge Waterproof work

Pay Item	Description	Unit
	Bridge Waterproof work	m <sup>2</sup>

## CHAPTER 7 ENHANCE RESPONSIBILITY ASSIGNMENT AND ADMINISTRATION PROCEDURES FOR ROAD MAINTENANCE (MEASURE 4)

### 7.1 BACKGROUND

The JICA Project aims to enhance capacity of national road maintenance for DRVN staff and its subsidiary organizations, focusing on the capacity associated with PDCA cycle management of road maintenance as shown in **Figure 7.1.1**.



**Figure 7.1.1 PDCA Cycle Management**

The Project selected the following five measures in order to enhance PDCA Cycle management capacity for National road maintenance in Viet Nam, as shown in **Table 7.1.1**. This Technical Paper associated with MEASURE 4 presents the second draft of recommendations for the enhancement of responsibility assignment and administration procedures.

**Table 7.1.1 Measures and Activities**

MEASURE	ACTIVITY
MEASURE 1;	Improve PMS data collection and processing technology
MEASURE 2;	Upgrade PMS and apply road network of RMB I, II, III and IV, and formulate draft pavement repair plans
MEASURE 3;	Improve inspection and repair work selection technologies on road facility and develop technical standards
MEASURE 4;	Enhance responsibility assignment and administration functions for road maintenance
MEASURE 5;	Plan and support implementation of training programs and conduct public relations

## **7.2 OBJECTIVE**

In order to apply proactive road asset management to national roads in Viet Nam, the Project is currently developing new computer systems and technologies in road maintenance and repair for national roads. To apply these new systems and technologies to the road maintenance and management currently conducted by DRVN and to ensure sustainable growth of road maintenance and management, it is particularly important to strengthen administration functions and responsibility assignments between stakeholders.

With this, MEASURE 4 aims to find out effective administration functions and responsibility assignment between stakeholders which are best fitted to the proactive road asset management by applying new technologies developed in this Project.

## **7.3 MEASURES AND ACTIVITIES SELECTED IN THIS PROJECT**

The following is the list of measures and activities incorporated into this Project. Detail description of these activities is shown in the WORK PLAN approved by the first JCC Meeting held on March 22<sup>rd</sup> of 2015.

### **(1) MEASURE 1; Improve PMS Data Collection and Processing Technology**

M1-1: Formulate PMS Database

M1-2: Implement Pavement Condition Survey

M1-3: Develop Web-based PMS Data Input System

### **(2) MEASURE 2; Upgrade PMS to Apply Road Network of RMB I, II, III, and IV, and Formulate Draft Repair Work Plan**

M2-1: Upgrade PMS

M2-2: Formulate PMS Dataset

M2-3: Formulate Pavement Repair Work Draft Plan

M2-4: Develop Web-based System for Displaying Pavement Condition Survey Data

M2-5: Develop Web-based PMS Operation System

M2-6: Develop Web-based Analysis System for Pavement Condition Survey Data

### **(3) MEASURE 3; Improve Inspection and Repair Work Selection Technology on Road Facility and Develop Technical Standards**

M3-1: Implement, Monitor and Evaluate Pilot Projects on Pavement Repair Technology

M3-2: Upgrade Road Facility Inspection Guideline

M3-3: Upgrade Road Routine Maintenance Manual

### **(4) MEASURE 5; Plan and Support Implementation of Training Programs and Conduct Public Relations**

M5-1: Prepare Draft Training Plan

M5-2: Support Training Implementation

M5-3: Conduct Public Relations (Refer to 2.1.5(3))

#### **7.4 CURRENT STATUS SURVEY ON THE REGULATIONS**

Before developing recommendations, the Project conducted the current status surveys on the major regulations closely associated with responsibility assignment in DRVN and road administration functions. List of regulations the Project conduct review is shown below;

#### **7.5 REGULATIONS RELEVANT TO RESPONSIBILITY ASSIGNMENT**

LAW ON GOVERNMENT ORGANIZATION No.76/2015/QH13, 19 June 2015

Decree No. 107/ND-CP, Government, 20 December 2012

Decision No. 60 /QĐ-TTg, PRIME MINISTER, 21 October 2013

Decision No. 2150/QĐ-TCĐBVN, DRVN, 6 December 2013

Decision No. 2151/QĐ-TCĐBVN, DRVN, 6 December 2013

Decision No. 400/QĐ-TCĐBVN, DRVN, 6 March 2014

Decision No. 2234/QĐ-TCĐBVN, DRVN, 18 December 2014

Decision No. 365/QĐ-TCĐBVN, DRVN, 21 March 2011

Decision No: 4038/QĐ-BGTVT, MOT, 9 December 2013

Decision No. 2207/QĐ-TCĐBVN, DRVN, 24 September 2014

Decision No. 2208/QĐ-TCĐBVN, DRVN, 24 September 2014

Decision No. 2209/QĐ-TCĐBVN, DRVN, 24 September 2014

Decision No. 2210/QĐ-TCĐBVN, DRVN, 24 September 2014

Decision No. 258/QĐ-TCĐBVN, DRVN, 11 February 2014

Decision No. 259/QĐ-TCĐBVN, DRVN, 11 February 2011

Decision No. 260/QĐ-TCĐBVN, DRVN, 24 February 2011

Decision No. 261/QĐ-TCĐBVN, DRVN, 11 February 2014

#### **7.6 REGULATIONS RELEVANT TO MAINTENANCE PROCEDURES**

LAW ON CONSTRUCTION, No.50/2014/QH13, 18 June 2014

LAW ON PUBLIC INVESTMENT, No.49/2014/QH13, 18 June 2014

LAW ON STANDARDS AND TECHNICAL REGULATIONS, No.68/2006/QH11, 29 June 2006

LAW ON ROAD TRAFFIC, No.23/2008/QH12, 13 November 2008

LAW ON BIDDING, No.43/2013/QH13, 26 November 2013

Decree No.10/2013/ND-CP, 11 January 2013

Decree No.11/2010/ND-CP, 24 February 2010

Decree No.18/2012/ND-CP, 13 March 2012

Decree No.32/2014/ND-CP, 23 April 2014

Decree No.46/2015/ND-CP, 12 May 2015

Decree No.59/2015/ND-CP, 18 June 2013

Decree No.77/2015/ND-CP, 10 September 2015

Decree No.114/2010/ND-CP, 6 December 2010



Circular No.52/2013/TT-BGTVT, 12 December 2013  
 Circular No.47/2012/TT-BGTVT, 12 November 2012  
 Circular No.20/2014/TT-BGTVT, 30 May 2014  
 Decision No.2988/QD-BGTVT, 6 August 2014  
 Decision No.06/Decision-VRA, 4 January 2007  
 DRVN DOCUMENT No.4754/TCDBVN-KHDT, 4 September 2015  
 Directive No.23/CT-TTg, 5 August 2014

## 7.7 FRAMEWORK OF RECOMMENDATION

The Project focused on the systems and the technologies developed in cooperation with DRVN in this JICA Project and developed recommendations on the management methods and responsibility assignment between stakeholders for the management of these systems and technologies. The recommendation is the second version after Recommendation Version-1 submitted to DRVN issued in January 2016. The second recommendation shall be discussed with DRVN after the JCC meeting, and then the final recommendation shall be developed in cooperation with DRVN after the discussion.

- Management Methods
- Responsibility Assignment between Stakeholders

## 7.8 FRAMEWORK OF ACTIVITIES TO BE COMMENTED

The Project first selected activities to be commented in this paper which need to be enhanced for the sustainable implementation of project outcomes as shown in **Table 7.8.1**. These activities were selected in line with the measures shown in “7.3. Measures and Activities Selected in This Project “. Recommendation shall also be discussed for each activity in the following chapters.

**Table 7.8.1 Focus Point of Institutional Enhancement**

Measures		Focus Point of Institutional Enhancement
1.	MEASURE 1; Improve PMS Data Formulation Technology	1.1 Management of Planning Annual and 5-year pavement repair Plans. 1.2 Management of Data Coding
2.	MEASURE 2; Upgrade PMS to Apply Road Network of RMB I, II, III, and IV, and Formulate Draft Repair Work Plan	1.3 Pavement Condition Survey 1.4 Management of PMS Database System
3.	MEASURE 3; Improve Inspection and Repair Work Selection Technology on Road Facility and Develop Technical Standards	3.1 Management of Technical Standards
5.	MEASURE 5; Prepare Draft Training Plan, Support Training Implementation and Conduct Public Relations	5.1 Management of Human Resource Development

## **7.9 MANAGEMENT OF PLANNING OF ANNUAL AND 5-YEAR PAVEMENT REPAIR PLANS BY PMS**

### **7.9.1 Key Points of Management**

#### **(1) Features of DRVN PMS for Planning Annual/5-year Pavement Repair Plans**

##### **1) Scientific Approach to the Formulation of Annual/5-year Pavement Repair Plans**

Lessons learned in road management has reported that pavement repair costs in general occupy a large part of road maintenance and repair costs, so that systematic approach in the formulation of Annual and 5-year pavement repair plans is now required for road administrator. A conventional approach employed in the national road management in Viet Nam to formulate Annual and 5-year Pavement Repair shall follow the following steps.

- a. Pavement condition survey by vehicle equipped with advanced sensors
- b. Forecast of future pavement deterioration
- c. Diagnosis of pavement damages and decision on the implementation of repair works
- d. Selection of repair works
- e. Prioritization of repair work implementation
- f. Cost estimate of repair works

The PMS developed by this project for DRVN national road management is a tool of road asset management which aims to forecast future deterioration of road pavement and find out the best timing of investment for periodic repair against deterioration in the long maintenance period, so that it is often classified as proactive road maintenance from conventional reactive road maintenance. The PMS developed in this Project packages a pavement condition survey and a planning system (PMS) and provides a scientific approach to the pavement condition survey, to the diagnosis of pavement damage levels, to the selection of appropriate pavement repair works, to the priority settlement of repair implementation and to the cost estimate of pavement repair works, thereby reduces human involvement in making judgements and ensures the quality and the consistency of pavement repair plans. The PMS logically is developed to follow the conventional planning steps and support formulation of Annual and 5-year Pavement Repair Plans.

##### **2) Periodic Pavement Repair as a Target of PMS Application**

**Table 7.9.1** shows three types of projects in general implemented during the long period of road maintenance. They are in general implemented with different objectives as seen in the table. The target project of PMS application is “Periodic Repair Project”, so that DRVN is requested to apply conventional planning methods to the planning of routine maintenance project and to the rehabilitation and reconstruction project.

**a. Routine Maintenance and Emergency Work**

Routine maintenance and emergency work consist of maintenance work and small-scale repair works and are implemented in order to keep preserving road service-ability, so that much attention is directed to the preservation of road safety. Budget planning for the routine maintenance and emergency work is in general carried out based on the fixed rates preliminary set at per road length.

**b. Periodic Repair**

Periodic repair consists of medium-scale (Pavement surface treatment and overlays, etc.) or large-scale repair works (Replacement of pavement etc.), is implemented to restore road facilities from aging in addition to maintaining service ability. Surface treatment, overlays and replacement of pavement facilities have been regularly implemented, so that it is important for road administrator to find out the best timing and methods for the investment of periodic repair by applying scientific approaches.

**c. Rehabilitation/Reconstruction**

Rehabilitation and Reconstruction are also implemented aiming to increase strength and capacity of road facility. They are often categorized as public investment in the prevailing regulations in Viet Nam, and the nature of these works is the same as that of conventional construction projects, so that budget planning for these projects shall follow the conventional approaches consisting of feasibility study (FS) and detailed design (DD) for public investment projects.

**Table 7.9.1 Projects in the Road Maintenance Period**

No.	Project	Sample Work	Objective			
			Maintain service ability	Restore from Aging	Increase strength	Increase capacity
1	Routine Maintenance	<ul style="list-style-type: none"> <li>Road facility cleaning</li> <li>Crack, pothole &amp; bump repair work</li> </ul>	x			
2	Emergency Work	<ul style="list-style-type: none"> <li>Disaster prevention</li> <li>Disaster restoration</li> </ul>	x			
3	Periodic Repair	<ul style="list-style-type: none"> <li>Overlays (Pavement)</li> <li>Structural overlays</li> <li>Cut and overlays, etc.</li> </ul>	x	x		
4	Rehabilitation /Reconstruction	<ul style="list-style-type: none"> <li>Pavement design upgrade</li> <li>Bridge Structural reinforcement</li> <li>Realignment</li> </ul>	x	x	x	
		<ul style="list-style-type: none"> <li>Increase in lanes (Widening)</li> <li>Bridge reconstruction</li> </ul>	x	x	x	x

## (2) Procedures for Planning 5-year Pavement Repair Plans

Figure 7.9.1 shows the flow chart for formulating 5-year Pavement Repair Plans by applying PMS. Planning procedures in particular for the formulation of 5-year pavement repair plans shall follow the following steps. Outlines of these planning procedures shall be briefly discussed below.

- **Step.1:** Prepare data coding for data registration (“S1” in the Flowchart)  
Data coding is to prepare data before inputting them into PMS DB. In order to use DB by various software, data should be recorded with the standard rule which is common to various software system. It is important to avoid case-by-case data recording. The standard coding rule can be applied not only to PMS database and to pavement condition survey, but to any kinds of databases including road asset database, maintenance history database, traffic volume database and so forth. Further detailed information is explained hereinafter in the relevant sections in this chapter.
- **Step.2:** Conduct pavement condition Survey (“S2” in the Flowchart)  
Pavement condition survey is to measure pavement deterioration every 100 meters by applying three deterioration indexes; pavement crack rate, rutting depth and International Roughness Index (IRI). Pavement condition data are the most fundamental information to the planning of annual and 5-year pavement repair plans. The pavement condition data can be also used in the road routine maintenance. Further detailed information is explained hereinafter in the relevant sections in this chapter.
- **Step.3:** Input PMS data into PMS DB (“S3” in the Flowchart)  
Formulation of strategic budget plans and annual/5-year pavement repair plans shall be conducted by PMS software based on the data stored in PMS DB. PMS DB is a generic term for the databases consisting of four databases; that are Road Asset DB, Pavement Condition DB, Maintenance History DB and Traffic Volume DB. However, during the long road maintenance period, many projects including road maintenance, repair projects and investment projects shall be implemented in the field which change information in the databases, in particular those in Road Asset DB and Maintenance History DB, so that it is necessary to update information for each DB on a project basis when big changes of information occur, and then consolidate these project-based updated information into PMS DB set at planning year level specified by the planner.  
  
DRVN is currently developing database systems including Road Asset DB, Maintenance History DB, and Traffic Volume DB etc. for the daily management of the national roads in the World Bank Project VRAMP. When the development is completed and these databases become available, PMS DB can be developed by directly converting data from these four databases without manual data input.

However, in this Project, data input was conducted by RMBs/SBs directly into Road Asset DB in 2015 and 2016, Maintenance History DB and Traffic Volume DB, selecting key data for the formulation of PMS DB. PMS data input software system developed in this project was applied for data input.

- **Step.4:** Process PMS data and formulate draft 5-year pavement repair plans (“4.1” – “4.3” in the Flowchart)

From Step-1 to Step-3 are the preparation of fundamental databases for the planning by PMS planning. Step.4 is an important procedure for the formulation of draft plans of strategic budget and annual/5-year pavement repair plans by PMS web system. It consists of two main processes. The first is the data processing for developing PMS data set and the second is the formulation of draft plans of strategic budget and annual/5-year pavement repair plans by PMS web system. In the data processing,

In the first data processing, based on the PMS DB developed in Step.3, 100-meter sectioning and data matching with administration DB shall be applied for Road Asset DB and Maintenance History DB, and then all databases including Pavement Condition DB and Traffic Volume DB shall be merged into PMS Dataset and broken down to PMS Module Datasets. PMS Web Operation Software shall manage all these procedures on its own.

The second process is for the formulation of strategic budget plans and annual and 5-year pavement repair plans. The PMS system shall output the budget plans in accordance with three scenarios, which can be used in the selection of budget frame for annual and 5-year pavement repair plans, taking account of budget trends in the past. On the other hand, the PMS system also output the draft pavement repair plans with 100-meter sectioning based on pavement deterioration.

Step.4 is the most important process of PMS operation which should be operated by professional or trained staff with advanced knowledge and experience in DRVN. Two processes in Step.4 are mutually related and shall not be separated each other, but need consistent operation.

- **Step.5:** Review draft 5-year plans and formulated RMB 5-year plans

PMS shall produce pavement repair plans with the following information; road number, repair section, necessity of detailed survey, repair costs, repair priority etc. for the pavement periodic repair works consisting of surface treatment, overlays and pavement replacement. In addition, pavement repair plans shall be formulated every 100 meters based on pavement deterioration measured by pavement condition survey vehicle.

For this reason, further level-up of these plans is important, taking local conditions into consideration. To begin with, it is necessary to add road sections which were unrepaired in the previous 5-year plans and carried over to the next 5-year plans. Also, it is important to review repair plans, taking local conditions (traffic volume, importance of roads, etc.) into consideration, implementing detailed field surveys (FWD etc.) and conducting field investigation to narrow down repair sections, thereby raising the quality of pavement repair plans.

The key points for the Step.5 is to conduct field confirmation including detailed field survey and to formulate the final candidate list of pavement repair works (5 years lists, S5.9). Then, coupled with the budget frame set in S5.10, annual components of repair works can be formulated for the 5-year pavement repair plans. RMBs are requested to manage all these processes in Step5, given the draft candidate lists of pavement repair plans produced by PMS system from DRVN.

(Reference; Detailed survey)

PMS output shall point out some road sections which may need detailed surveys such as FWD survey and so forth, showing a special note, “Big Repair”, to the section data. These are the sections which include some locations where serious pavement deterioration is observed from pavement condition data, thereby replacement of pavement is needed. For this reason, RMBs are proposed to identify the locations in the section data and to conduct a detailed survey (FWD) and to try to estimate the depth of replacement based on the results of FWD survey.

- **Step.6:** Formulate DRVN 5-year pavement repair plans and submit plans to MOT/MOF for approval

Upon completion of the formulation of 5-year pavement repair plans (5 years lists of pavement repair works plans), RMBs shall submit the regional-level last draft 5-year plans to DRVN to conduct final adjustment by DPI and then authorization by DG. Upon completion of these procedures, DRVN shall submit the DRVN-level final draft 5-year plans to MOT/MOF for approval.

During the formulation of 5-year plans, the budget frame for each year of 5-year plans may change. If changed, it is necessary to go back to the list of final candidate repair plans shown in S5.10 and then to follow the processes in the flow chart.

### **(3) Procedures for Planning Annual Pavement Repair Plans**

**Figure 7.9.2** shows the flowchart for the formulation of annual budget plans for pavement repair plans to be conducted every year. The procedures basically follow those for 5-year plans shown in **Figure 7.9.1**. Review of annual pavement repair plan shall be conducted

based on the annual plans set in the 5-year pavement repair plans which were already approved by MOT. Based on the annual plans, the planner is requested to add road sections unrepaired and carried over from previous year to the planning year (A3 in the flowchart), to review repair priority if there are changes of policy or road conditions (A4), to conduct a field survey to narrow repair sections (A5) and detailed survey (A6) if necessary, and to finally update the list of pavement repair sections (A9).

The procedures are followed by the selection of budget frame for the specified year, the selection of pavement repair sections within the budget frame, and then the report of RMB draft plans to DRVN for final adjustment and authorization by DG. Remaining procedures shall be the same as those shown in the flow chart for 5-year plan formulation.

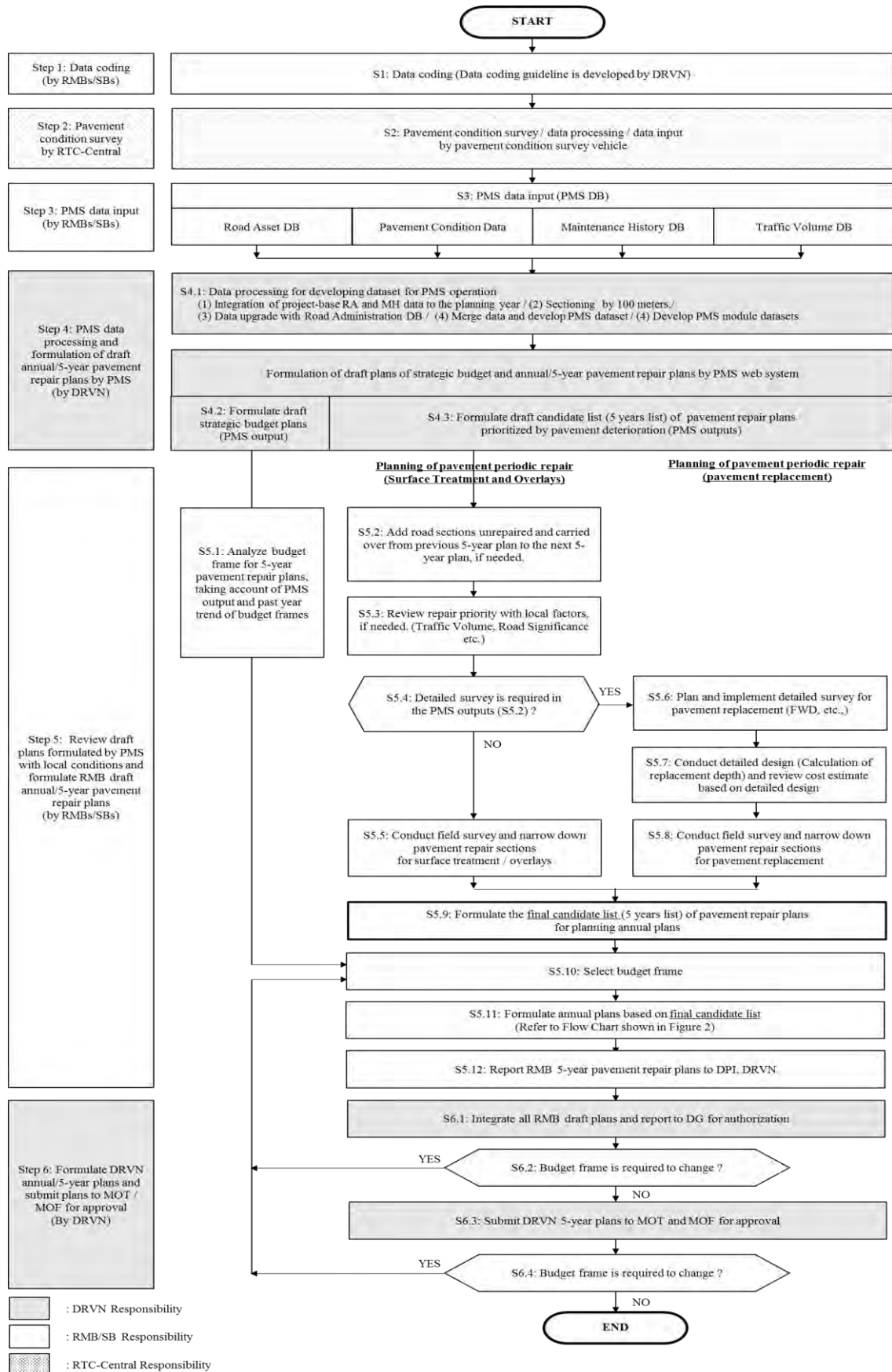


Figure 7.9.1 Flow Chart for the Formulation of 5-year Pavement Repair Plan by PMS



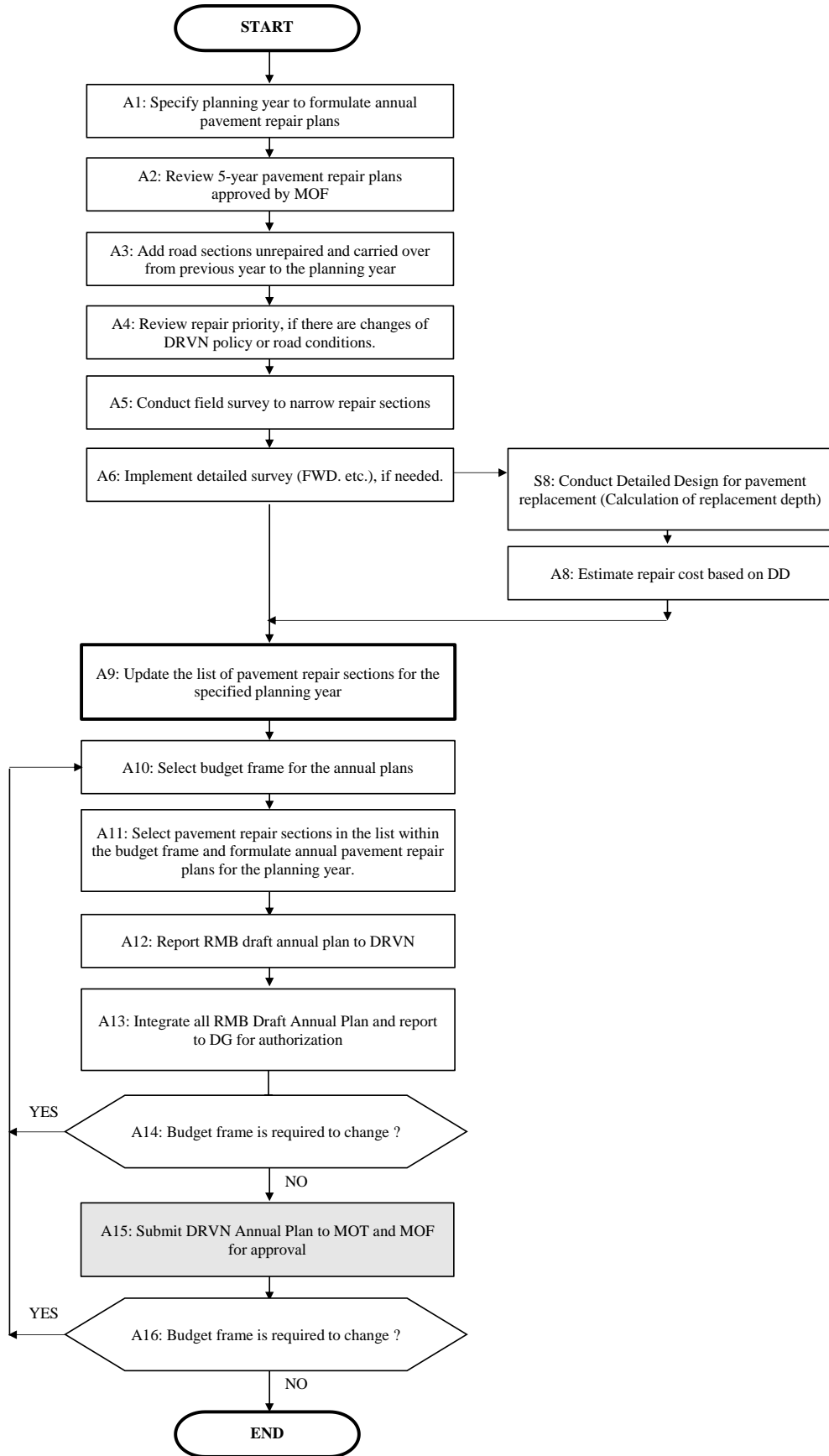


Figure 7.9.2 Flow Chart for the Formulation of Annual Pavement Plan by PMS

**(4) Buildup of PDCA Cycle Management for Annual/5-year Pavement Repair Plans Formulation**

Flowcharts in the previous sections show all the processes to formulate 5-year and annual pavement repair plans, which is a kind of cycle management for the formulation of annual and 5-year pavement repair plans. Also, flowchart shows that it is important to establish close cooperation between stakeholders, in particular between DRVN and RMBs. With these reasons, DRVN is requested to put high priority on the establishment of cycle management for planning annual and 5-year pavement repair plans in the first stage of institutional arrangement.

**Table 7.9.2 Cycle Management for Planning 5-year Pavement Repair Plans**

Step	Cycle management for the planning of Annual / 5-year Pavement Repair Plans	Schedule (Year)				
		1	2	3	4	5
Step.1	Set Data Coding rules	■				
Step.2	Conduct pavement condition survey and analysis	■	■	■		
Step.3	Input and update PMS Data	■	■	■		
Step.4	Process data and formulate draft pavement repair plans		■	■		
Step.5	Review draft plans with local conditions Conduct detailed survey			■	■	
	Formulate RMB draft repair plans				■	
Step.6	Formulate DRVN draft repair plans				■	
Step.7	Examination, Approval of Annual and 5-Year Plan				■	◎

**(5) Consistent Management of PMS and PMS Data**

It is important to continue to improve data quality and PMS system functions while actually operating PMS. It was recognized in the PMS data input and in the pavement condition survey implemented in this Project that there is room for improvement in data preparation (coding) before data input. It was also recognized that in the operation of PMS, cooperation of many organizations of DRVN becomes very important for the smooth implementation of PMS. For these reasons, it is recommended to conduct consistent management for the series of PMS operation ranging from PMS DB data input, data processing and PMS application to the planning of strategic budget plans and repair plans for the pavement facility as shown in **Figure 7.9.3**.

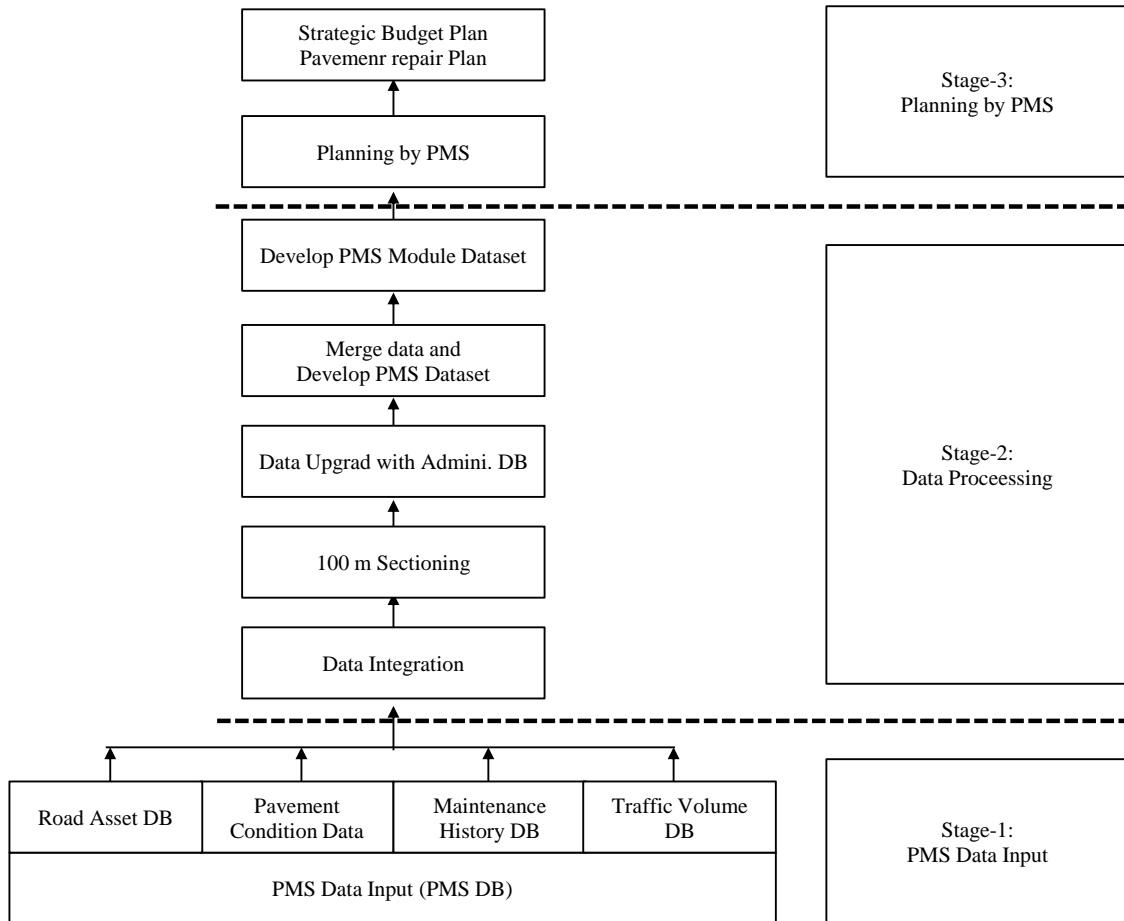


Figure 7.9.3 PMS Data Processing Flow

**(6) Continuous R&D on PMS Development**

The PMS model developed in this project is a customized model specialized for the operation of National Roads under DRVN. However, in order to make it more user-friendly and more suitable for not only the DRVN national roads but the PDOT national roads or expressway systems, the Project propose to continue R&D even from now on. In order to continue R&D, there are two ways of capacity reinforcement; reinforcement of RTC-Central R&D function or reinforcement of research collaboration with universities like UTC/UTT or with external research institutes like ITST. The former will be beneficial for DRVN to accumulate R&D technologies in DRVN as a future road map, but for the time being, it is recommended to continue to have R&D support from UTC in particular in developing PMS web operation system, since the Project has received technical support from UTC for 6 years in the past since its Phase 1 project.

To support human resource development in R&D, JICA commenced a new scheme of supporting research study in Japan on Road Asset Management and is now calling for the students for 2017 autumn enrolment. Now applications are open to MOT, DRVN, ITST, UTC, UTT etc. It is recommended that DRVN make best use of this system as much as possible.

**(7) Legalization of PMS Operation as a Formal Planning System**

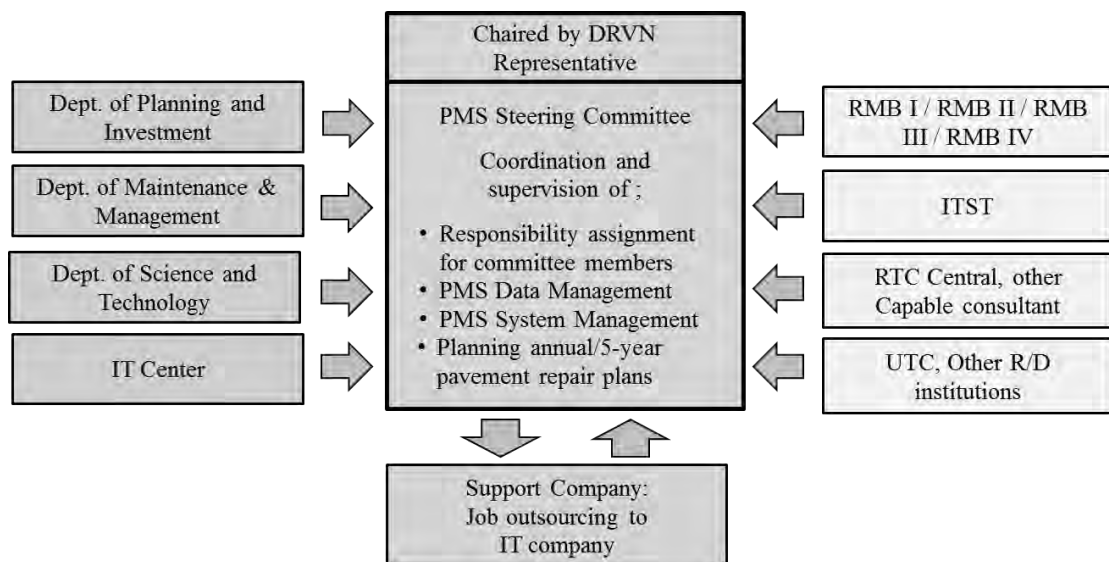
It is proposed that DRVN legalize PMS planning system to be a formal system for the formulation of annual and 5-year pavement repair plans.

**7.9.2 Responsibility Assignment between Stakeholders**

**(1) Planning Process Management by PMS Committee**

The current status survey conducted in this Project has reported that there’s constraint in the number of staff currently engaged in the DRVN national road management. However, in order to add new responsibilities such as data processing, system management, and planning by PMS needed for creating a pavement repair plan, it is necessary to strengthen the business execution structure. With this, the Project proposes to organize a PMS Steering Committee and to manage a series of work with manpower support outsourced to an IT company, thereby strengthen the DRVN business execution structure as shown in **Figure 7.9.4**. It is proposed to continue this management style until the data quality becomes stabilized to a reasonable level and DRVN stakeholders become familiar with PMS operation or DRVN staff structure is strengthened.

- i. Define responsibility assignment between stakeholders
- ii. Supervise progress of preparatory works
- iii. Report progress to Director General
- iv. Identify problems raised during preparatory works
- v. Find solutions to the problems



**Figure 7.9.4 PMS Steering Committee**

## **(2) Outsourcing of PMS System Management**

The basic function of PMS is to predict future deterioration using pavement condition survey data and PMS database and to formulate pavement strategic budget plans and repair work plans. In the operation of PMS, much data processing is required, and expertise in system management and planning is also required. For this reason, it is proposed to make a contract with an IT consultant who has been involved in the system development in the Project and to outsource manpower work including data processing and system management

## **(3) Review of Responsibility Assignment for DRVN and RMBs**

DRVN responsibility assignment recommended in this Project for the formulation of annual and 5-year pavement repair plans is shown below.

### **1) Department of Planning and Investment (DPI)**

DPI is requested to play an important role for the formulation of annual and 5-year pavement repair plans. The Project recommends that DPI should conduct overall manage of PMS data processing and formulation of draft annual and 5-year pavement repair plans by PMS software (Step.4 in **Figure 7.9.1**).

- Final Confirmation of PMS data before planning
- Application of PMS software and formulate annual and 5-year pavement repair plans (Step.4 in the flow chart **Figure 7.9.1**)
- Final compilation of annual and 5-year pavement repair plans (Step.6 in the flow chart **Figure 7.9.1**)
- Support RMBs responsibility for formulating regional-level annual and 5-year pavement maintenance plans

### **2) Department of Maintenance and Management**

- Formulation of data collection plans
- Development and maintenance of the Data Coding Guideline
- Preparation of the unit cost and the work selection criteria for pavement repair works
- Management of road administration database with latest road conditions
- Preparation of pavement condition survey plan.

### **3) Department of Science, Technology, Environment and International Cooperation**

- Maintenance and upgrade of software group
  - PMS DB data web input system
  - Pavement condition data web display system
  - PMS web operation system
  - Pavement Monitoring web operation System (PMoS)
  - Pavement condition data web analysis system
  - DRVN Maintenance technology web management system (PR)

**4) IT Center**

- Operation support of software group
- Contract management of outsourcing to IT company
- Supervision of consultant work.

**(4) RMBs and SBs**

RMBs and SBs responsibility assignment recommended in this Project for the formulation of annual and 5-year pavement repair plans is shown below:

a. Support pavement condition survey

SBs shall support pavement condition survey implemented by RTC-Central by giving regional road information and on-site guidance to RTC-Central, if needed.

b. Input PMS data

RMBs and SBs shall conduct PMS data input for road network under RMB jurisdiction. RMB shall outsource data input for revising Road Asset DB and Maintenance History DB against any changes of information caused by repair works, rehabilitation, reconstruction of road facilities under RMB jurisdiction.

c. Contract management for outsourcing data input

RMB shall manage contracts with contractors or supervision consultants involved in the repair, rehabilitation and reconstruction projects.

d. Supervision of consultant data input

SBs shall supervise data input or revision conducted by contractors or consultants based on the contracts made by RMBs.

e. Review pavement repair plans and formulate RMB draft plan of annual and 5-year pavement repair plans

Draft pavement repair plans created by PMS software by DRVN shall be delivered to RMBs for further upgrade. Upon receiving draft plans from DRVN, RMBs/SBs shall conduct the following tasks and formulate RMB draft plans for annual and 5-year pavement repair plans.

- Add road sections unrepaired in the previous 5-year plans and carried over to the next 5-year plans to the draft pavement repair plans delivered to RMBs
- Review repair priority with local conditions set for each region
- Implement detailed survey (FWD etc.)
- Implement filed survey to narrow pavement repair sections
- Formulate the final candidate lists of pavement repair plans

- Formulate RMB draft annual and 5-year pavement repair plans based on the final candidate list
- Report RMB draft annual and 5-year pavement repair plans to DRVN for final adjustment and authorization.

## 7.10 MANAGEMENT OF DATA CODING

### 7.10.1 Key Points of Management

#### (1) Data Coding

DB digital information shall be utilized by various computer software for road maintenance through digital code, so that data should be properly processed to digital codes in the data preparation stage by applying standardized common coding rules in order to avoid data problems such as duplication of data, unable search, data missing and so forth. In fact, lessons learned from the PMS DB development conducted in this Project have reported that there observed many improper data treatment to develop digital data in the data preparation stage due to the absence of standard coding rules (Refer to MEMO described below). It is of course possible to eliminate these improper data to some extent by input-data-control function installed in the DB data input system, but it is impossible to solve all these problems completely. Use of improper data into the planning of strategic budget plans or pavement repair plans may cause system operation errors or unprecise computation outputs. It was sometimes misunderstood that error was attributed to the system at the worst case, but in many cases the errors are attributed to data coding. Whenever problems may occur, it is important to return to the original data coding and review data. Standardization of coding methods is very much important to reduce data errors.

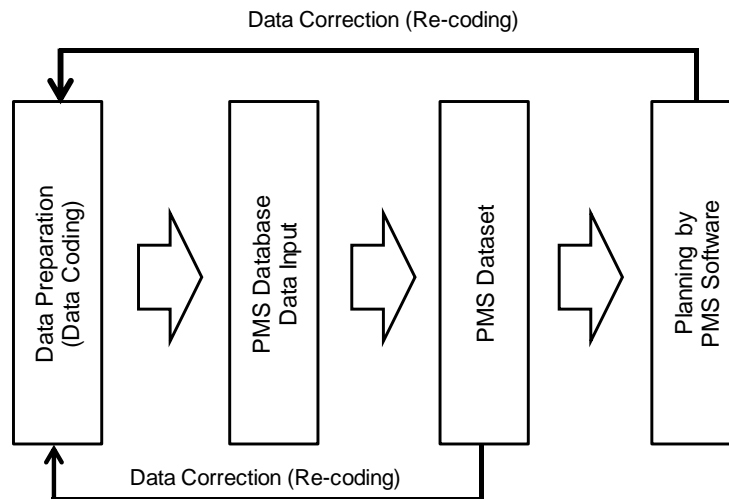


Figure 7.10.1 Flow of PMS Data Processing

[MEMO] JICA Project conducted data input to PMS DB which consists of Road Asset DB, Pavement Condition DB, Maintenance History DB and Traffic Volume DB. As a result, it took 14 months for data input and correction. During that period, the Project found that there's no standardized coding rules and various coding methods have been applied case-by-case to the construction of bypasses and branch roads. This forces us to spend long time for data correction.

**(2) Review of Coding Rules and Information Dissemination by OJTs**

As mentioned in the above section, data preparation is an important process before going into data input. DRVN is recommended to play a leading role in developing guidelines for data processing as well as coding methods applicable to the newly development of database when new roads come into DRVN road maintenance or to the changes of databases caused by periodic repairs or by road improvement projects. Also, it is necessary to disseminate this information through OJTs to relevant stakeholders including RMBs, SBs, outsourcing consultants in charge of data input and so forth.

**(3) Maintenance of survey vehicle and equipment**

Pavement condition survey vehicle provided by JICA is equipped with advanced technologies including laser scanner, GPS, memo-motion camera and control system to observe and record pavement damages. It is therefore recommended to implement regular inspection on the vehicle and equipment by making a maintenance contract with the survey vehicle provider, PASCO in Japan. With this contract, system upgrade shall become available for PC analysis system and for data check system

**7.10.2 Responsibility Assignment between Stakeholders**

DRVN Maintenance and Management Department is recommended to take a leading role in developing a Data Coding Guideline and to deliver it to RMBs and SBs through OJTs.

**7.11 MANAGEMENT OF PAVEMENT CONDITION SURVEY**

**7.11.1 Key Points of Management**

Pavement Condition Survey is conducted as part of pavement asset management. Pavement condition data can be utilized in many ways in the various road maintenance and management activities, not only in the formulation of pavement repair plans, but also in the daily management of routine maintenance. With this reason, it is strongly recommended to implement the pavement condition survey continuously.

Key points of the management of pavement condition survey include regular implementation of survey, management of field survey, maintenance of pavement condition vehicle and equipment, and selection of survey consultants. Management of these key points shall be discussed in detail in the following sections.



**(1) Legalization of Survey Implementation**

Pavement condition survey is a useful tool in providing information not only to the planning of pavement repair works and strategic budget plans by PMS, but also to the road routine maintenance now underway every day. For this reason, it is important to standardize the pavement condition survey by regulation as a regular survey.

In order to ensure smooth implementation of the pavement condition survey, it is recommended to implement the survey as a component of preparatory works for developing annual and 5-year road maintenance and repair plans and to implement the survey every five (5) years in conformity with 5-year plans. Lessons learned in the Project has reported that it takes about two (2) years to conduct the survey and data processing for all road networks under the current RMBs jurisdiction.

**Table 7.11.1 Time Schedule of Pavement Condition Survey**

Region	Lane Length (Lane km)	Time Schedule (Month)	
		Field Survey	Data Processing
RMB I	2,318	3	5
RMB II	4,232	3	5
RMB III	2,201	2	4
RMB IV	3,856	3	8
Total	12,607	11	22

(Note) The above data are actual performance obtained in this Project

**(2) Field Survey Data Management**

Pavement condition survey conducted for RMB II, III and IV road networks in this Project has reported that there observed many data inconsistency which caused a long time to review and to correct data. For example, inconsistency between field observation and road inventory data, missing or miss installation of kilo posts and so forth. With these reasons, it is recommended to establish a survey management system, such as the attendance of RMB or SB staff to pavement condition survey, for the smooth implementation of pavement condition survey. Appropriate treatments to these data problems can minimize the negative effects on the next pavement condition survey.

**7.11.2 Responsibility Assignment between Stakeholders**

**(1) Maintenance of Survey Vehicle and Management of Survey and Analysis**

Pavement condition survey vehicle supplied by JICA is equipped with advanced technologies including laser scanner, GPS, memo-motion camera and control system to observe and record pavement damages. Also, pavement condition survey and data processing need professional knowledge and experience in implementation. It is therefore recommended to outsource pavement condition survey to a competent organization continuously, including field survey,

data processing and the maintenance of survey vehicle. In this JICA Project, the Project selected RTC-Central as a competent organization and transferred technologies relevant to survey and data processing to the RTC-Central. RTC-Central has deeply engaged in this JICA Project since Phase 1 project and currently has ability enough to continue implementing pavement condition survey and data processing in the future.

**(2) Data Installation into DRVN Database Server**

Regarding pavement condition data registration into DRVN database system, it is recommended to assign IT Center to have responsibility for installing Pavement Condition Database into DRVN Database Server.

**7.12 MANAGEMENT OF PMS DATABASE SYSTEM**

**7.12.1 Key Points of Management**

**(1) Introduction**

JICA Project for Capacity Enhancement Phase 1 formulated data database formats and offline-based data input computer software needed for the management of national roads. They are Road Asset DB (29 facilities), Pavement Condition Data DB, Maintenance History DB and Traffic Volume DB. When the Project was over, all of these data formats including data input systems were all taken over to DRVN. Later, DRVN decided to improve the database system as a web-based system and assigned the development and the management of these databases to VRAMP Project (RAMS: Road Asset Management System).

In this JICA Phase-2 Project, the Project focuses on the development of PMS database needed for the operation of PMS planning system whose development is currently underway by the Project and develops PMS database as a web operation PMS data input system.

In this section, the Project developed some recommendations on the management of PMS DB and its web operating system for their successful implementation.

**(2) Maintenance and Update of PMS DB and Systems**

Road Database is the tool which can provide data to various business activities, so that it should be maintained in good condition anytime. However, there will be many changes in road facilities which may provide serious effects on DB information such incorporation of new road to DRVN maintenance, transfer of road facilities to other road operators, repair works and improvement of road facilities. Under these circumstances, road operator is responsible for maintaining and updating DB information anytime to make it possible to provide the latest information to users.

But unfortunately, lessons learned in the foreign practices have reported that there have been many countries where maintenance and update of DB information did not work well and thus DB system didn't function well. With this reason, much attention should be paid on the

maintenance and upgrade of DB data in developing DB systems in order to make DB system operable for a long time to come.

**(3) Development of Administration Database**

It is recommended to develop Road Administration Database which can govern all database systems for road maintenance which are now under development. Road Administration Database is to include fundamental but the most important information on road numbers, sections and date of transfer of road sections transferred to DRVN road maintenance after construction and to Provincial People's Committee. Also, it is recommended to include information on road improvement projects which are not registered into road maintenance databases.

**(4) Legalization of Database Management**

It is recommended to establish appropriate database management system and stipulate the status of this database management system in the regulation. Further discussion needs to be done in the VRAMP on the management system and its legalization.

**(5) Outsourcing of Data Input to Database**

In handling road database, road operator often has to handle massive data. Road operator also needs to upgrade data input system. However, road operators in general have limited capacity in institutional arrangement including the number of staff, so that it is extremely difficult for them to manage data inputs and system modifications on their own. With this, it is recommended to make use of outsourcing as much as possible; (1) outsourcing of data management to private companies and (2) outsourcing of system management to the software company who have been involved in the system development in the Project. The following is the recommendation on the database data management for DRVN.

**1) New Road Incorporation:**

When a new road is transferred to DRVN for maintenance, RMB is recommended to outsource manpower data input work to a consultant and to develop new road database. SB shall take responsibility for supervising data input work. To be noted here is that duplication of data codes between new roads and existing roads should be carefully avoided.

**2) Transfer of Whole Road Sections or Part of Road Sections to Other Road Operator's Jurisdiction:**

When whole road sections or part of road sections are transferred to other road operator's jurisdiction including PPCs, BOT Companies, Vietnam Expressway Administration (VEA), Vietnam Expressway Company (VEC) and so forth, the road operator shall update all data in the DBs in accordance with changes. In the future, when databases for provincial road and for express are developed, road operator can simply transfer digital data to responsible organizations and then delete old data in the DBs.

**3) Periodic Repair and Road Improvement:**

When road periodic repairs or improvement projects are carried out on the national road, DB data shall be updated immediately after the project. It is recommended to oblige supervision consultants or contractors of these projects to update DB data within their project range by regulation or by contract change.

**(6) Staged Development of Road Database**

Database development in general may need big investment and human resource, so that it is recommended to develop DB systems step by step and to enhance their quality, focusing more on the DBs frequently used in daily road maintenance and management. It is also important that DBs are to be improved while being operated and further developed to conform to the road management of DRVN.

**7.12.2 Responsibility Assignment between Stakeholders**

**(1) Assign Specialists for Data and System Management**

DRVN is currently developing a comprehensive database system in the VRAMP for the national road maintenance and management and conducting data input to the databases. However, unless coding problem discussed above remain unsolved, concern may also arise in the data input in the VRAMP, so that it is recommended to take quick action to the standardization of data coding method and to build data management system including data check.

Also, Upgrade of data input system is often needed in parallel with data input. With this, it is recommended to establish a management system which can take care of data and data input system together in order to take quick action to the system upgrade any time when demand arises. It is also important to assign professional experts who know well about both data and system management.

**(2) Assign Database Manager at Each RMB and SB**

In case a new road is transferred to DRVN for maintenance and new database needs to be formulated, or in case big changes occur due to the implementation of periodic repairs or improvement projects, it is recommended in this Project to outsource DB development and data update. With this, RMB is requested to place persons responsible for contract management of outsourcing, and also SBs are requested to place persons responsible for supervision of data input conducted by contractors.

**(3) Strengthening of Road IT Center Function**

In addition, DRVN is recommended to strengthen the IT center, to place persons responsible for DB data management and input system management, and to implement work management for these tasks.

#### **(4) Management of Road Administration Database**

The Road Administration Database is so called a master database to control other road sub databases, managing road administration information. For this reason, DRVN is recommended to conduct management of the database on its own. With this, IT Center shall strengthen its functions and manage and operate this Administration Database. In addition, Dept of Maintenance and Management who knows well about its information shall manage data contents, conducting a cooperative management with IT Center.

### **7.13 MANAGEMENT OF TECHNICAL STANDARDS**

#### **7.13.1 Key Points of Management**

##### **(1) Road Map for Developing Technical Standards in the Future**

Fundamental procedures for road maintenance and repair fall in the following categories. Road administrator is recommended to prepare technical standards, manuals or guidelines for processing these procedures. However, due to the differences in work environment between new road construction and road maintenance and repair in the field, it is important to develop technical standards specialized for road maintenance and repair work. It is therefore proposed that DRVN formulate a future road map paving the way to the development of technical standards for road maintenance and repair work

- Survey and inspection
- Repair work selection
- Design of repair work
- Contract management for outsourcing

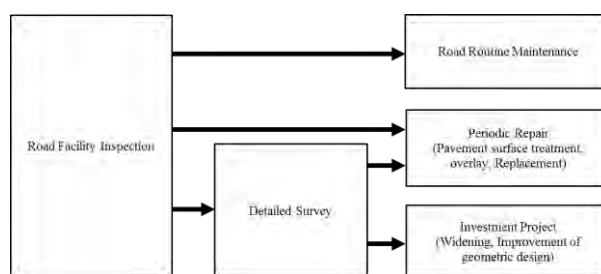
##### **(2) Strengthening of Road Facility Inspection**

###### **1) Development of Independent Road Facility Inspection Standards**

According to the current DRVN Routine Maintenance Standard, a contractor is required to fulfil responsibilities which cover road facility inspection, maintenance and small repair works in the same contract.

However, road facility inspection, in particular inspections for pavement, bridge and tunnel structures, requires survey staff who are qualified for professional knowledge, experience and objectivity in survey implementation. They are absolutely different from those required for road maintenance and repair work. The Project therefore recommends that inspection should be implemented separately and independently from the maintenance and repair work.

Road facility inspection falls into daily inspection, periodic inspection, emergency inspection and detailed inspection (detailed survey) for inspection. Since each inspection has an important role, it is recommended to institutionalize the framework of road facility inspection and to develop a Road Facility Inspection Standard (Manual or Guideline) independently from Road Routine Maintenance Standard.



**Figure 7.13.1 Information Flow**

## 2) Capacity Enhancement for Road Facility Inspection

As road facility inspection requires professional knowledge and experience in survey implementation, it is recommended that DRVN outsource inspection surveys to professional consultants who are qualified for road facility inspection with professional knowledge and experience. However, it is already known that it is not easy issue to find out qualified consultants for road facility inspection in Viet Nam, so that it is recommended that DRVN develop its own human resource and accumulate professionalism for road facility inspection to RTC-Central.

## (3) Development of Technical Standard for Road Maintenance and Repair

**Table 7.13.1** shows the current status of technical standards for road maintenance and repair. Currently, Technical Standard for Routine Maintenance 2013 has been applied to the inspection and routine maintenance and repair of national roads. On the other hand, for periodic repair and improvement project (investment project), MOT technical standards for road construction have been applied to the periodic repair and to the road improvement project (investment project). In addition, in the contract management of road maintenance and repair, a contract document of work specification is developed by design consultant for each project and is applied to the maintenance and the repair projects.

However, a road construction is in principle carried out in the open air condition, on the other hand, road maintenance and repair work are carried out on the existing roads while controlling road traffic. Due to the big difference in working environment, it is in general very hard to apply road construction standards to road maintenance and repair work. It is therefore recommended to develop DRVN own technical standards specialized for road maintenance and repair and to apply them to the inspection and repair work selection and implementation of periodic repair work as shown in **Table 7.13.2**. It is also recommended to standardize work specification and to develop a common specification for road maintenance and repair in order to secure quality of work specification.

For large road improvement projects (investment project) such as road widening and reconstruction, MOT technical standards can be applied to the survey, work selection, work implementation and designing of road facilities just in the past. It is also reasonable to apply specifications developed by design consultants to large improvement projects.

**Table 7.13.1 Current Status of Technical Standards**

	<b>Routine Maintenance</b>	<b>Periodic Repair</b>	<b>Improvement Project</b>
Survey & Inspection	DRVN Standard for Routine Maintenance	MOT Survey Standards	MOT Construction Standards
Work Selection & Work Implementation	DRVN Standard for Routine Maintenance	MOT Construction Standards	
Design	MOT Construction Standards		
Contract Management	Specification (TOR) developed by Design Consultant		

(Note) Blue; DRVN Standards

Yellow; MOT Standards

Green; Project-based specification developed by design consultant

**Table 7.13.2 Future Road Map for Developing Technical Standards**

	<b>Routine Maintenance</b>	<b>Periodic Repair</b>	<b>Improvement Project</b>
Survey & Inspection	<b>DRVN Inspection Standard</b> (Supporting Material: JICA Inspection Guideline)		MOT Construction Standards
Work Selection & Work Implementation	<b>DRVN Maintenance Standard</b> (Supporting Material: JICA Maintenance Manual)		MOT Construction Standards
Design	<b>DRVN Design Standards for Periodic Repair</b>		MOT Construction Standards
Contract Management	<b>DRVN Standard Specification for Contract (TOR)</b>		Specification (TOR) developed by Design Consultant

(Note) Supporting Materials: Guideline and Manual developed by JICA Project Phase II. Standard Specification for Contract; Consisting of a Common and a Specific Specification. Standardization is in principle done for the Common Specification.

### 7.13.2 Responsibility Assignment for the Management Technical Standard

#### (1) Development of Technical Standards by DRVN Steering Committee

Development of standards, guidelines and manuals for road inspection and maintenance need professional staff with knowledge and experience. It is in general very difficult for consultants to develop technical standards, guidelines and manuals, because they rarely have experience in road maintenance. For this reason, it is proposed to conduct cooperative study with competent organizations such as universities and research institutes. This scheme is a prevailing method to develop technical standards, guidelines and manuals not only in Japan but in the many other foreign countries. This Project recommends the installation of a steering committee specialized for this purpose under the management of DRVN representative where professional experts can get together to discuss draft technical standards.

In order to support the manpower work of committee members, it is also recommended to outsource manpower work to consultants. DRVN shall take a leading role in developing technical standards. With this scheme, DRVN can accumulate know-how of developing technical standards in its organization.

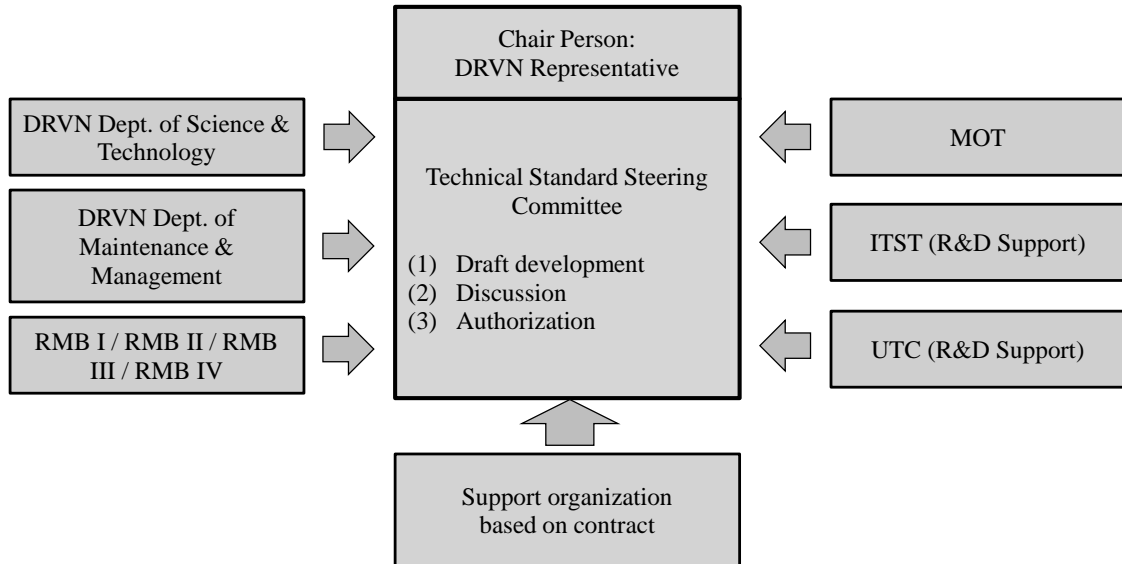


Figure 7.13.2 Steering Committee for Developing Technical Standards

**(2) Entrustment of Developing Technical Standards**

Another alternative method of developing technical standards is to entrust the third sector or universities to develop technical standards, which also has been applied in many foreign countries. In the case of DRVN committee mentioned above, there are some cases which are difficult to conduct logistics including conference management, draft management and payment to committee members. With this, it is proposed to entrust development of technical standards to the third sector organization such as Road and Bridge Association, Viet Nam Federation of Civil Engineers Association (VFCEA) etc., or to the universities. Since this method seems to be most suitable for DRVN, the Project recommends this method in this project.

**(3) Capacity Enhancement for Road Facility Inspection at RMBs and SBs**

In case outsourcing is applied to road facility inspection, it is necessary to enhance RMB’s and SB’s capacity of supervising the survey.

**7.14 MANAGEMENT OF HUMAN RESOURCE DEVELOPMENT PROGRAMS**

**7.14.1 Key Points of Human Resource Development**

Road Asset Management is not general, but very much special for road administration, so that it is necessary for road administrator to develop human resource by enhancing road asset



management capacity. Key points for the better management of human resource development are shown below;

**(1) Clarification of DRVN Policy on Human Resource Development**

Road infrastructure is an important social infrastructure that supports not only road traffic, but socio-economic activities in Viet Nam. For this reason, Road administrator is requested to keep roads anytime in good condition. However, road maintenance technology is not a prevailing technology in the general market, so that road administrators should develop their own human resource by themselves. In order to meet this demand, DRVN is recommended to clarify human resource development policy before going into developing human resource development programs.

**(2) Clarification of Objectives of DRVN Human Resource Development**

In developing human resource development programs, it is recommended to set two objectives as shown below; the first is to enhance PDCA management capacity for DRVN staff, and the second is to enhance field management capacity and supervision capacity of outsourcing work for RMB and SB staff.

**1) To enhance PDCA Cycle Management Capacity for DRVN Staff**

- Planning capacity
- Road facility inspection capacity
- Road maintenance and repair implementation capacity
- Plan evaluation capacity
- Data processing and maintenance capacity
- System management and operation capacity

**2) To Enhance Road Field Management Capacity and Supervision Capacity of Outsourcing for RMB and SB Staff**

- Road facility inspection capacity
- Road maintenance and repair capacity
- Data management capacity

**(3) Development of Training Programs**

In order to enhance the road maintenance and management capacity of DRVN staff, the Project proposes that DRVN take the initiative to build compulsory training programs suited for DRVN business practices and legalize them as formal and regular training programs. Recommended programs are shown below and summarized in **Table 7.14.1**, **Table 7.14.2** and **Table 7.14.3**.

**1) Administration Training (Officer Training)**

Administration training is the training by position or by the number of years of business experience. It is in general given to the person who took a new position in the organization.

Since DRVN already has compulsory Officer Training program almost equivalent to this administration training, it shall not be included in the recommendation of this project.

## **2) Business Sector Training**

Regarding business sector training, it is recommended to develop the following two types of training courses in this category.

The first training shall be for DRVN staff and manager class staff of RMB/SB. It shall improve practical management skills for DRVN major business sectors such as Road Maintenance Management, Traffic Safety and Management, Information Management, Construction Management, Transportation and Vehicle Management etc. It shall provide training on the requirements of businesses including business structure, roles, responsibilities, outputs and so forth. Especially, staff who newly entered into the business sector should propose to attend the training.

The second training shall be for those in charge of site management at RMBs/SBs. It shall provide training on the practical technologies of road maintenance and traffic management such as road inspection/survey, maintenance and repair, traffic counting, quality management/acceptance of outsourcing works and data management required at local RMBs and SBs.

## **3) Advanced Technology Training**

In recent years, evolution of information technology is advancing rapidly, and information technology has already become indispensable to the world of road maintenance and management. It is therefore desirable for DRVN to actively apply these technologies to the improvement of efficiency and economy of road maintenance and traffic management. For this purpose, it is recommended to organize cross-sectional training courses and to provide training on the application of selected technologies. It is also proposed to conduct training for the staff at DRVN departments and RMBs/SBs who actually use these technologies. The proposed technical training is as follows.

- Pavement condition survey
- PMS and VBMS
- Road facility inspection and diagnosis
- Data Registration to Databases
- Application of IT technology to road maintenance
  - PMOS
  - Pavement condition data display system

## **4) E-learning System**

The Project has developed computer software listed below in order to support planning of 5-year pavement repair plans, PMS data processing and pavement monitoring during routine road maintenance. The Project has also conducted training courses, aiming to transfer technologies to DRVN and RMB/SB staff during the project period. However, it is also

important to continue training even after the Project. For this reason, the Project has developed video clips to facilitate implementation of training lectures and self-learning (E-learning system).

- Web-based PMS Data Input System
- Web-based PC Data Display system
- Web-based PMS Operation System
- Web-based PMOS System
- Web-based Data Analysis System
- Web-based Maintenance Technology Information System

**Table 7.14.1 Target of Training and Implementation Methods**

Training Type	Training Course	Target of Training	Frequenc y	Days / course	Lectured by;
1. Officer Training	Apply DRVN existing system				
2. Business Sector Training	(1) Road Maintenance Management Training	To enhance PDCA cycle management capacity including planning and road maintenance management to keep road and traffic service levels in good conditions. Training course for DRVN staff.	Once/year	2 days	DPI/RMMD/ Experts
	(2) Traffic Safety and Management Training	To enhance traffic management capacity including traffic safety, traffic survey, problem identification and solution finding to minimize the negative effects given to road traffic. Training course for DRVN staff.	Once/year	2 days	Traffic Safety Dept/ Experts
	(3) Information Management Training	To enhance information management capacity to maximum use of database and information technologies into daily road asset management. Training course for DRVN staff.	Once/year	2 days	TSEID Information Center/ Experts
	(4) Road Maintenance and Traffic Management Training	To enhance management capacity of road maintenance and traffic management in the field. Training course for RMB and SB staff.	Once/year	2 days	DRVN Departments
3. Advanced Technology Training	(1) Pavement Management System (PMS)	To enhance the operation capacity of PMS system including data processing and plan formulation.	Once/year	1 day	DPI/RMMD/TS EID/ IT Consultant
	(2) Bridge Management System (VBMS)	To enhance the operation capacity of BMS system including data processing and plan formulation.	Once/year	1 day	RMMD/TSEID/ IT Consultant
	(3) Road Database Management	To enhance the operation skill of road DB system including data registration, update and maintenance.	Once/year	1 day	TSEID/ IT Consultant
	(4) Road Facility Inspection And Diagnosis Technology	To enhance road facility inspection skills by road facility including survey, diagnosis and repair work selection.	Once/year	1 day	RMMD/TSEID/ Experts
4. E-learning System (Self-learning)	(1) Web-based PMS Data Input System	To enhance web-based software operation skills at any time with their own time schedule.	As required	As required	TSEID/ Information Center (Technical Support)

(Note) DPI: Planning & Investment Dept. RMMD: Road Maintenance Dept. TSEID: Technology Science, Environment and International Cooperation

**Table 7.14.2 Lecture Contents by Training Type**

Training Type	Training Course	Lecture Contents
1. Officer Training		<ul style="list-style-type: none"> <li>• Apply DRVN existing system</li> </ul>
2. Business Sector Management Training	(1) Road Maintenance Management Training • (for DRVN staff and RMB manager class staff)	<ul style="list-style-type: none"> <li>• Regulations</li> <li>• Road Maintenance Policy</li> <li>• Responsibility assignment</li> <li>• Technical standards, guideline and manuals</li> <li>• 5-year plan / Annual plan</li> <li>• Planning processes &amp; time schedule</li> <li>• PMS/VBMS Functions</li> <li>• Data Processing and Databases</li> <li>• Bridge/Pavement management</li> <li>• Routine maintenance, periodic repair and investment projects</li> <li>• Road patrol, road facility inspection and diagnosis</li> <li>• Damages and deterioration</li> <li>• Repair work selection</li> <li>• Repair cost data management</li> </ul>
	(2) Traffic Safety and Management Training • (for DRVN staff and RMB manager Class)	<ul style="list-style-type: none"> <li>• Regulations</li> <li>• Responsibility assignment</li> <li>• Traffic Management Policy</li> <li>• Traffic control and surveillance</li> <li>• Traffic safety</li> </ul>
	(3) Information Management Training • (for DRVN staff and RMB managers)	<ul style="list-style-type: none"> <li>• Regulations</li> <li>• Responsibility assignment</li> <li>• Information management policy</li> <li>• Systematization of road maintenance</li> <li>• Architecture of DRVN information system</li> <li>• Information system and equipment management</li> <li>• DB management</li> </ul>
	(4) Road Maintenance and Traffic Management Training • (for RMB/SB engineers)	<ul style="list-style-type: none"> <li>• Regulations</li> <li>• Responsibility assignment</li> <li>• Road Patrol</li> <li>• Road facility inspection and road maintenance and repair</li> <li>• Contract management</li> <li>• Inspection and maintenance work supervision</li> <li>• Quality management / Acceptance</li> <li>• Work zone labor safety</li> <li>• Maintenance data registration</li> <li>• Traffic count</li> <li>• Over-loading vehicle control</li> </ul>
3. Advanced Technology Training	(1) Pavement Management System (PMS)	<ul style="list-style-type: none"> <li>• Regulations</li> <li>• Pavement Condition Survey</li> <li>• System operation guideline</li> <li>• System structure</li> <li>• Data processing</li> <li>• System operation</li> </ul>
	(2) Bridge Management System (VBMS)	<ul style="list-style-type: none"> <li>• Regulations</li> <li>• System operation guideline</li> <li>• System structure</li> </ul>

Training Type	Training Course	Lecture Contents
		<ul style="list-style-type: none"> <li>• Data processing</li> <li>• System operation</li> </ul>
	(3) Road Database Management	<ul style="list-style-type: none"> <li>• Regulation</li> <li>• DB Operation Guideline</li> <li>• Database structure</li> <li>• Data registration</li> <li>• Data update</li> <li>• DB maintenance</li> <li>• Responsibility assignment</li> </ul>
	(4) Road Facility Inspection and Diagnosis	<ul style="list-style-type: none"> <li>• Regulations</li> <li>• Road facility inspection guideline</li> <li>• Inspection methods by structure</li> <li>• Inspection results and diagnosis</li> <li>• Data registration</li> <li>• Responsibility assignment</li> </ul>
4. E-learning System	(1) Web-based PMS Data Input System	<ul style="list-style-type: none"> <li>• System operation</li> </ul>
	(2) Web-based PC Data Display system	<ul style="list-style-type: none"> <li>• System operation</li> </ul>
	(3) Web-based PMS Operation System	<ul style="list-style-type: none"> <li>• System operation</li> </ul>
	(4) Web-based PMOS System	<ul style="list-style-type: none"> <li>• System operation</li> </ul>
	(5) Web-based Data Analysis System	<ul style="list-style-type: none"> <li>• System operation</li> </ul>
	(6) Web-based Maintenance Technology Information System	<ul style="list-style-type: none"> <li>• System operation</li> </ul>

**Table 7.14.3 Expected Trainees**

Training Type	Training Course	DRVN					RMBs/SBs	
		DPI	Finance Dept	RMMD	TSEID	Traffic Safety Dept.	Management staff	Engineers
1. Officer Training	Apply DRVN existing system							
2. Business Sector Training	(1) Road Maintenance Management Training	X	X	X	X		X	
	(2) Traffic Safety and Management Training	X	X		X	X	X	
	(3) Information Management Training	X	X	X	X	X	X	

Training Type	Training Course	DRVN					RMBs/SBs	
		DPI	Finance Dept	RMMD	TSEID	Traffic Safety Dept.	Management staff	Engineers
	(4) Road Maintenance and Traffic Management Training							X
3. Advanced Technology Training	(1) Pavement Management System (PMS)	X		X	X			X
	(2) Bridge Management System (VBMS)	X		X	X			X
	(3) Road Database Management	X		X	X			X
	(4) Road Facility Inspection and Diagnosis Technology			X	X			X
4. E-learning System (Self-learning)	(1) Web-based PMS Data Input System	X					X	
	(2) Web-based PC Data Display System							
	(3) Web-based PMS Operation System							
	(4) Web-based PMOS System							
	(5) Web-based Data Analysis System							
	(6) Web-based Maintenance Technology Information System							

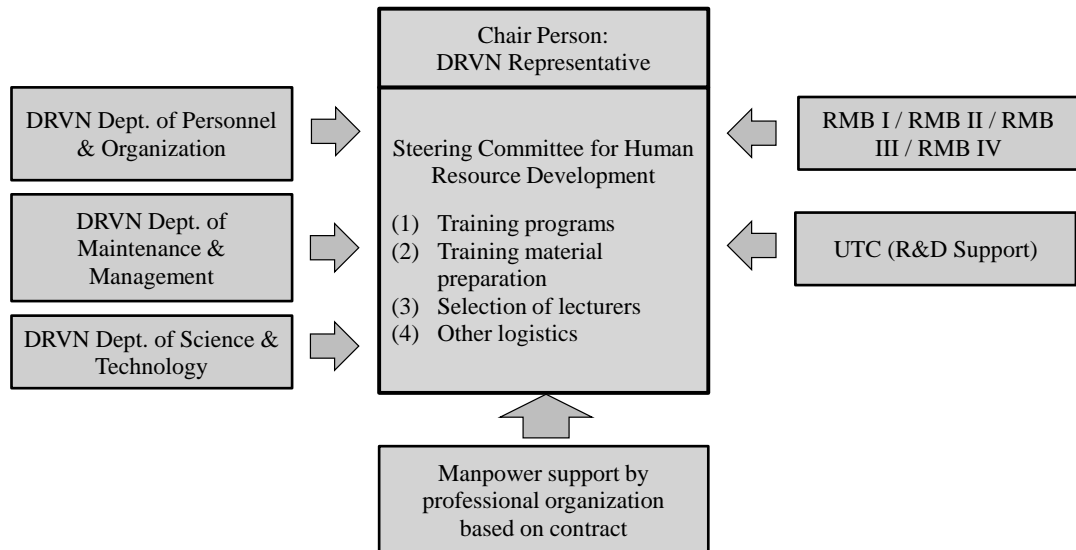
#### 7.14.2 Responsibility Assignment for the Management of Human Resource Development

##### (1) Establishment of Steering Committee for Human Resource Development

For the successful implementation of training courses, it is important to keep maintaining cooperation with neighbour organizations including the dispatch of lectures. It is also important for DRVN to take a leading role in the planning and implementation of training programs. For this purpose, DRVN is recommended to set up a steering committee for human resource development and to implement training management under the leadership of chairperson. The steering committee is a useful tool for the management of the project where many stakeholders get together.

However, the steering committee is not an organization to conduct manpower tasks of training coordination, but a management organization for the smooth implementation of training programs, so that DRVN is recommended to set up a supporting system specialized for conducting manpower coordination tasks by applying road maintenance fund and contracting out to the competent institution outside of DRVN on a contract basis.

In order to set up this training support function within the current DRVN organization, Personnel and Organization Department, it is necessary to strengthen the organizational structure and personnel, and it is assumed that it is difficult to realize this under the current State Budget.



**Figure 7.14.1 DRVN Steering Committee for Human Resource Development**

**(2) Installation of Training Support System**

In order to carry out training programs, training coordination becomes very important. Training coordination has the following LOGISTICS operations. Since this LOGISTICS work is expected to increase as the number of training programs increases in the future, it is recommended to conclude an outsourcing agreement with a competent institution and establish a supporting system.

- Planning of training programs training courses
- Development of training materials
- Selection of lectures and their invitation
- Adjustment of training schedule
- Liaison between lectures or trainees
- Prepare training room and facilities
- Prepare accommodation for trainees
- Settlement of travel costs for lecturers and trainees

The following are the recommended supporting institutions.

- Universities and colleges such as UTC, UTT and Northern College
- Associations such as Road and Bridge Association etc.
- Foundation of DRVN own training center

The Project recommends the use of either UTC, UTT or Road and Bridge Association as a competent agency which is qualified for the knowledge and the experience on road administration and road maintenance. Playing a leading role in managing training programs and sharing manpower LOGISTICS work to the competent agency, DRVN can concentrate



on the management task and accumulate know-how of human resource development in its organization.

Human resource development is essentially an important responsibility of DRVN. Therefore, if increase in training programs is needed in the future due to the expansion of national road network and due to the diversification of DRVN responsibilities, DRVN may go into the next stage of establishing its own training center and operating it with accumulated know-how. This shall a future road map.

**(3) Others**

The roads in Vietnam are currently managed by various road operators including PDOTs for national and provincial road management and VEC for expressway management. Also, BOT companies recently actively participate in road maintenance and management in Viet Nam. However, for such small operators unlike DRVN, it will be very hard for them to develop their own human resource programs due to limited staff resource available. As road management environment is now rapidly changing, so that MOT is requested to have a future vision of human resource development for all organizations involved in road maintenance and management. DRVN can support these organizations to develop human resource by applying accumulated know-how of training programs. Also, existing training organizations such as UTT and Northern College can also provide training to engineers involved in road maintenance in the field.

## **CHAPTER 8 PLAN AND IMPLEMENT TRAINING PROGRAMS AND SUPPORT PUBLIC RELATION ACTIVITY (MEASURE 5)**

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### **8.1 PLANNING AND IMPLEMENT TRAINING PROGRAMS**

In order to ensure sustainable implementation of the project outputs, the Project places high priority on the technology transfer of the project outputs to the DRVN officials and the staff. The Project prepares various training programs, which fall into the following classifications. Each of the programs is outlined hereinafter in the following sections.

- (1) “During-Project” Training Program for Project Outputs
  - Seminar
  - Workshop
  - On-the-Job Training (OJT)
  - PMS Intensive Training
  - Special OJT for Pavement Condition Survey
- (2) Training in Japan
- (3) “Post (After)-Project” Training Program for Project Outputs
- (4) Future Training Programs for Road Asset Management (RAM)
- (5) Country-Focused Training Program on RAM
- (6) JICA Scholarship Study in Japan

### **8.2 CURRENT STATUS STUDY ON “DRVN” HUMAN RESOURCE DEVELOPMENT PROGRAMS**

Before going into the development of the above training programs, the Project Team, in cooperation with the WG 3, conducted the current status survey under JICA Phase I Project on the followings:

- (1) Training institutions and organizations;
- (2) Training implemented under the DRVN, RMBs, RTCs and SBs.

The results of the study have been updated during the course of Phase II Project (refer to Appendix 8.1).

From the said study, it has been confirmed that the regular training programs on the road maintenance are yet to be established, and the trainings have not been sufficiently offered to the officials and the staff of the DRVN, RMBs, SBs and the RTCs in order to deliver PDCA cycle on the road maintenance.

### 8.3 FOREIGN PRACTICES – HUMAN RESOURCE DEVELOPMENT PROGRAMS IN JAPAN

#### 8.3.1 National Road Human Resource Development Program – MLIT Practice

##### (1) MLIT Training Programs

The MLIT (Ministry of Land, Infrastructure, Transport and Tourism) offers regular trainings with emphasis on the improvement of the maintenance and the management capacity including the supervision of the outsourcing operations. The MLIT has various training institutions (e.g. own college, in-house trainings, technical offices, etc.). The MLIT College makes it possible to provide systematic and high quality trainings on the MLIT managing fields to the officials, which includes the road administration. Technical trainings are provided at the Technical Offices under the Regional Development Bureaus (RDB) of the MLIT.

##### (2) Local Government Training Programs

The local government provides the training opportunities to their civil servants at the respective local levels. In addition, the MLIT College shares a part of the training programs to the local government officials. Likewise, the Japan Construction Training Centre (JCSC) and the RDB Technical Offices accept the trainees from the local government.

#### 8.3.2 Expressway Human Recourse Development Program – NEXCO-Central Japan

NEXCO has established its own training institution, Human Resource Development Center, and provides extensive training on the administrative/management and technical trainings on their management field. The trainings are conducted at the NEXCO training centers/technical training centers, also external training institutions, research institutions, and the MLIT College. The NEXCO Central offers the following 3 training programs and develops the detailed training programs. They offer the trainings to the staff of the private companies as well as the subsidiary companies.

##### (1) Administration Training (same as the Officer Training for DRVN Staff)

Administration Training is the program organized on the basis of the position or work experiences. In general, it is given to the officials who took new position in the organization. The frequency of the trainings is once 2 to 3 years, and there are currently about 16 courses categorized into 7 as shown in the below Table. Lecturers are selected from the NEXCO group or the external agencies.

**Table 8.3.1 Category of Administration Training and Number of Course**

	Training Category	No. of Course
1	New Employee Training	4
2	Second Year Training	1
3	Senior Engineer I Training (up to 5 year-working experiences)	2
4	Senior Engineer II (5 to 10 year-working experiences) Training	2
5	Manager Training	4
6	Office Director Training	2
7	Department Director Training	1

### 1) Business Sector Training

Business Sector Training is implemented with an aim of improving the management skills of the business departments in charge, examples are shown below. Training of how to apply the technical standards is also included in the program. There are about 18 courses categorized into 9 as shown in the below Table. The trainees are not only from the NEXCO Central but also from group companies. The lecturers are selected from the NEXCO group and from the external competent agencies.

**Table 8.3.2 Category of Business Sector Training and Number of Course**

	<b>Training Category</b>	<b>No of Course</b>
1	Basic Training on Road Construction Management Technology (Civil Engineering, Facilities)	3
2	Construction Management Training	3
3	Structural Inspection Management Training	3
4	Crisis Management/Disaster Prevention Training	2
5	Toll Collector Training	1
6	Traffic Management Training	1
7	Bridge Management Training	2
8	Information Management Technology (RIMS)	1
9	Electric Facility Training	2

### 2) Advanced Technology Training

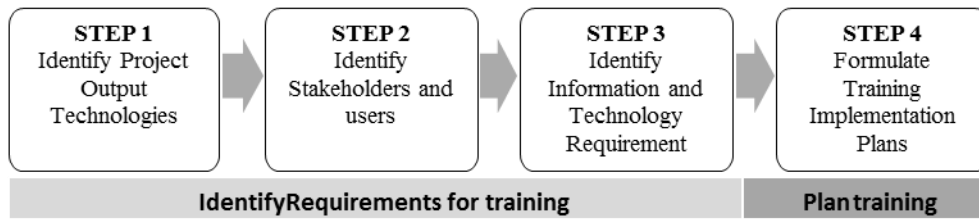
Advanced Technology Training aims to train the advanced technology of construction and management of each road structure crossing over hierarchy and business divisions. There are about 10 courses, and the priority technical fields, such as bridge, tunnel, environment, earthwork, etc., are selected. The trainees are not only from the NEXCO Central but also from the group companies. The professional engineers are to be selected as lecturers.

## 8.4 PROCEDURES FOR PLANNING TRAINING PROGRAMS

In order to implement the training programs in the most effective (including the cost) and efficient manner, the Project Team developed training implementation plans in collaboration with the WG 3. The training implementation plans provide the detailed information (e.g. schedule, duration, contents, target groups, trainers and materials), with consideration of the progress of the Project activities. Once the plan was agreed before implementation, the details were discussed among the experts of the Project and the WGs.

The “Step by Step” approach has been applied to the formulation of the implementation plans as shown in the **Figure 8.4.1**. From Step 1 to Step 3 are to identify the requirements for the trainings, and Step 4 is to plan the training implementation plans based on these requirements.

- Step 1: Identify output technologies produced in the Project
- Step 2: Identify responsible agencies (stakeholders) and users in charge of developing, distributing and utilizing these technologies.
- Step 3: Identify information and technology needed for technology transfer to these responsible agencies and stakeholders
- Step 4: Formulate Training Programs Implementation Plans:



**Figure 8.4.1 Steps of Training Program Development**

**8.4.1 Identification of Project Output Technologies (STEP 1)**

Outputs produced by the Project are all listed in the **Table 8.4.1**. In addition, responsible WGs involved in the development of the outputs are shown in the same Table. Development of the training programs lies under the WG-3 management.

**Table 8.4.1 Project Activities, Outputs and Responsible Agencies**

Project Activities	Project Output	Responsible Agency
<b>MEASURE 1: Improve PMS data formulation technology</b>		
<ul style="list-style-type: none"> <li>Formulate PMS Database</li> <li>Develop Web-based PMS Data Input System</li> </ul>	<ul style="list-style-type: none"> <li>PMS data</li> <li>Web-based PMS Data Input System</li> </ul>	WG-1
<ul style="list-style-type: none"> <li>Implement Pavement Condition Survey</li> </ul>	<ul style="list-style-type: none"> <li>Pavement Condition Database</li> </ul>	
<b>MEASURE 2: Upgrade PMS to apply road network of RMB I, II, III, and IV, and formulate draft repair work plan</b>		
<ul style="list-style-type: none"> <li>Upgrade PMS</li> <li>Formulate PMS Dataset</li> <li>Formulate Pavement Repair Work Draft Plan</li> <li>Develop web-based PMS Operation System</li> <li>Develop Web-based System for Displaying Pavement Condition Survey Data</li> <li>Develop Web-based Analysis System for Pavement Condition Survey Data</li> <li>Develop Web-based Pavement Monitoring System</li> </ul>	<ul style="list-style-type: none"> <li>Data Conversion System</li> <li>PMS Dataset</li> <li>Web-based PMS Operation System (budget planning/ repair work planning)</li> <li>Annual and 5-year Repair Work Plan</li> <li>Web-based System for Displaying Pavement Condition Survey Data</li> <li>Web-based Analysis System for Pavement Condition Survey Data</li> <li>Web-based Pavement Monitoring System</li> </ul>	WG-1
<b>MEASURE 3 Improve inspection and repair work selection technology on road facility and develop technical standards</b>		
<ul style="list-style-type: none"> <li>Implement, Monitor and Evaluate Pilot Repair Works on Pavement Repair Technology</li> </ul>	<ul style="list-style-type: none"> <li>Evaluation report of Pilot Repair Works</li> </ul>	WG-2
<ul style="list-style-type: none"> <li>Upgrade Road Facility Inspection Guideline</li> </ul>	<ul style="list-style-type: none"> <li>Road Facility Inspection Guideline</li> </ul>	
<ul style="list-style-type: none"> <li>Upgrade Road Routine Maintenance Manual</li> </ul>	<ul style="list-style-type: none"> <li>Road Routine Maintenance Manual</li> </ul>	
<b>MEASURE 4: Clarify administrative procedure and responsibility assignment for road maintenance</b>		
<ul style="list-style-type: none"> <li>Prepare Amendment Plan for Road Maintenance Responsibility Assignment</li> </ul>	<ul style="list-style-type: none"> <li>Draft plan for Maintenance Responsibility Assignment</li> <li>Draft Amendment Plan of Regulation for Responsibility Assignment</li> </ul>	WG-2
<ul style="list-style-type: none"> <li>Prepare Amendment Plan for Road Maintenance Administrative Procedure</li> </ul>	<ul style="list-style-type: none"> <li>Recommendation on the Improvement of Road Maintenance Procedures</li> <li>Revision Plan of Relevant Regulations</li> </ul>	
<b>MEASURE 5: Plan and implement training programs and develop PR tools and materials</b>		
<ul style="list-style-type: none"> <li>Plan and implement training programs</li> </ul>	<ul style="list-style-type: none"> <li>Training Programs for During-project, Post-Project and Future Training</li> </ul>	WG-3
<ul style="list-style-type: none"> <li>Develop PR tools and materials</li> </ul>	<ul style="list-style-type: none"> <li>Annual Report, Video Crip, General Information Brochure, Road Maintenance Technology Web Operation System</li> </ul>	

### 8.4.2 Identification of Stakeholders (STEP 2)

In the STEP 2, the Project clarified targeted stakeholders through discussion with the WG 3 as shown in the Table 8.4.2. Stakeholders include those who are involved in the development, implementation, maintenance and the distribution of the Project output technologies.

**Table 8.4.2 Stakeholder’s Information**

Region	Work Position	Target Stakeholder
Central Level	Institutional Level	Members of TWG and DRVN major departments, MOT, research and academic institutions and any other decision makers.
	Management Level	Director, Deputy Director level of DRVN major departments
	Engineer Level	Engineer of DRVN major Departments, RTC Central
Regional Level	Management Level	Director, Deputy Director level of RMBs, RTCs and Sub Bureaus
	Engineer Level	Engineers of RMBs, SBs, RTCs

### 8.4.3 Identification of Information and Technology Required (STEP 3)

Information and technology required for each stakeholder to develop, implement, maintain and to distribute these technologies were thoroughly examined. Table 8.4.3 summarizes the requirement of information and technologies by the targeted work position.

**Table 8.4.3 Required Information and Technologies**

Output	Responsible Department/Unit	Target Work Position	Required Information and Technologies
<b>MEASURE 1 Improve PMS data formulation technology</b>			
<ul style="list-style-type: none"> <li>PMS data</li> <li>Web-based PMS Data Input System</li> </ul>	WGs responsible for outputs	Institutional Level	<ul style="list-style-type: none"> <li>General Guidance on PMS data &amp; Web-based PMS Data Input System</li> </ul>
		Management Level	<ul style="list-style-type: none"> <li>General Guidance on PMS data &amp; Web-based PMS Data Input System</li> </ul>
		Engineer Level	<ul style="list-style-type: none"> <li>General guidance on PMS data and web based PMS data input system</li> <li>System Operation (data input)</li> <li>System Operation (edit and assembling)</li> <li>Monitoring of data inputting</li> <li>Validation of input data</li> <li>System maintenance, upgrade and management</li> </ul>
Pavement Condition Survey data	WGs responsible for outputs	Institutional Level	<ul style="list-style-type: none"> <li>General Guidance on Pavement Condition Survey</li> </ul>
		Management Level	<ul style="list-style-type: none"> <li>General Guidance on Pavement Condition Survey</li> </ul>
		Engineer Level	<ul style="list-style-type: none"> <li>General Guidance on Pavement Condition Survey</li> <li>Preparation of survey</li> <li>Operation of on Board Equipment &amp; Survey Vehicle</li> <li>Survey</li> <li>Analysis</li> <li>Data Management</li> <li>System Operation (analysis system for pavement condition survey data)</li> <li>System Maintenance &amp; Management</li> </ul>
<b>MEASURE 2 Upgrade PMS to apply road network of RMB I, II, III, and IV, and formulate draft repair work plan</b>			
<ul style="list-style-type: none"> <li>Web-based PMS operation system</li> <li>Data conversion system</li> <li>PMS dataset</li> <li>Annual/3 year</li> </ul>	WGs responsible for outputs	Institutional level	<ul style="list-style-type: none"> <li>General Guidance on PMS</li> </ul>
		Management Level	<ul style="list-style-type: none"> <li>General Guidance on PMS</li> </ul>
		Engineer Level	<ul style="list-style-type: none"> <li>General Guidance on Web-based system</li> <li>System operation (initial dataset)</li> </ul>

Output	Responsible Department/Unit	Target Work Position	Required Information and Technologies
<ul style="list-style-type: none"> <li>• repair work plan</li> <li>• Web-based PMS Operation System</li> </ul>			<ul style="list-style-type: none"> <li>• System operation (pavement deterioration prediction)</li> <li>• System operation (budget planning / annual, 5 year planning)</li> <li>• Data management</li> <li>• System maintenance, upgrade and management</li> </ul>
Web-based system for displaying pavement condition survey data	WGs responsible for outputs	Institutional Level	<ul style="list-style-type: none"> <li>• General Guidance on Web-based system</li> </ul>
		Management Level	<ul style="list-style-type: none"> <li>• General Guidance on Web-based system</li> </ul>
		Engineer Level	<ul style="list-style-type: none"> <li>• General Guidance on Web-based system</li> <li>• System Operation using Surveyed Data</li> <li>• Data Management</li> <li>• System Maintenance, Upgrade and Management</li> </ul>
Web-based analysis system for pavement condition survey data	WGs responsible for outputs	Institutional Level	<ul style="list-style-type: none"> <li>• General Guidance on Web-based System</li> </ul>
		Management Level	<ul style="list-style-type: none"> <li>• General Guidance on Web-based System</li> </ul>
		Engineer Level	<ul style="list-style-type: none"> <li>• General Guidance on Web-based System</li> <li>• Selection of Analysis Items</li> <li>• System Operation</li> <li>• Data Management</li> <li>• System Maintenance, Upgrade and Management</li> </ul>
<b>MEASURE 3 Improve inspection and repair work selection technology on road facility and develop technical standards</b>			
Evaluation report of pilot repair works		Institutional Level	<ul style="list-style-type: none"> <li>• General Guidance on Evaluation report of Pilot Repair Works</li> <li>• Legalization of Standards</li> </ul>
		Management Level	<ul style="list-style-type: none"> <li>• General Guidance on Evaluation report of Pilot Repair Works</li> <li>• Legalization of Standards</li> </ul>
		Engineer Level	<ul style="list-style-type: none"> <li>• Outline of Pilot Repair Works</li> <li>• Standardization Policy of Pavement Repair Technologies by Pilot Project</li> <li>• Evaluation Report of Pilot Repair Works</li> <li>• Legalization of Standards</li> </ul>
Road Facility Inspection Guideline	WGs responsible for outputs	Institutional level	<ul style="list-style-type: none"> <li>• General Guidance on Road Facility Inspection Guideline and its Application</li> </ul>
		Management Level	<ul style="list-style-type: none"> <li>• General Guidance on Road Facility Inspection Guideline and its Application</li> </ul>
		Engineer Level	<ul style="list-style-type: none"> <li>• General Guidance on Road Facility Inspection Guideline and its Application</li> <li>• Inspection and Data Registration on site on pavement, slope /retaining wall, bridge, drainage and other road facilities</li> </ul>
Road Routing Maintenance Manual		Institutional Level	<ul style="list-style-type: none"> <li>• General Guidance on Routine Maintenance Manual and its Application</li> </ul>
		Management Level	<ul style="list-style-type: none"> <li>• General Guidance on Routine Maintenance Manual and its Application</li> </ul>
		Engineer Level	<ul style="list-style-type: none"> <li>• General Guidance on Routine Maintenance Manual and its Application</li> <li>• Application of Road Routine Maintenance Manual to pavement, slope and retaining wall, bridge, drainage and other road facilities.</li> </ul>
<b>MEASURE 4 Clarify administrative procedure and responsibility assignment for road maintenance</b>			
Draft amendment	WGs	Institutional	<ul style="list-style-type: none"> <li>• Introduction of the draft amendment plan for state</li> </ul>

Output	Responsible Department/Unit	Target Work Position	Required Information and Technologies
plan of regulation for responsibility assignment	responsible for outputs	Level	management responsibility assignment
		Management Level	
		Engineer Level	
Recommendation on the improvement of road maintenance procedures		Institutional level	<ul style="list-style-type: none"> <li>• Introduction of the draft amendment plan of road maintenance procedures</li> </ul>

#### 8.4.4 Formulation of Training Implementation Plans (STEP 4)

Based on the information on the Project output technologies and stakeholders identified in the previous sections, the Project formulated implementation plans for each training program listed in "8.1.Planning and Implement Training Programs".

### 8.5 IMPLEMENTATION PLAN FOR “DURING PROJECT” TRAINING

#### 8.5.1 Classification of Training Programs

In this Project, there are 3 types of training courses applied to the “During Project” Training Program, namely “Seminar”, “Regional Workshop” and ”On-the-Job Training (OJT)”.

##### (1) Seminar

“Seminar” has been used as a tool for providing information on the RAM. This targets the ministerial level decision makers in the MOT, MPI and the MOF, and high ranking officials in the DRVN who are influential to the road maintenance and management in terms of arranging the organization, officials/staff, budgeting, promulgating regulations and so forth.

In the Seminars, by inviting these stakeholders from the wider fields who are involved in the institutional arrangement of the road maintenance and management, the Project has presented not only the progress report of this Project but also the information on the foreign practices of the road maintenance and management. That includes the institutional arrangement and the advanced technologies in Japan.

##### (2) Regional Workshop

“Regional Workshop” is a course intended to provide information on the work plans, progress and final outputs of this Project to managerial officials/staff in the RMB, SBs and the RTCs. It also provides key information on RAM, PDCA cycle management of the road maintenance, etc.

##### (3) OJT

“OJT” is a training tool to provide practical as well as technical information, such as the operational method of Project outputs, to young officials/staff (engineer level) of the DRVN, RMBs, SBCs and the RTCs who are expected to handle the technologies of the Project outputs. In this Project, OJTs were implemented together with regional workshops within the same day.

##### (4) PMS Intensive Training

Pavement Management System (PMS) is a web-based pavement management system consisting of many processes in formulating PMS data set, 5-year budget plans for planning



and the road pavement repair plans, which may require in-depth technology transfer to the stakeholders. PMS intensive training is to transfer professional knowledge specialized for PMS operation including practical exercise for system operation to those who are directly involved in PMS operation. The training is provided by JICA experts together with IT consultants in charge of developing PMS software system.

**(5) Special OJT on Pavement Condition Survey**

The Project conducted pavement condition surveys by applying the special survey vehicle provided by JICA to the DRVN during the Phase I Project for the RMB I. The surveys which implemented during Phase II Project covered the road network managed by the RMB II, RMB III and the RMB IV. The Training is to provide information on the survey vehicle and equipment operation, also on the survey mechanisms of detecting pavement deterioration to the RMB officials/staff that cooperate with this survey in their regions.

**8.5.2 Focus Points of “During Project” Training**

The focus points of the training at each Project year are described in the below Table. Further details of the respective trainings will be described in the following section.

**Table 8.5.1 Training Focus Points by Project Year**

<b>Project Year</b>	<b>Focus Points</b>
1st year of training	Introduction on the Project activities Introduction on RAM Information dissemination on the Project progress and exchange of opinions
2nd year of training	Information dissemination of the Project progress Technical transfer on the operation and the application of the Project outputs
3rd year of training	Report on the results of the Project activities and the recommendation Final technical transfer on the operation and application of the Project outputs

**8.5.3 Training Programs**

In line with planning procedures discussed above, training programs were formulated and set as an implementation guideline. Table 8.5-6 summarizes the training programs formulated for the workshops and the OJTs.

**8.5.4 Training Coordination**

DRVN is requested to play a leading role in coordinating and implementing training programs, receiving technical support from subordinate departments in the DRVN. The followings are the roles and responsibilities of the DRVN departments involved in the training.

- (1) Department of Science, Technology, Environment and International Cooperation (PC: Project Counterpart), takes responsibility of conducting overall coordination and developing training programs in cooperation with JICA Project Team.
- (2) Department of Road Maintenance Management is requested to conduct lectures in the workshops and the OJTs on the current status and the points of interest in the national road maintenance in Viet Nam.
- (3) Personnel Department of DRVN is assigned to be a coordinator of all training programs and plays an important bridge role between the DRVN, JICA Project Team and the regional subordinate organizations (RMBs and SBs).

### 8.5.5 Selection of Trainees

DRVN Personnel Department is in charge of selecting appropriate trainees in line with this Training Program Implementation Plan based on the information on the project outputs and on the stakeholders identified in STEP 1 and STEP 2. For 5 times of regional workshops and OJTs, about 60 officials/staff were selected as trainees each time for each region at the RMB I, RMB II, RMB III and the RMB IV.

### 8.5.6 Selection of Venues

Based on the careful consideration of the training budget, trainers, and equipment available, the Project has planned the trainings in 4 regions of the RMBs, namely Hanoi, Vinh, Da Nang and Ho Chi Minh. This allows ensuring dissemination of the trainings to the nationwide officials, staff and also the others from the regional agencies to attend. Moreover, it allows obtaining feedback from those participants. Seminars are held in Hanoi only. The Project appreciates RMBs offered their offices as training venue for the regional workshops and OJTs.

### 8.5.7 Frequency and Training Schedule

Concerning the human resource development, it is crucial that the trainings are provided to the right target groups regularly for sufficient duration and frequency. In particular, the technical subjects require regular trainings to assure proper and stable capacity of the stakeholders, as well as to transfer and update the latest technologies.

In this Project, 2 Seminars to introduce RAM and 5 regional trainings (Workshop and OJTs) for the technical transfer of the Project outputs were planned as “During project” training programs as shown in the **Table 8.5.2**.

**Table 8.5.2 Training Schedule (Initial Planning)**

ITEMS	2015												2016												2017												2018			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
JCC / TWG				▲ JCC			△			△			△			▲ JCC			△			△					▲ JCC			△			△							
Seminar (Hanoi)																																								
Workshop																																								
OJT/ Computer based Training																																								
Training in Japan																																								

### 8.5.8 Training Material and Equipment Required

As primary training materials, the Project utilizes outputs of the Project such as software system, guidelines/manuals, and supplemental materials as required. Equipment such as PCs and inspection tools, as well as venue and permission required are also arranged prior to the training implementation.

The following are the materials and equipment prepared for the regional workshops and OJTs.

**(1) Pavement Condition Survey Vehicle**

For the training of the pavement condition survey, the vehicle which was procured during the Phase I Project has been utilized for the training on the pavement condition survey. The vehicle has been operating for the survey across Viet Nam under Activity 1-2 of the Project. Taking advantage of this situation, OJTs have been also using this procured vehicle.

**(2) Materials and Equipment for OJTs on Technical Standards**

**Table 8.5.3** shows the list of materials and equipment prepared for the implementation of the field survey for technical standards. Preparation was done in close cooperation with JICA Project Team and the RMBs.

**Table 8.5.3 Material and Equipment for OJTs on Technical Standards**

Classification	Material and Equipment	Prepared by	Quantify
Item-1: To be prepared by RMBs	Hand shovel	RMBs	1 set
	Survey Pole (2 m long)	RMBs	2 sets
	Traffic Control Unit (or device) (with traffic control permission)	RMBs	Cones: 6 sets/ Traffic sign: 2 sets /Flags: 2 sets
Item-2: To be prepared by JICA Team	Safety uniforms (Helmet, Safety Jacket)	JICA Team	120 sets
	Steel measuring tape (5m long)	JICA Team	120 sets
	Linen measuring tape (30m-50m long)	JICA Team	4 sets
	White board & markers	JICA Team	4 sets
	Crack scale	JICA Team	120 sets
	Survey notes & ball point pens	JICA Team	120 sets
	Hand speaker	JICA Team	4 sets

**(3) Materials and Equipment for OJTs on PMS**

**Table 8.5.4** also shows the equipment to be prepared for PMS lectures in the OJTs. The Project Team arranged the Laptop PCs by leasing.

**Table 8.5.4 Equipment for OJTs on Pavement Management System (PMS)**

Material and Equipment	Quantify	Note
Laptop PC	20 sets	For each time each region

**8.5.9 Cost Sharing**

JICA Project Team and DRVN discussed the issue on the cost sharing, and agreed at the 1<sup>st</sup> JCC in April 2015, as shown in the **Table 8.5.5**. Prior to organizing the training, the contents of the cost sharing have been reviewed and revised at each time. The budget has been secured and executed accordingly.

**Table 8.5.5 Cost Sharing**

Training Style	Items	DRVN	JICA	Note
Seminar	Venue including equipment, flower and banner		x	
	Tea and lunch		x	
	Training materials		x	
	Cost for Vietnamese attendants and speakers	x		As agreed on R/D
	Cost for Japanese attendants and speakers		x	

Training Style		Items	DRVN	JICA	Note
		Cost for attendants from ASEAN countries		x	
Regional Training	Work-shop	Venue including equipment	x		Available room of RMBs
		Training materials		x	
		Cost for Vietnamese attendants and trainers	x		As agreed on R/D
		Cost for Japanese attendants and trainers		x	
	OJT	Venue if required	x		Available room of RMBs
		Training materials, equipment, vehicle using during OJTs		x	
		Cost for Vietnamese attendants and trainers	x		As agreed on R/D
		Cost for Japanese attendants and trainers		x	

Note: Costs for Vietnamese attendants and speakers include transport, accommodation and per-diem.

### 8.5.10 Other Consideration Required

Viet Nam Road Asset Management Project (VRAMP) funded by the World Bank has commenced in November 2015, and it had a plan to conduct a series of trainings from 2016 autumn. Close coordination is required for the training proposed by JICA and the WB for efficient and effective delivery, and also for maximum outputs.

**Table 8.5.6 Formulation of Training Plans for Workshops and OJTs**

Training	Date/ Duration	Trainer / Speaker	Venue	Seminar/ Workshop (Information provision)	OJT (Technical Transfer Training)			
					Measure 1 Improve PMS Data Collection and Processing Technology	Measure 2 Upgrade PMS to Apply Road Network of RMB I, II, III, and IV, and Formulate Draft Repair Work Plan	Measure 3 Improve Inspection and Repair Work Selection Technology on Road Facility and Develop Technical Standards	Measure 4 Enhance Responsibility Assignments and Administration Procedures for Road Maintenance
<b>FIRST YEAR</b>								
1 <sup>st</sup> Training	2015 Jul 1day	DRVN JICA experts	RMB I, II, III, IV	<ul style="list-style-type: none"> <li>• Current status and plans of road maintenance in Viet Nam</li> <li>• Project Work Plan</li> <li>• Road maintenance institutions in Japan</li> <li>• Expressway pavement in Japan</li> <li>• Results of pavement condition survey in RMBI</li> </ul>	‘-----	‘-----	‘-----	‘-----
		DRVN JICA experts	RMB I, II, III, IV	‘-----	PMS Database Data Input System (offline system)	‘-----	‘-----	‘-----
<b>SECOND YEAR</b>								
2 <sup>nd</sup> Training	2016 May 1day	DRVN JICA experts	RMB I, II, III, IV	<p>Topics are to be selected from the followings;</p> <ul style="list-style-type: none"> <li>• The 1<sup>st</sup> progress report on JICA Project</li> <li>• Legalization of Project outputs</li> <li>• Database management in Japan</li> <li>• R&amp;D on maintenance technology development in Japan</li> <li>• Road maintenance training programs in Japan</li> <li>• Expressway asset management in Japan</li> <li>• Guideline / Manuals for road maintenance &amp; management in Japan</li> <li>• Introduction of advanced maintenance &amp; inspection technology in Japan</li> </ul>				

Training	Date/ Duration	Trainer / Speaker	Venue	Seminar/ Workshop (Information provision)	OJT (Technical Transfer Training)			
					Measure 1 Improve PMS Data Collection and Processing Technology	Measure 2 Upgrade PMS to Apply Road Network of RMB I, II, III, and IV, and Formulate Draft Repair Work Plan	Measure 3 Improve Inspection and Repair Work Selection Technology on Road Facility and Develop Technical Standards	Measure 4 Enhance Responsibility Assignments and Administration Procedures for Road Maintenance
				<ul style="list-style-type: none"> <li>• Introduction of New Technology Registration System (NETIS) in Japan</li> <li>• Engineer qualifications in Japan</li> <li>• Introduction of road maintenance in foreign countries</li> <li>• Introduction of PR in road sector in Japan</li> <li>• Exchange of opinions</li> </ul>				
3 <sup>rd</sup> Training	2016 Nov	DRVN JICA experts	RMB I, II, III, IV		<p>[Web-based PMS Database Data Input System]</p> <ul style="list-style-type: none"> <li>• General guidance on PMS data and web based PMS data input system</li> <li>• System operation (data input)</li> <li>• System operation (edit and assembling)</li> <li>• Monitoring of data inputting</li> <li>• Validation of input data</li> <li>• System maintenance, upgrade and management</li> </ul> <p>[Pavement Condition Survey]</p> <ul style="list-style-type: none"> <li>• Progress of pavement condition survey</li> <li>• Results of pavement condition survey data</li> </ul>	<p>[Web-based System for Displaying Pavement Condition Survey Data]</p> <ul style="list-style-type: none"> <li>• General guidance on web-based system</li> <li>• System operation using surveyed data</li> <li>• Data management</li> <li>• System maintenance, upgrade and management</li> </ul> <p>[PMS]</p> <ul style="list-style-type: none"> <li>• Basic concept</li> <li>• Functions</li> <li>• Data requirements</li> <li>• Preparation of PMS Dataset (RMB I &amp; IV)</li> <li>• Preparation of simulation condition data (e.g. Cost unit) (RMB I &amp; IV)</li> <li>• Computation flow</li> <li>• Development of pavement repair work</li> </ul>	<p>[Pilot Repair Works]</p> <ul style="list-style-type: none"> <li>• Outline of pilot repair works</li> <li>• Standardization policy of pavement repair technologies by pilot project</li> </ul> <p>[Road facility inspection guideline]</p> <ul style="list-style-type: none"> <li>• Based on agreed road facility inspection guideline</li> <li>• Outline of Road Facility Inspection Guideline and its application</li> <li>• Pavement inspection and data registration on site</li> <li>• Inspection of slope /retaining wall and data registration on site</li> </ul> <p>[Road Routine Maintenance Manual]</p> <ul style="list-style-type: none"> <li>• Based on agreed Routine Maintenance Manual;</li> </ul>	<p>[Road Maintenance Responsibility Assignments and Administrative Procedure]</p> <ul style="list-style-type: none"> <li>• New technology introduced by JICA Project</li> <li>• Exchange of opinions on improvement of responsibility assignments and administrative procedure</li> </ul>

Training	Date/ Duration	Trainer / Speaker	Venue	Seminar/ Workshop (Information provision)	OJT (Technical Transfer Training)			
					Measure 1 Improve PMS Data Collection and Processing Technology	Measure 2 Upgrade PMS to Apply Road Network of RMB I, II, III, and IV, and Formulate Draft Repair Work Plan	Measure 3 Improve Inspection and Repair Work Selection Technology on Road Facility and Develop Technical Standards	Measure 4 Enhance Responsibility Assignments and Administration Procedures for Road Maintenance
					analysis in RMB I & IV <ul style="list-style-type: none"> <li>Exchange of opinions</li> </ul>	plan using RMB I & IV data <ul style="list-style-type: none"> <li>General guidance on Web-based system</li> <li>Exchange of opinions</li> </ul>	<ul style="list-style-type: none"> <li>Outline of Routine Maintenance Manual and its application</li> <li>Application of Road Routine Maintenance Manual to pavement, slope and retaining wall.</li> <li>Exchange of opinions</li> </ul>	
<b>THIRD YEAR</b>								
4 <sup>th</sup> Training	2017 May	DRVN JICA experts	RMB I, II, III, IV	Topics are to be selected from the followings; <ul style="list-style-type: none"> <li>The 2<sup>nd</sup> progress report on JICA Project</li> <li>Legalization of Project outputs</li> <li>Database management in Japan</li> <li>R&amp;D on maintenance technology development in Japan</li> <li>Road maintenance training programs in Japan</li> <li>Expressway asset management in Japan</li> <li>Guideline and manuals for road maintenance and management in Japan</li> <li>Introduction of advanced maintenance and inspection technology in Japan</li> <li>Introduction of New Technology Registration System(NETIS) in Japan</li> <li>Engineer qualifications in Japan</li> <li>Introduction of road maintenance in foreign countries</li> <li>Introduction of PR in road sector</li> </ul>	[Pavement Condition Survey] <ul style="list-style-type: none"> <li>Progress of pavement condition survey</li> <li>Results of pavement condition survey data analysis in RMB III</li> <li>Exchange of opinions</li> </ul>	[PMS] <ul style="list-style-type: none"> <li>Preparation of PMS Dataset (RMB III)</li> <li>Preparation of simulation condition data (e.g. Cost unit) (RMB III)</li> </ul> [Web-based PMS Operation System] <ul style="list-style-type: none"> <li>General Guidance on Web-based system</li> <li>System operation (Initial dataset)</li> <li>System operation (Pavement deterioration prediction)</li> <li>System operation (Budget planning / annual, 5 year planning)</li> <li>Data management</li> <li>System maintenance, upgrade and management</li> <li>Exchange of opinions</li> </ul>	[Pilot Repair Works] <ul style="list-style-type: none"> <li>Result on the evaluation of pilot repair works</li> </ul> [Road facility inspection guideline] <ul style="list-style-type: none"> <li>Based on agreed Road facility inspection guideline;</li> <li>Inspection of bridge and data registration on site</li> </ul> [Road Routine Maintenance Manual] <ul style="list-style-type: none"> <li>Based on agreed Routine Maintenance Manual;</li> <li>Application of Road Routine Maintenance Manual to bridge</li> <li>Exchange of opinions</li> </ul>	[Road Maintenance Responsibility Assignment and Administrative Procedure] <ul style="list-style-type: none"> <li>New technology introduced by JICA Project</li> <li>Exchange of opinions on improvement of responsibility assignment and administrative procedure</li> </ul>

Training	Date/ Duration	Trainer / Speaker	Venue	Seminar/ Workshop (Information provision)	OJT (Technical Transfer Training)			
					Measure 1 Improve PMS Data Collection and Processing Technology	Measure 2 Upgrade PMS to Apply Road Network of RMB I, II, III, and IV, and Formulate Draft Repair Work Plan	Measure 3 Improve Inspection and Repair Work Selection Technology on Road Facility and Develop Technical Standards	Measure 4 Enhance Responsibility Assignments and Administration Procedures for Road Maintenance
				in Japan <ul style="list-style-type: none"> <li>• Exchange of opinions</li> <li>• Result of Pavement Condition Survey</li> </ul>				
5 <sup>th</sup> Training	2017 OCT	DRVN JICA experts	RMB I, II, III, IV	Topics are to be selected from the followings; <ul style="list-style-type: none"> <li>• Summary of JICA Project and Next Step</li> <li>• Exchange of opinions</li> </ul>	[Final report on Pavement Condition Survey] <ul style="list-style-type: none"> <li>• Results of pavement condition survey data analysis for entire regions</li> <li>• Exchange of opinions</li> </ul>	[Final report on Web based systems] <ul style="list-style-type: none"> <li>• System Training using training video clip</li> <li>• Exchange of opinions</li> </ul>	[Final report on road facility inspection guideline/road routine maintenance manual] <ul style="list-style-type: none"> <li>• Status of Standardization of pavement repair technologies</li> <li>• Based on agreed road facility inspection guideline</li> <li>• Road Routine Maintenance Manual</li> <li>• Exchange of opinions</li> </ul>	[Final report on institutional enhancement of Road Maintenance Responsibility Assignment and Administrative Procedure]

*Note: Trainings on Measure 3 have been implemented based on the agreed Road Inspection Guideline and Road Maintenance Manual.-Trainings on Measure 4 have been implemented based on the agreed amendment plans.*



## 8.6 IMPLEMENTATION OF “DURING PROJECT” TRAINING

“During Project” training programs have been implemented in cooperation with the DRVN in line with Training Implementation Plans developed in the previous section.

**Table 8.6.1** shows the implementation summary while the Table 8.6.2 shows the number of the participants to the trainings. Each training program is elaborated in the following sections.

**Table 8.6.1 Summary of Implemented “During Project” Training**

Training Method	Target Group	Trainer/ Speaker	Venue	Frequency
Seminar (2 times)	Agencies involved in legislation of road maintenance regulation and institution including leaders of DRVN, MOT, (PDOTs)*, ITST** and UTC***, and ASEAN countries. (Total 100)	DRVN Experts from Japan JICA experts	Hanoi	1 <sup>st</sup> : 21 <sup>st</sup> Oct, 2015 (Full day) 2 <sup>nd</sup> :29 <sup>th</sup> Nov, 2017 (Half day)
Workshop (5 times)	Focus on Management level Officials and Engineers of DRVN, RMBs, SBs and RTCs (Total 30-50)	DRVN JICA experts	RMB I, II, III, IV Region	1 <sup>st</sup> : 20-27 Jul, 2015 (4 cities) 2 <sup>nd</sup> : 16-23 May, 2016 (4 cities) 3 <sup>rd</sup> : 31.Oct - 8 Nov, 2016 (4 cities) 4 <sup>th</sup> : 15-26 May, 2017 (4 cities) 5 <sup>th</sup> : 22-30 Oct, 2017 (4 cities)
OJTs (5 times)	Focus on Engineer of DRVN, RMBs, SBs and RTCs (Total 15-20)	DRVN JICA experts	RMB I, II, III, IV Region	1 <sup>st</sup> : 20-27 Jul, 2015 (4 cities) 2 <sup>nd</sup> : 16-23 May, 2016 (4 cities) 3 <sup>rd</sup> : 31.Oct - 8 Nov, 2016 (4 cities) 4 <sup>th</sup> : 15-26 May, 2017 (4 cities) 5 <sup>th</sup> : 22-30 Oct, 2017 (4 cities)
Intensive Training (3 times)	Focus on Engineer of DRVN, RMBs, SBs, RTCs (Total 15-20)	JICA Expert IT Consultant	Hanoi	1 <sup>st</sup> : 2 Jun, 2017 2 <sup>nd</sup> : 23.11.2017 & 24-30.11.2017 3 <sup>rd</sup> :19.12.2017
Special OJTs for Pavement Condition Survey (3 times)	Focus on Engineer of RMBs, SBs and RTCs (Total 5-10)	JICA Expert	RMB II, III, IV Region	1 <sup>st</sup> : 4 Nov, 2015 2 <sup>nd</sup> : 23 Feb, 2016 3 <sup>rd</sup> : 25 Apr, 2016

Note: \*PDOT: Provincial Department of Transport  
\*\*Institute of Transport Science and Technology  
\*\*\*University of Transport and Communications

**Table 8.6.2 Number of Participants for the Training**

Training	Date	Venue	Style	M OT	DRVN			RMBs			Others	Sub Total	Total
					DRVN	RTCC	PMU3	RMB	RTC	SBs			
1 <sup>st</sup> Seminar	21.10.2015	Hanoi	VN	2	19	1	3	2	0	0		38*	38
			JP										27
<b>TOTAL</b>													<b>65</b>
2 <sup>nd</sup> Seminar	29.11.2017	Hanoi	VN	7	20	2	6	5	9	3	18**	70	70
			JP										17
<b>TOTAL</b>													<b>87</b>
1 <sup>st</sup> Work- shop & OJT	27.07.2015	RMBI	WS		17	2	2	10	2	15		48	48
			OJT									0	
	20.07.2015	RMB II	WS					9	8	17		34	53
			OJT					5	2	12		19	
	24.07.2015	RMB III	WS					16	4	13		33	58
			OJT					9	3	13		25	
22.07.2015	RMBIV	WS					11	1	13		25	48	

Training	Date	Venue	Style	M OT	DRVN			RMBs			Others	Sub Total	Total
					DRVN	RTCC	PMU3	RMB	RTC	SBs			
			OJT					1	2	20		23	
	<b>TOTAL</b>				<b>17</b>	<b>2</b>	<b>2</b>	<b>61</b>	<b>22</b>	<b>103</b>		<b>207</b>	
2 <sup>nd</sup> Work-shop	23.05.2016	RMBI	WS		16		2	10	9	20		57	
	16.05.2016	RMB II	WS		4			19	3	17		43	
	20.05.2016	RMB III	WS		4			15	7	19		45	
	18.05.2016	RMBIV	WS		4			8	5	25		42	
	<b>TOTAL</b>				<b>28</b>		<b>2</b>	<b>52</b>	<b>24</b>	<b>81</b>		<b>187</b>	
3 <sup>rd</sup> Training (Work-shop & OJT)	07-08.11.2016	RMBI	WS		25		3	5	8	19		60	
			OJT				3	4	13		20		
	10-11.11.2016	RMB II	WS					16	2	22		40	
			OJT				5	3	14		22		
	31.10-01.11.2016	RMB III	WS					16	4	12		32	
			OJT				7	4	9		20		
	03-04.11.2016	RMBIV	WS					6	4	21		31	
			OJT				3	2	15		20		
<b>TOTAL</b>				<b>25</b>		<b>3</b>	<b>61</b>	<b>31</b>	<b>125</b>		<b>245</b>		
4 <sup>th</sup> Training (Work-shop & OJT)	22-23.05.2017	RMBI	WS		9		3	8	4	16		40	
			OJT		1			3	4	10		18	
	25-26.05.2017	RMB II	WS		2		1	16	2	22		43	
			OJT				5	3	14		22		
	15-16.05.2017	RMB III	WS		3		1	16	4	13		37	
			OJT				7	4	9		20		
	18-19.05.2017	RMBIV	WS		1		1	6	4	21		33	
			OJT				5	1	9		15		
<b>TOTAL</b>				<b>16</b>	<b>0</b>	<b>6</b>	<b>66</b>	<b>26</b>	<b>114</b>		<b>228</b>		
5 <sup>th</sup> Training (Work-shop & OJT)	30.10.2017	RMBI	WS		5			8	19	6	4	42	
			OJT		3			8	14	2		27	
	27.10.2017	RMB II	WS		4		1	18	4	20		47	
			OJT		4			10		5		19	
	23.10.2017	RMB III	WS		3		1	16	8	13		41	
			OJT		3			7	3	8		21	
	25.10.2017	RMBIV	WS		3		1	8	7	16		35	
			OJT		2			4	4	14		24	
<b>TOTAL</b>				<b>27</b>	<b>3</b>	<b>79</b>	<b>59</b>	<b>84</b>	<b>4</b>		<b>256</b>		
Intensive Training (PMS/Pavement Condition Survey)	02.06.2017	Hanoi	OJT		12			4				16	
	23.11.2017	Hanoi	OJT		9	8		9	7			33	
	24-30.11.2017				1	8			8			17	
	19.12.2017	Hanoi	OJT		9							9	
<b>TOTAL</b>				<b>22</b>	<b>16</b>		<b>13</b>	<b>16</b>			<b>75</b>		
OJT on Pavement Condition Survey	25.04.2016	RMB II	OJT					6	8	9		23	
	23.02.2016	RMB III	OJT					1	5	10		16	
	04.11.2015	RMBIV	OJT					4	5	3		12	
	<b>TOTAL</b>								<b>11</b>	<b>18</b>	<b>22</b>	<b>51</b>	
<b>GRAND TOTAL</b>												<b>1,401</b>	

Note: \*Subtotal includes 11 other participants from UTC, construction company and vocational school.

\*\*Subtotal includes 18 participants from UTT, Software company, Vocational School, Vietnam Expressway Administration (VEA), Construction Management Administration (CMA)

### 8.6.1 Details of “During Project” Training

The following shows the detailed information of the respective trainings. The number of the participants of each training is summarized in the below Tables, and further details are described in the Appendix 8.3.

**(1) Seminar**

**1) 1<sup>st</sup> Seminar**

- Date: 21<sup>st</sup> Oct, 2015
- Venue: Hanoi Daewoo Hotel
- No. of Participants: Total 65 people

**Table 8.6.3 Seminar Timetable**

Time	Presentation Title	Presenter
8:00	Registration	
8:30 – 9:00	Opening Remarks	Mr. Nguyen Van Huyen, General Director, DRVN Mr. Hiroshi ANZO (Senior Project Formulation Advisor, Japan International Cooperation Agency, Viet Nam Office)
9:00 – 9:30	Key Note I: Infrastructure Asset Management and Implementation in Viet Nam	Professor Kiyoshi KOBAYASHI (Kyoto University)
9:30 – 10:00	Key Note II: Pavement in Japan	Dr. Kazuyuki KUBO (Team Leader, Pavement, Road Technology Research Group, Public Works Research Institute, MLIT, Japan)
10:00 – 10:20	Current Status and Issue of Road Maintenance in Viet Nam	Mr. Le Hong Diep, Director of Road Management and Maintenance Department, DRVN
10:20 – 10:40	Tea Break	
10:40 – 11:10	Challenges of RAM	Mr. Tsuneo KATO, Team leader, JICA Project Team
11:10 – 11:40	Pavement Management for Expressway System in Japan	Dr. Keizo KAMIYA, Chief Researcher for pavement Road Research Department, NEXCO Research Institute Company Limited
11:40 – 12:00	Discussion	
12:00 – 13:30	Lunch	
13:30 – 13:50	Current Status of Road Maintenance Standard	Mr. Thieu Duc Long, Deputy Director of Science, Technology, Environment and International Cooperation Department DRVN
13:50 – 14:20	Human Capacity Development of Engineers in MLIT	Mr. Yoshiaki MATSUNO, JICA Expert / MLIT, Japan
14:20 – 14:50	Discussion	
14:50 – 15:00	Closing Remarks	Representative of DRVN
15:00	Close	

**2) 2<sup>nd</sup> Seminar**

- Date: 29<sup>th</sup> Nov, 2017
- Venue: Melia Hotel, Hanoi
- No. of Participants: Total 87 People

**Table 8.6.4 Seminar Timetable**

Time	Presentation Title	Presenter
7:30 – 8:00	Registration	
8:00 – 8:10	Opening Remarks	DRVN Representative JICA Representative
8:20 – 8:35	Key Note Speech: Current State of Research and Human Resource Development on Road Asset Management in Japan	Dr. Kohei NAGAI Associate Professor, International Center for Urban Safety Engineering, Institute of Industrial Science, The University of Tokyo, Japan
8:35 – 9:00	Special Lecture I: Diversification of Road Maintenance and Management	Dr. TSUNEOKA, Nobuyuki Senior Advisor, JICA, Japan
9:00 – 9:20	Special Lecture II: Road Maintenance in Viet Nam	Mr. Le Hong Diep Director, Dept. of Road Management and Maintenance, DRVN

Time	Presentation Title	Presenter
9:20 – 9:40	Report of JICA Project Achievement	Mr. Tsuneo KATO, Team leader, JICA Project Team
9:40 – 10:00	Tea Break	
10:00 – 10:30	Specific Approach to the Proactive RAM <i>Pavement Condition Survey and PMS</i>	Project Team
10:30 – 10:50	Systematization of Road Inspection and Monitoring <i>DB Application to Pavement Management</i>	Project Team
10:50 – 11:10	Establishment of Road Inspection and Maintenance <i>Road Facility Inspection Guideline / Road Maintenance Manual</i>	Project Team
11:10 – 11:30	Human Resource Development for RAM <i>Capacity Enhancement by Training Courses</i>	Project Team
11:30 – 11:50	Information Dissemination and Close Cooperation in RAM (Public Relations) <i>Annual Report, Video Clip &amp; Brochure, TIS</i>	Project Team
11:50 – 12:10	Discussion	
12:10 – 12:20	Closing Remarks	DRVN
12:20 - 14:00	Lunch	
14:00	Close	

## (2) Regional Workshop and OJT

### 1) 1<sup>st</sup> Workshop and OJT

The same timetable and programs were applied to all RMBs. The number of the participants is summarized in the **Table 8.6.5**.

- RMB II Vinh City: 20<sup>th</sup> July, 2015
- RMB IV HCMC: 22<sup>nd</sup> July, 2015
- RMB III Da Nang City: 24<sup>th</sup> July, 2015
- RMB I Hanoi City: 27<sup>th</sup> July, 2015

**Table 8.6.5 1<sup>st</sup> Regional Training Timetable**

Time	Min.	Presentation Title	Presenter
8:00 – 8:30	30	Registration	
8:30 – 8:40	10	Opening Remark	Mr. To Nam Toan, Director of STE-ICD, DRVN
8:40 – 9:00	20	Current Status and Plans of Road Maintenance in Viet Nam	Mr. Thieu Duc Long, Deputy Director of STE-ICD, DRVN
9:00 – 9:35	35	Work Plan of JICA Phase I Project	Mr. Tsuneo KATO, Team Leader, JICA Project Team
9:35 – 9:50	15	Discussion	
9:50 – 10:10	20	Tea Break	
10:10– 10:35	25	Road Maintenance Institution of National Highways in Japan	Mr. Yoshiaki MATSUNO, Project Advisor, JICA Expert
10:35- 11:00	25	Pavement Maintenance for the Expressway System in Japan	Mr. Tsuneo KATO / Mr. Kazutaka SUZUKI, JICA Project Team
11:00– 11:25	25	Results of Pavement Condition Survey for RMB I Road Network	Mr. Yoshiro KUNIMASA/ Dr. Bhoj Raj PANTHA, JICA Project Team
11:25 – 11:50	25	Discussion	
11:50– 12:00	10	Closing Remark	Mr. To Nam Toan, Director of STE-ICD, DRVN
12:00		Close	

--- **On-the-Job Training: Data Input** -----

12:30 – 13:00		Registration	
13:00 – 13:15	15	Session I: Opening Remark	Mr. To Nam Toan, Director of STE-ICD, DRVN
13:15 – 14:00	45	Session II: General Guidance on Operation of Data Input System PMS and Pavement Maintenance Plans PMS Dataset	Dr. PANTHA Bhoj Raj, JICA Project Team

Time	Min.	Presentation Title	Presenter
		PMS Database PMS Data Input System Data Input Control and Validation Check Operation and Management of Data Input System Data Input Demonstration	
14:00 – 14:45	45	Session III: Computer Practicing Data Inputting, Editing Data Assembling	Dr. PANTHA Bhoj Raj /Mr. Bui Cong Do, JICA Project Team
14:45 – 15:15	30	Discussion	
15:15		Close	

Note: STE-ICD: Science, Technology, Environment, and International Cooperation Department

## 2) 2<sup>nd</sup> Workshop and OJT

The same timetable and contents were used at all regions. The number of the participants is summarized in the **Table 8.6.6**.

- RMB II Vinh City: 16<sup>th</sup> May, 2016
- RMB IV HCMC: 18<sup>th</sup> May, 2016
- RMB III: Da Nang City: 20<sup>th</sup> May, 2016
- RMB I Hanoi City: 23<sup>rd</sup> May, 2016

**Table 8.6.6 2<sup>nd</sup> Regional Training Timetable**

Time	Min.	Presentation Title	Presenter
8:00 – 8:30	30	Registration	
8:30 – 8:40	10	Opening Remark	Mr. To Nam Toan Director, STE-ICD, DRVN
8:40 – 9:00	20	Focus Points of National Road Maintenance	Mr. Le Hong Diep, Director, Road Maintenance/Management Dept., DRVN
9:00 – 9:20	20	Progress Report of the Project	Mr. Tsuneo KATO, Team Leader, JICA Project Team
9:20 – 9:40	20	System for Utilizing New Technology in Japan	Mr. Yoshiaki MATSUNO, JICA Expert, Project Advisor
9:40 – 10:10	30	Formulation of Road Maintenance Plan by PMS	Dr. Bhoj Raj PANTHA, JICA Project Team
10:10– 10:30	20	Tea Break	
10:30– 10:45	15	Enhancing Road Facility Inspection and Road Routine Maintenance	Dr. Nguyen Dinh THAO, JICA Project Team
10:45– 11:00	15	Current Status of Pavement Condition Survey	Mr. Yoshiyasu TSUCHIYA, JICA Project Team
11:00– 11:15	15	Web Display System for Pavement Condition Data and Data Input System	Mr. Yoshiro KUNIMASA, JICA Project Team
11:15 – 11:30	15	Introduction of Foreign Practices in Bridge Management	Mr. Tsuneo KATO, Team Leader, JICA Project Team
11:30 – 11:50	20	Discussion	
11:50– 12:00	10	Closing Remark	Mr. To Nam Toan, Director, STE-ICD, DRVN
12:00		Close	

## 3) 3<sup>rd</sup> Workshop and OJT

The same timetable and contents were used at all regions. The number of the participants is summarized in the **Table 8.6.7**.

- RMB I Hanoi City: 7<sup>th</sup> -8<sup>th</sup> Nov, 2016
- RMB II Vinh City: 10<sup>th</sup> -11<sup>th</sup> Nov, 2016

- RMB III Da Nang City: 31<sup>st</sup> Oct – 1<sup>st</sup> Nov, 2016
- RMB IV HCMC: 3<sup>rd</sup> -4<sup>th</sup> Nov, 2016

**Table 8.6.7 3<sup>rd</sup> Regional Training Timetable**

**DAY 1**

Time	Min.	Presentation Title	Presenter
8:00 – 8:05	5	Opening Remark	Dr. To Nam Toan. Director of STE-ICD
<b>----- Workshop -----</b>			
8:05 – 8:25	20	Road Maintenance and Traffic Safety	Mr. Le Hong Diep, Director of RMMD
8:25 – 8:45	20	Report on Project Progress	Mr. Tsuneo KATO, Team Leader, JICA Project Team
8:45 – 9:05	20	Strategy for Road Landslide Disaster Prevention in Japan	Mr. Yoshiaki MATSUNO, JICA Expert, Project Advisor
9:05 – 9:35	30	Enhancement of Institutions for Better Road Maintenance	Mr. Tsuneo KATO, Team Leader, JICA Project Team
9:35 – 10:00	25	Tea Break	
<b>----- On-the-Job Training: Inspection Guideline &amp; Maintenance Manual-----</b>			
10:00– 10:50	50	Session I: Road Facility Inspection Guideline (Based on agreed Road facility inspection guideline)	Mr. Rikiya IIZUKA/ Dr. Nguyen Dinh Thao, JICA Project Team
10:50– 11:40	50	Session II: Road Routine Maintenance Manual (Based on agreed Routine Maintenance Manual)	Mr. Seiichi KUSANO, JICA Project Team
11:40 – 12:00	20	Discussion	
12:00 – 13:00		Lunch	
13:00 – 14:00	60	Move to the site	
14:00 – 17:00	180	Session III; Field Training for Road Facility Inspection Guideline and Road Routine Maintenance Manual (Joint Session)	Mr. Rikiya IIZUKA/ Mr. Seiichi KUSANO, JICA Project Team
17:00		Close	

**DAY 2**

Time	Min	Presentation Title	Presenter
8:00		Start	
8:00 – 9:10	70	Session IV: Web based PMS Data Input System	Dr. Bhoj Raj PANTHA, JICA Project Team / SAOMAI
9:10 – 9:50	40	Session V: Web-based System for Displaying Pavement Condition Survey Data	Mr. Yoshiro KUNIMASA , JICA Project Team / SAOMAI
9:50 –10:00	10	Supplemental Discussion	
10:00 – 10:15	15	Tea Break	
10:15– 11:45	90	Session VI: PMS Budget Simulation and PMS Pavement Repair Work Plan	Dr. Kazuya AOKI / Dr. Bhoj Raj PANTHA, JICA Project Team
11:45 –11:55	10	Supplemental Discussion	
11:55 –12:00	5	Closing Remark	

**4) 4<sup>th</sup> Workshop and OJT**

The same timetable and contents were used at all regions. The number of the participants is summarized in the **Table 8.6.8**.

- RMB I Hanoi City: 22<sup>nd</sup> -23<sup>rd</sup> May, 2017
- RMB II Vinh City: 25<sup>th</sup> -26<sup>th</sup> May, 2017
- RMB III Da Nang City: 15<sup>th</sup> -16<sup>th</sup> May, 2017
- RMB IV HCMC: 18<sup>th</sup> -19<sup>th</sup> May, 2017

**Table 8.6.8 4<sup>th</sup> Regional Training Timetable**

**DAY 1**

Time	Min.	Presentation Title	Presenter
8:00 – 8:05	5	Opening Remark	Dr. To Nam Toan, STE-ICD, DRVN
----- Workshop -----			
05 – 8:25	20	Report on Project Progress	Mr. Tsuneo KATO, JICA Project Team
8:25 – 8:45	20	Revised Periodical Inspection for Road Facilities in Japan	Mr. Yoshiaki MATSUNO, JICA Expert
8:45 – 9:05	20	Survey and Analysis on Pavement Condition Survey	Mr. Do Hong Phong , JICA Project Team
9:05 – 9:25	20	Institutional Arrangement for PMS Planning	Mr. Tsuneo KATO, JICA Project Team
9: 25– 9:55	30	Report on Pilot Pavement Repair Project	Dr. Nguyen Dinh Thao, JICA Project Team
9: 55– 10:10	15	Discussion	
10:10 – 10:25	15	Tea Break	
----- On-the-Job Training -----			
10:25– 11:15	50	Session I: Road facility inspection guideline (Based on agreed Road facility inspection guideline )	Mr. Rikiya IIZUKA, JICA Project Team
11:15– 12:05	50	Session II: Road Routine Maintenance Manual (Based on agreed Routine Maintenance Manual )	Mr. Seiichi KUSANO / Tsuneo KATO, JICA Project Team
12:05 – 12:25	20	Discussion	
12:25 – 13:25	60	Lunch	
13:25 – 13:55	30	Move to the site	
13:55 – 16:55	180	Session III; Field Training for Road Facility Inspection Guideline and Road Routine Maintenance Manual (Joint Session)	Mr. IIZUKA/KUSANO/KATO, JICA Project Team
16:55		Close	

**DAY 2**

Time	Min	Presentation Title	Presenter
----- On-the-Job Training -----			
8:00		Start	
8:00 – 9:30	90	Session IV: Web based PMS Operation	Mr. AOKI/PANTHA/DO, JICA Project Team / SAOMAI
9:30 – 9:50	20	Discussion	
9:50 – 10:05	15	Tea Break	
10:05– 11:35	90	Session V: PMS Budget Simulation and PMS Pavement Repair Work Plan and Practices by Trainees using PC	Mr. AOKI/PANTHA/DO, JICA Project Team / SAOMAI
11:35 –11:55	20	Discussion	
11:55 –12:00	5	Closing Remark	Dr. To Nam Toan , STE-ICD, DRVN

**5) 5<sup>th</sup> Workshop and OJT**

The same timetable and contents were used at all regions. The number of the participants is summarized in the **Table 8.6.9**.

- RMB I Hanoi City: 30<sup>th</sup> Oct, 2017
- RMB II Vinh City: 26<sup>th</sup> Oct, 2017
- RMB III Da Nang City: 22<sup>nd</sup> Oct, 2017
- RMB IV HCMC: 24<sup>th</sup> Oct, 2017

**Table 8.6.9 5<sup>th</sup> Regional Training Timetable**

Time	Min.	Presentation Title	Presenter
8:00 – 8:05	5	Opening Remark	Dr. Toan, DRVN
----- <b>WORKSHOP</b> -----			
8:05 – 8:25	20		Mr. MATSUNO, JICA Expert
8:25 – 8:45	20	Human Resource Development for Expressway Management in Japan	NEXCO Central
9:05 – 9:45	40	Project Final Progress Report	Mr. KATO, JICA Project Team
9: 45– 10:05	20	Discussion	
10:05 – 10:30	25	Tea Break	
----- <b>On-the-Job Training</b> -----			
10:30– 11:30	60	Session I: Technical Guidelines (1) Road facility Inspection Guideline (2) Road Maintenance Manual (3) Pavement and Bridge Repair Technologies based on Pilot Repair Work	Dr. THAO, JICA Project Team
11:30 – 11:50	20	Discussion	
11:50 – 13:20	90	Lunch	
13:30 – 15:30	120	Session II: Web based PMS Operation System (1) Pavement Monitoring System (2) Budget Simulation and Repair Work Planning for Road Pavement (3) Video Crips for Self-Learning	JICA Project Team
15:30 –16:00	30	Discussion	
16:00		Close	

**(3) PMS Intensive Training**

**1) 1<sup>st</sup> PMS Intensive Training**

- Date: 2<sup>nd</sup> June, 2-17
- Venue: Hanoi
- Programs: Shown in the Table below

**Table 8.6.10 1<sup>st</sup> Intensive Training Program**

	Content	Method	Presenter
1.	Institutional issue for PMS implementation, Project Formulation and Annual Budget Plan	Lecture/Discussion	JICA Project Team
2.	Introduction of PMS and PMS related Systems	Lecture	JICA Project Team
3.	PMS Dataset and Module Dataset Preparation	Lecture	JICA Project Team / SAOMAI
4.	Deterioration Evaluation	Lecture/Practice	
5.	Repair Work Planning	Lecture/Practice	
6.	Others		
	<ul style="list-style-type: none"> <li>• Understanding of PC Data</li> <li>• Planning of PC Survey</li> <li>• PMS Database Management</li> <li>• Strategic Budget Simulation</li> </ul>		

**2) 2<sup>nd</sup> Intensive Training (Pavement Condition Survey)**

- Date: 23<sup>rd</sup> Nov., 2017 /24<sup>th</sup> -30<sup>th</sup> Nov., 2017
- Venue: Hanoi
- Programs: Shown in the Table below



**Table 8.6.11 2<sup>nd</sup> Intensive Training Program**

**Program 1 (23.11.2017)**

Time	Training Session	Contents	Style	Presenter
9:00 – 9:30		Registration	-	
9:30 – 11:00	Training 1	Explanation of summary of operation manual on pavement condition survey	Lecture	Mr. Maeda, JICA Project Team
11:10 – 12:00	Training 2	Preparation of the survey plan	Lecture	Mr. Sakai, JICA Project Team
12:00 – 13:30		Lunch time	-	
13:30 – 14:50	Training 3	Make the Survey Plan Section Table (Table-1)	Practice	Mr. Sakai, JICA Project Team
14:50 – 15:20	Training 4	Confirmation the road inventory information	Lecture	Mr. Phong, JICA Project Team
15:20 – 16:20	Training 5	Check of PC data	Practice	Mr. Phong, JICA Project Team
16:20– 17:00	Training 6	Installation of PC data to Web-system	Lecture	Mr. Sakai, JICA Project Team

**Program 2 (24-30.11.2017)**

**Schedule:**

Date	Contents	Style
24.11.2017	Explanation of technical update of pavement condition survey	Lecture and Practice
27-29.11.2017	Make PC data	Practice
30.11 2017	Check PC data / Review	Lecture

**Timetable (24.11.2017):**

Time	Min.	Contents	Style	Presenter
9:00 – 9:30	30	Registration	-	
9:30 – 9:40	10	Explanation of Instruction in this training	Lecture	Mr. Maeda, JICA Project Team
9:40– 10:15	35	Preparation of the survey plan	Lecture	RTC-C
10:15-11:15	60	Point out un-perfect points of PC data Learn how to analyze to avoid mistakes	Lecture	Mr. Phong, JICA Project Team
11:15-12:00	45	Demonstration of Pavement Condition Survey Vehicle	Lecture	RTC-C
12:00 – 13:30	90	Lunch time	-	
13:30 – 14:00	30	Explanation of update contents in analysis system	Lecture	Mr. Maeda, JICA Project Team

**3) 3<sup>rd</sup> Intensive Training (System Administration)**

- Date: 19<sup>th</sup> Dec., 2017
- Venue: Hanoi
- Programs: Shown in the Table below

**Table 8.6.12 3<sup>rd</sup> Intensive Training Program**

	Content	Method	Presenter
1.	Outline of System Administration	Lecture	JICA Project Team
2.	Brief of Back-end Settings	Lecture/Practice	SAOMAI
3.	Case Study	Lecture/Practice	JICA Project Team

**(4) Special OJT for Pavement Condition Survey**

**1) 1<sup>st</sup> OJT on Pavement Condition Survey**

The same program was applied to all OJTs. The number of the participants is summarized in the **Table 8.6.12**.

- Date: 4<sup>th</sup> Nov., 2015
- Venue: RMB IV (Ho Chi Minh City)
- Program: Shown in the table below

**Table 8.6.12 OJT on Data Input System Timetable**

Time	Min	Training Content	Trainer
8:00 –8:30		Registration	
8:30 – 10:00	90	Session I: Pavement Condition Survey System (Technical Component) Overall Introduction Pavement Condition Survey Data Analysis and Processing Data Utilization Demonstration of Analysis System	JICA Project Team, with support of RTC Central
10:00 – 10:30	30	Session II: Pavement Condition Survey System (Management Component)	
10:30 – 12:00	90	Session III: Practice of Pavement Condition Survey using Inspection Vehicle	
12:00		Close	

**2) 2<sup>nd</sup> OJT on Pavement Condition Survey**

The same program was basically applied to all OJTs. The number of the participants is summarized in the **Table 8.6.13**.

- Date: 23<sup>rd</sup> Feb., 2016
- Venue: RMB III (Da Nang)
- Program: Shown in the table below

**Table 8.6.134 OJT on Data Input System Timetable**

Time	Min	Training Content	Trainer
8:00 –8:30		Registration	
8:30 – 10:00	90	Session I: Pavement Condition Survey System (Technical Component) Overall Introduction Pavement Condition Survey Data Analysis and Processing Data Utilization Demonstration of Analysis System	JICA Project Team, with support of RTC Central
10:00 – 10:30	30	Session II: Pavement Condition Survey System (Management Component) Supervise Work for Pavement Condition Survey	
10:30 – 12:00	90	Session III: Practice of Pavement Condition Survey using Inspection	

Time	Min	Training Content	Trainer
		Vehicle Explanation of Equipment Practice of Pavement Condition Survey	
12:00		Close	

### 3) 3<sup>rd</sup> OJT on Pavement Condition Survey

The same program was basically applied to all OJTs.

- Date: 25<sup>th</sup> April, 2016
- Venue: RMB II (Vinh city)
- Program: Shown in the table below

**Table 8.6.14 OJT on Data Input System Timetable**

Time	Min	Training Content	Trainer
8:00 –8:30		Registration	
8:30 – 10:00	90	Session I: Pavement Condition Survey System (Technical Component) Overall Introduction Pavement Condition Survey Data Analysis and Processing Data Utilization Demonstration of Analysis System	JICA Project Team, with support of RTC Central
10:00 – 10:30	30	Session II: Pavement Condition Survey System (Management Component) Supervise Work for Pavement Condition Survey	
10:30 – 12:00	90	Session III: Practice of Pavement Condition Survey using Inspection Vehicle Explanation of Equipment Practice of Pavement Condition Survey	
12:00		Close	

### (5) Review of Trainings

Prior to closing the trainings, the Project conducted feedback survey at each time. The shared views and opinions from the participants have been reflected into the review of the plan in order to improve the following trainings.

The below Table shows some of the examples of the feedback, which reflected in the other (following) trainings to make them better.

**Table 8.6.15 Some Feedback Reflected into the Other Trainings**

Items	Feedback (Comments and Suggestions)
WS Contents/Program	<ul style="list-style-type: none"> <li>• Increase duration of WS</li> <li>• Introduce foreign experiences in road management and maintenance</li> <li>• Distribute presentation materials in the form of soft-files before the WS</li> <li>• Add visual aids (video, images) in the presentations</li> </ul>
PMS/Web-based system	<ul style="list-style-type: none"> <li>• Do test run on the web-based system and roadmap for test run</li> <li>• Provide account &amp; password for SBII.5 to use the software</li> <li>• More computer practicing on data inputting &amp; PMS</li> <li>• The data input by RMBs should be reviewed and if errors occurred, correct and present at the WS as an example</li> </ul>
Road Facility	<ul style="list-style-type: none"> <li>• Introduce road routine maintenance manual and details of bridge inspection</li> </ul>

Items	Feedback (Comments and Suggestions)
Inspection and Road Routine Maintenance Manual	process <ul style="list-style-type: none"> <li>• More training courses on road facility inspection and incident prediction</li> <li>• Application of data in formulating the maintenance plan.</li> <li>• Capacity enhancement in road and bridge inspection</li> <li>• Analysis of damage level' remedies (periodical, unscheduled and emergency)</li> </ul>
Technologies	<ul style="list-style-type: none"> <li>• Pilot application of new technologies into repair of pavement and bridge deteriorations at site</li> <li>• Demonstration of new technologies by videos</li> </ul>
On-site Practice	<ul style="list-style-type: none"> <li>• On-site practice (such as pavement survey and bridge inspection) to apply the knowledge from the presentations in real situations</li> </ul>
Computer-based PMS OJT	<ul style="list-style-type: none"> <li>• More intensive and broaden training for operation</li> <li>• The data should be updated frequently to update the changes of section as soon as possible</li> <li>• Add in the option for administration and link to web</li> <li>• The system should be displayed in Vietnamese for Vietnamese users (traffic volume)</li> </ul>

### 1) The 1<sup>st</sup> Year Training

Based on the training program for “During-Project”, training implementation plan has been prepared and delivered.

Workshop and the OJT in the regions were well received with high attendants, thanks to the support of the DRVN for fine coordination and taking part as speakers and trainers. From the feedback of the training, JICA Project Team considers the needs for more training on the Database. At the same time, the seminar had a very limited number of turnouts from the DRVN and decision makers, which require some improvement.

### 2) The 2<sup>nd</sup> Year Training

The 2<sup>nd</sup> and the 3<sup>rd</sup> regional trainings were conducted as planned. Overall, there were a high number of attendants at each training; however, more participants from the management level are expected in the near future to meet the objective of the workshop. In regard to the OJTs, some issues remained for improvement, such as the selection of the OJT sites, timekeeping by the participants, and response to the feedback from the participants.

### 3) The 3<sup>rd</sup> Year Training

The 4<sup>th</sup> and the 5<sup>th</sup> regional training programs were successfully implemented having strong commitments from the DRVN and the trainees. The issues raised from the 1<sup>st</sup> and the 2<sup>nd</sup> year trainings of the OJTs have been almost overcome. The DPIs of the RMBs were requested to participate in the computer-based training and the 2<sup>nd</sup> intensive training courses in order to obtain in-depth skills and knowledge on the databases. Likewise, it was requested for the DRVN, RMBs & RTCs to participate in the PMS/PCS (intensive trainings) as well. The 2<sup>nd</sup> seminar received a higher number of attendants, especially from the MOT and the MPI.

## 8.7 TRAINING IN JAPAN

### 8.7.1 Introduction

There are several training programs organized in Japan under JICA. Amongst those, “Counterpart (CP) Training” has been adopted to the Project. “CP Training” offers specific programs which are prepared to enable the CPs of JICA projects to learn necessary knowledge and technology to achieve the project goals.

Those knowledge and technology should be relevant to the project activities, and the training is implemented through the lectures and the site visits. Also it should deepen the understandings of the project activities and promote effective technical transfer of the project.

Under the Project, the said training was held 3 times in total. The planning of the “CP trainings” was done having in depth discussions with the DRVN. Moreover, this approach is applicable to any of the training programs under the Project, not necessarily limits to the “CP Training”.

### 8.7.2 Planning of Training Programs

In accordance with the “Steps of Training Program Development”, the Project Team discussed with the DRVN regarding the details of the Trainings in Japan. The outputs, stakeholders and the stakeholders’ information requirements have been identified and analyzed. Accordingly, the most appropriate training schedule including the topics, target officials (staff) and the others have been determined.

### 8.7.3 Implementation of Training in Japan

#### (1) First “CP Training”

The 1<sup>st</sup> “CP training” was conducted for 7 days from the 13<sup>th</sup> to the 19<sup>th</sup> of September, 2015. The following parts explain the details of the said training.

#### 1) Participants

5 officials from the RMBs and the DRVN were participated in the 1<sup>st</sup> “CP training” in Japan.

**Table 8.7.1 Participants for the 1<sup>st</sup> “CP Training”**

	Name	Position
1	Mr. Nguyen Ngoc Son	Vice Chairman of RMB I
2	Mr. Dao Van Minh	Vice Chairman of RMB II
3	Mr. Do Huy Thanh	Vice Chairman of RMB III
4	Mr. Nguyen Thuan Phuong	Chairman of RMB IV
5	Mr. Le Hong Diep	Director of Road Management and Maintenance Department, DRVN

## 2) Training Schedule

Lectures and site visits were offered during the training. The schedule is shown below.

**Table 8.7.2 Training Schedule for the 1<sup>st</sup> “CP Training”**

Days	Date	Time	Subject	Training Institution
Day 1	13 <sup>th</sup> Sep		Arriving Tokyo	
Day 2	14 <sup>th</sup> Sep	AM	Briefing	JICA
		PM	Orientation Lecture on Road Administration in Japan	KEI
Day 3	15 <sup>th</sup> Sep		Lecture on Road Maintenance in National Road Site visit to Road Traffic Information Centre, Bridge Weigh in Motion System, Tatsumi Check Point, Repairing Site of Bridge over Arakawa River Estuary	RDB
Day 4	16 <sup>th</sup> Sep	AM	Lecture on Operation of Pavement Management System used in Local Authority	PASCO
		PM	Lecture on Pavement Repair Material, Surface of Bridge Deck Pavement, Water-proofing Practice for Floor Slab	Nichireki
Day 5	17 <sup>th</sup> Sep	AM	Lecture on Research on Pavement Technology Site visit to Research Centre	NEXCO Research Centre
		PM	Site visit to TOMEI & SHIN TOMEI Expressway, Ebina Service Area, Maintenance Centre (maintenance vehicle, patrol car, Disaster prevention division) Lecture on Construction and Maintenance of Expressway	NEXCO Central
Day 6	18 <sup>th</sup> Sep	AM	Presentation	
Day 7	19 <sup>th</sup> Sep		Fly back to Hanoi	

### (2) Second “CP Training”

The second “CP Training” was conducted for 11 days from the 27<sup>th</sup> of September to the 6<sup>th</sup> of October, 2016.

#### 1) Participants

Total of 10 participants from the MOT, DRVN and the RMBs were participated in the 2<sup>nd</sup> “CP Training”.

**Table 8.7.3 Participants for the 2<sup>nd</sup> “CP Training”**

	Name	Job Position / Organization
1	Mr. Ngo The Thong	Expert, Central Road Maintenance Fund Office, MOT
2	Mr. Nguyen Manh Cuong	Expert, Infrastructure Department of MOT
3	Mr. Pham Van Toan	Director of Administrative Affairs & Personnel Organizing Department, RMBI
4	Mr. Nguyen Thanh Hoai	Director of Technical/Planning Department, RMBII
5	Mr. Bui Hung Man	Director of Technical/Planning Department, RMBIII
6	Mr. Tran Thanh Nam	Director General of Sub-Bureau IV.3, RMBIV
7	Mr. Nguyen Manh Hung	Deputy Director, Road Maintenance & Management Department, DRVN
8	Mr. Pham Minh Tam	Deputy Director, Traffic Safety Department, DRVN
9	Mr. Dinh Cao Thang	Deputy Director, Finance Department, DRVN
10	Mr. Hoang Manh Tri	Director, Personnel Organizing Department, DRVN

## 2) Training Schedule

Lectures, site visits and demonstrations were conducted during the 2<sup>nd</sup> “CP Training”. The 2<sup>nd</sup> “CP Training” schedule is shown below.

**Table 8.7.4 Training Schedule for the 2<sup>nd</sup> “CP Training”**

Day	Date	Time	Subject	Training Institution
Day 1	26 <sup>th</sup> Sep		Arriving Tokyo	
Day 2	27 <sup>th</sup> Sep	AM	Briefing	JICA
		PM	Orientation / Lecture on Road Administration in Japan	KEI
Day 3	28 <sup>th</sup> Sep	AM	Lecture on works of Maintenance and Management Technical Center Site visit to New Technology at Construction Technology Exhibition Centre, Explanation on Environmental Pavement Trial	RDB
		PM	Lecture on efforts of Road Manager toward 2020 Olympic games Site visit on current status and effects of Environmental Pavement Trial	
Day 4	29 <sup>th</sup> Sep	AM	Lecture on Road Maintenance and Management at Local Government	Yamanashi Prefectural Government
		PM	Site visit nearby Mt. Fuji	
Day 5	30 <sup>th</sup> Sep	AM	Lecture on Operation of Pavement Management System	PASCO
		PM	Demonstration of Pavement Condition Vehicle	
Day 6	1 <sup>st</sup> Oct			
Day 7	2 <sup>nd</sup> Oct			
Day 8	3 <sup>rd</sup> Oct	AM	Lecture on Research on Pavement Technology Site visit to Research Centre	NEXCO Research Centre
		PM	Site visit to Ebina Service Area Lecture on Construction and Maintenance of Expressway Lecture on Expressway Maintenance and Management Lecture on Communication Plaza FUJI / Kawasaki Traffic Control Centre Works of Maintenance Service Centre, Site visit (maintenance vehicle etc.)	NEXCO Central
Day 9	4 <sup>th</sup> Oct	AM	Lecture on Pavement Repair Technology Demonstration of Repair Technology	Nichireki
		PM	Demonstration of Repair Technology	
Day 10	5 <sup>th</sup> Oct	AM	Presentation on Training in Japan	
Day 11	6 <sup>th</sup> Oct		Fly back to Hanoi	

### (3) Third “CP Training”

The 3<sup>rd</sup> “CP Training” was conducted for 14 days from the 3<sup>rd</sup> to the 16<sup>th</sup> September, 2017.

#### 1) Participants

10 participants from the DRVN and the RMBs were participated in the 3<sup>rd</sup> “CP Training”.

**Table 8.7.5 Participants for the 3<sup>rd</sup> “CP Training”**

	Name	Job Position / Organization
1	Mr. Nguyen Xuan Lam	Deputy Director, RMB I
2	Mr. Pham Van Tam	Director of Technical/Planning Dept., RMB I
3	Mr. Vu Tuan Anh	Director of SB I.4, RMB I
4	Mr. Nguyen Duc Dung	Deputy Director of Technical/Planning Dept., RMB II
5	Mr. Nguyen Viet Phuong	Director of SB II.2, RMBII
6	Mr. Le Minh Tuan	Director of SB III.4, RMB III
7	Mr. Nguyen Van Thanh	Deputy Director, RMBIV
8	Mr. Dinh Van Hiep	Director of SB IV.5, RMB IV
9	Mr. Vu Anh Thang	Expert, DPI (DRVN)
10	Mr. Tran The Anh	Expert, DPI (DRVN)

## 2) Training Schedule

Lectures, site visits, and demonstration were carried out during the course of the training. The 3<sup>rd</sup> “CP Training” schedule is shown below.

**Table 8.7.6 Training Schedule for the 3<sup>rd</sup> “CP Training”**

Days	Date	Time	Subject	Training Institution
Day 1	3 <sup>rd</sup> Sep.		Arriving Tokyo	
Day 2	4 <sup>th</sup> Sep.	AM	Briefing	JICA Tokyo
		PM	Orientation / Lecture on Road Administration, Inspection, and Road Maintenance in Japan	
Day 3	5 <sup>th</sup> Sep.	AM	Lecture on Maintenance and Management of National Road	MLIT
		PM	Site visit to the construction work site at Bridge of Arakawa Estuary	
Day 4	6 <sup>th</sup> Sep.	AM	Move to Kyoto	Kyoto University
		PM	Lecture on Industrial Academic Government Cooperation of Kyoto University	
Day 5	7 <sup>th</sup> Sep.	AM	Lecture on Political Measures of Asset Management	Kyoto University
		PM	Move to Kobe	
Day 6	8 <sup>th</sup> Sep.	AM	Site visit to Akashi Kaikyo Bridge Exhibition Center	Honshu-Shikoku Bridge Expressway Company Limited
		PM	Lecture on Transportation Control, Equipment for Maintenance, Bridge Maintenance Management and Operation. Site visit to Akashi Kaikyo Bridge Site visit to Nojima Fault Preservation Museum	
Day 7	9 <sup>st</sup> Sep.		Move back to Tokyo	
Day 8	10 <sup>th</sup> Sep.			
Day 9	11 <sup>rd</sup> Sep.	AM	Lecture on Research and Development (R & D) of Pavement Technology Site visit to Institute	Nippon Expressway Research Institute
		PM	Lecture on PMS Operation	PASCO
Day 10	12 <sup>h</sup> Sep.	AM	Site visit to Communication Plaza Kawasaki Lecture on High-way Business Highway Maintenance and Management Site visit to Transport Central Control Center Demonstration of Repair Technology	NEXCO Central



Days	Date	Time	Subject	Training Institution
		PM	Site visit to Ashigara Service Area Site inspection of Tomei and Shintomei Highway (from bus) Lecture on Fuji Service Center Site visit to Fuji Service Center, Inspection of vehicles for Road Maintenance and Management Site visit to Communication Plaza Fuji Site visit to Fujikawa Service Area	NEXCO Central
Day 11	13 <sup>th</sup> Sep.	AM	Lecture on Road Management of Yamanashi Prefecture	Yamanashi Prefecture
		PM	Site visit to the construction work site at route to Mt. Fuji Site visit to the route to Mt. Fuji	Yamanashi Prefecture
Day 12	14 <sup>th</sup> Sep.	AM	Lecture on Pavement Materials and Pavement Repair Technology	Nichireki Co., Ltd
		PM	Demonstration of Pavement	Nichireki Co., Ltd
Day 13	15 <sup>th</sup> Sep.	AM	Presentation on Training in Japan	JICA
Day 14	16 <sup>th</sup> Sep.		Fly back to Hanoi	

## 8.8 POST (AFTER)-PROJECT” TRAINING PROGRAM

### 8.8.1 Introduction

In order to enhance the capacity of the PDCA cycle management at the DRVN, the Project has introduced and developed new technologies including pavement condition survey technology, web-based operation system for the PMS including its related software, and technical guidelines and manuals for the national road maintenance and management. The Project has also prepared recommendations on the institutional arrangement in the road maintenance procedures and responsibility assignment in order to disseminate new technologies to the RMBs and the SBs in the regions. In addition, the Project has conducted 5 times of “During-Project” Training including the workshops and the OJTs at the RMBs in Da Nang City, HCMC, Vinh City and Hanoi City.

However, institutional arrangement to realize the above Project outputs is under discussion with the DRVN and JICA Project Team and has not been fixed yet. Thus the DRVN is requested to set Post-Project Training opportunities to the DRVN officials/staff after the Project based on the fixed maintenance procedures and new responsibility assignment.

Moreover, improvement may be required anytime whenever institutional arrangement is revised to comply with the upgrading of the technologies and systems in the business application, thus it is important to provide additional training to the DRVN officials/staff whenever any changes in the maintenance procedures and in the responsibility assignment occur in the future.

### 8.8.2 Objectives of Post-Project Training

- (1) To implement the Post-Project Training based on the institutional arrangement authorized by the DRVN to disseminate Project outputs to the regions upon completion of the project.

- (2) To disseminate up-to-date information in order to comply with any improvement of the systems and the technologies.
- (3) To disseminate information on the changes in the responsibility assignment expected to arise due to the improvement of the institutional arrangement in the future.

### **8.8.3 Trainee's Comments for During-Project Training**

In order to transfer technologies developed under the Project to the DRVN officials/staff, the Project has conducted 5 times of workshops and OJTs as a series of "During-Project" Training programs. Workshops and OJTs were held at the same time at each DRVN RMB located in Da Nang City, HCMC, Vinh City and Hanoi city.

Questionnaire surveys conducted in each workshop and OJT have clarified as follows; many participants appreciate that those were very much informative and meaningful to them as to learn Project outputs. But, they showed strong interests in having more training opportunities, longer training period and regular workshops and OJTs throughout a year. In particular, the followings were some of the most useful issues that the participants commented; Technical Guidelines and the Manuals for the road inspection, maintenance and repair, and the operation of PMS software family related matter.

Based on the analysis of these questionnaire surveys, the Project has concluded that the RMBs and the SBs showed substantial demand for more training opportunities or regular training throughout a year even after the Project is over.

### **8.8.4 Identification of Project Output and Responsibility Assignment**

**Table 8.8.1** summarizes the Project outputs and their formats. Of these products, the Project has paid special attention to the technology transfer for the following technologies in the "During Project" Training Programs. These technologies are deemed key for the success of the PDCA cycle management of the road maintenance. DRVN headquarters is recommended to continue providing training opportunities to the RMBs and the SBs in compliance with the responsibility assignment which shall be determined by the DRVN upon completion of the Project.

#### **(1) Improve planning capacity for PMS Planning Systems (5 systems)**

- Web-based PMS
- Web-based Pavement Condition Data Display System
- Web-based PMoS
- Web-based PC Data Analysis System
- Web-based PMS Data Input System

**(2) Improve operation capacity for PMS databases (5 DBs) including Pavement Condition Survey**

- Road Inventory (Asset) Database
- Maintenance History Database
- Pavement Condition Database
- Traffic Volume Database
- Road Administration Database

**(3) Improve implementation capacity for Road Inspection, Maintenance and Repair**

- Road Facility Inspection Guideline
- Road Routine Maintenance Manual
- Expressway Maintenance Manual
- Implementation of Pilot Pavement and Bridge Repair Work

**(4) Improve Training Capacity for Road Maintenance Management**

- Planning and implementation of the training programs (Workshop and OJT)

**Table 8.8.1 Project Outputs**

Measures	Outputs	Product Format
Measure-1	(1) Web-based PMS Data Input System	DRVN Server
	(2) Operation Manual	Operation Manual (Vol. 2.2)
	(3) Pavement Condition Survey	Main Report (Vol. 2.1)
	(4) PMS Database (DB) - Road Asset) DB (Inventory) - Maintenance History DB - Pavement Condition DB - Traffic Volume DB - Road Administration DB	DRVN DB Server
Measure-2	(1) Web-based PMS - PMS Dataset Formulation Module - Pavement Deterioration Forecasting Module - Budget Simulation Module - Pavement Repair Plan Formulation Module	DRVN Server
	(2) Web-based Pavement Condition Data Display System	
	(3) Web-based PMoS	
	(4) Web-based PC Data Analysis System	
	(5) Pavement Strategic Budget Plans and Annual / 5-year Repair Plans - For RMB I, II, III, IV	Main Report (Vol.1)
	(6) Operation Manuals	Manuals (Vol. 2 2)
Measure-3	(1) Road Facility Inspection Guidelines - Photo Album for Road Facility Defects	Guideline (Vol. 3.1) Photo Album (Vol. 3.4)
	(2) Road Routine Maintenance Manual	Manual (Vol. 3.2)
	(3) Expressway Maintenance Manual	Manual (Vol. 3.3)
	(4) Summary Report for Pilot Pavement and Bridge Repair Work	Main Report (Vol. 1)
Measure-4	(1) Recommendation on the Institutional Arrangement for the Dissemination of Project Outputs	Main Report (Vol. 1)
Measure-5.1	(1) Implementation Report of During-Project Training Programs (2) Post-Project Training Plan (3) Future Training Plan on RAM	Main Report (Vol. 1)
	(4) PMS Video Clips for Self-learning • Video Clip for Pavement Condition Data Display System • Video Clip for PMS Data Input System • Video Clip for DRVN Information System for Road Maintenance Technology (TIS)	DRVN Server

Measures	Outputs	Product Format
	<ul style="list-style-type: none"> <li>• Video Clip for PMS-1: PMS Overview</li> <li>• Video Clip for PMS-2: Pavement Dataset Preparation</li> <li>• Video Clip for PMS-3: Pavement Deterioration Evaluation</li> <li>• Video Clip for PMS-4: Strategic Budget Planning for Pavement Repair Work</li> <li>• Video Clip for PMS-5: Pavement Repair Work Planning</li> <li>• Video Clip for PMS-6: PMoS</li> <li>• Video Clip for PMS-7: Pavement Condition Data Analysis System (PDAS)</li> <li>(1) Video Clip for PMS-8: Introduction of Pavement Condition Survey</li> </ul>	
Measure-5.2	(1) DRVN Annual Report 2016	Annual Report 2016
	(1) Video Clip for DRVN Road Maintenance Management	CD-ROM
	(1) Web-based Information System for Road Maintenance Technologies	DRVN Server
	(1) DRVN General Information 2016	General Information Brochure

### 8.8.5 Institutional Arrangement for Project Outputs

DRVN is requested to enhance institutions for the maintenance procedures and responsibility assignment in order to fully implement the Project outputs and to disseminate the technologies to the regions (refer to Measure 4, Chapter 7). Currently, 3 departments, including the Dept. of Science and Technology, Environment and International Communications, Dept. of Maintenance Management and the Dept. of Organization and Personnel, are actively involved in the institutional arrangement plans of the departments. The recommendation submitted to the DRVN by the Project team is summarized in the relevant chapter.

Major focuses on the enhancement of the institutional arrangement include the followings;

- (1) To institutionalize (formalize) new technologies produced under the Project, which are shown in the Table 8.8.1, as formal DRVN technologies.
- (2) To clearly assign responsible organizations or departments to manage, maintain and upgrade these technologies and systems.
- (3) To establish management committees and supporting systems for 1) planning the 5-year pavement maintenance and repair plans; 2) developing technical standards; 3) and implementing the training programs for the DRVN human resource development.

Specifically, it is recommended that the DRVN implement “Post-Project” Training programs based on the new institutional arrangement set by them. However, institutional arrangement shall be reviewed and improved as demand arises in accordance with the progress of the Project output implementation. Thus, the DRVN is requested to regularly implement the trainings as series of “Future” training programs and the recommendations for this particular Programs are explained hereinafter in this chapter.

### **8.8.6 Planning of Post-Project Training**

Based on the experiences in the “During-Project” training programs, the Project formulated the “Post-Project” training programs as shown in the **Table 8.8.3**. Key points in developing the training programs are stated as follows.

#### **(1) Training Programs**

Training programs recommended for the “Post-Project” training are mainly followings.

- 1) PMS Data Collection and Processing
- 2) PMS System Operation and Planning by PMS
- 3) Road Facility Inspection and Maintenance and Repair

#### **(2) Training Courses**

It is recommended to divide the “Post-Project” training programs into the following 2 courses.

- 1) Training program for the management officials/staff who give instructions to the engineers and approval them
- 2) Training program for the engineering staff who are involved in the practical engineering tasks in the fields.

Management officials/staff are required to have overall (wide and shallow) knowledge in providing instructions to the engineering staff. On the other hand, the engineering staff is required to have in-depth knowledge for their responsible tasks (narrow and deep). Training programs need to be consistent with these requirements. Over the course of the “During-Project” training, the workshops were implemented for the management officials/staff and the OJTs for the engineering staff.

#### **(3) Trainers**

Dept. of Planning and Investment, Dept. of Maintenance and Management, Dept. of Science, Technology, Environment and International Communications shall play leading roles in giving lectures on the road maintenance management. It is suggested that the departments raise a multiple number of trainers from each department including Director, Deputy Director, Senior Engineer, etc. to comply with a variety of training demands. It is also significant to make use of the external lecturers, such as university lecturers/professors, professional researchers at the Research and Development institutes to diversify the training programs.

#### **(4) Venue**

It is recommended that the trainings be conducted at each RMB region to secure maximum benefits of the trainings, for instance, high number of attendants, responding to the regional needs, and economical delivery of the trainings.

**(5) Training Material**

The training materials developed under the Phase II Project shall be fully utilized and updated for the “Post-Project” training. Particularly, the video clips which have been screened during the course of the Phase II Project trainings, should be well utilized. Video clips may be used as self-learning systems, in particular for the training targeting to the PDOT officials/staff in the future. **Table 8.8.2** shows the contents of the video clips developed by the Project.

**Table 8.8.2 Contents of the Video Clip**

Video clip		Contents
(1) Pavement Condition Data Display System		How to use Pavement Condition Data Display System, which display Pavement Condition Data on Web System
(2) PMS Data Input System		How to use Input System for Inputting PMS Data including Road Inventory, Maintenance History, Traffic Volume.
(3) DRVN Information System for Road Maintenance technology		How to use Information System for Road Maintenance Technology, which is a communication tool between DRVN and Private Companies
(4) Pavement Management System	Component-1; PMS overview	The video clip introduces the Pavement Management System
	Component-2; PMS dataset Preparation	How to use system to prepare PMS dataset. PMS dataset is synthesized dataset from some data tables in order to use PMS Planning modules.
	Component-3; Pavement deterioration evaluation	How to use system to evaluate Pavement deterioration on PMS
	Component-4; Strategic budget planning for pavement repair work	How to make strategic budget plan for pavement maintenance
	Component-5 Pavement repair Work Planning	How to make Pavement Repair Work Plan for 5-year period or annual plan
(5) Pavement Monitoring System (PMoS)		How to use PMoS - Pavement Monitoring System
(6) Pavement Condition Data Analysis System		How to use data analysis module on PMS
(7) Introduction of Pavement Condition Survey		The video clip introduces the overview and step-by-step procedures of the pavement condition survey from preparation, data collection and data processing.

In addition to the aforementioned existing materials, the supplemental materials, such as the followings, will be also required.

- Materials prepared by the DRVN officials (staff), DRVN trained trainers and the experts
- Updated materials and system prepared during the Project

**8.8.7 Conclusion**

In order to enhance the road maintenance capacity of the DRVN officials/staff, it is indispensable to provide appropriate training to the DRVN officials/staff as well as to legalize the technical standards. In this Project, much focus has been placed on the technology transfer for the Project outputs. Technologies introduced and developed in this Project in cooperation with the DRVN are significant ones for the PDCA cycle management of the national roads. Thus, it is recommended that the DRVN draw a future roadmap including institutionalization of the human resource development programs and continuous implementation of the DRVN’s own regular training programs.

**Table 8.8.3 Proposed Training Program for the Post-Project**

Training Requirements for “Post- Project”			Training Program Planning for “Post- Project”				
Output	Target Work position	Required information	Responsible Dep. for implementation	Trainers	Training Style	Frequen cy	Training Material
<b>1. PMS Data Collection and Processing Technology</b>							
Pavement Condition Survey data	Management Level of DRVN	General Guidance on Pavement Condition Survey	RMMD SCI-ICD DOP	RMMD SCI-ICD Trained Trainers	Workshop	1/year	Presentation Material
	Engineer Level of DRVN RMBs SBs RTCs	General Guidance on Pavement Condition Survey Preparation of survey Operation of on board equipment & survey vehicle Data management System Operation System Maintenance & Management			Workshop OJT (Lecture & Field)	1/year	Survey Vehicle System for pavement condition survey and analysis Operation Manual
Web-based PMS Data Input System	Management Level of DRVN	General Guidance on PMS data & Web-based PMS Data Input System	DPI RMMD SCI-ICD DOP	RMMD SCI-ICD Trained Trainers IT company	Workshop	1/year	Presentation Material
	Engineer Level of DRVN RMBs SBs	General guidance on PMS data and web based PMS data input system System Operation Monitoring of data inputting Validation of input data System maintenance, upgrade and management			Workshop OJT	2/year	Database system software Operation Manual Self-learning training video
<b>2. PMS System Operation and Planning by PMS</b>							
Web-based PMS operation system	Management Level of DRVN	General Guidance on PMS	DPI RMMD SCI-ICD DOP	RMMD SCI-ICD Trained Trainers Academy IT company	Workshop	1/year	Presentation Material
	Engineer Level of DRVN RMBs SBs	General Guidance on Web-based system System operation Data management System maintenance, upgrade and management			Workshop OJT	2/year	PMS Dataset Operation system software Operation Manual Self-learning training video
• Web-based system for	Management Level of DRVN	General Guidance on Web-based system	DPI RMMD	RMMD SCI-ICD	Workshop	1/year	Operation system software

Training Requirements for “Post- Project”			Training Program Planning for “Post- Project”				
Output	Target Work position	Required information	Responsible Dep. for implementation	Trainers	Training Style	Frequen cy	Training Material
displaying pavement condition survey data/ • Web-based analysis system for pavement condition survey data/ • Web-based Pavement Monitoring System	Engineer Level of DRVN RMBs SBs	General Guidance on Web-based system System Operation using surveyed data Data management System maintenance, upgrade and management	SCI-ICD DOP	Trained Trainers	Workshop OJT	1/year	Operation Manual Self-learning training video
<b>3. Road Facility Inspection and Maintenance and Repair</b>							
• Road Facility Inspection Guideline/ • Road Routine Maintenance Manual	Management Level of DRVN  Engineer Level of DRVN RMBs SBs	General Guidance on Road Facility Inspection Guideline, Road Routine Maintenance Manual and its application  General Guidance on Road Facility Inspection Guideline, Road Routine Maintenance Manual and its application Planning Implementation of Inspection Diagnosis Repair work selection Data registration	RMMD SCI-ICD DOP	RMMD SCI-ICD Trained Trainers Academy R&D Institute	Workshop  Workshop OJT (Lecture & Field)	1/year  1/year	Road Facility Inspection Guideline

Note:

*DPI (Department of Planning and Investment)*

*RMMD (Road Maintenance and Management Department),*

*SCI-ICD (Science, Technology, Environment and International Cooperation Department)*

*DOP (Department of Organization and Personnel)*



## **8.9 FUTURE TRAINING PROGRAMS ON ROAD ASSET MANAGEMENT (RAM)**

### **8.9.1 Introduction**

Road infrastructure is a national asset to be taken over from generation to generation. It is therefore very important to apply the RAM, and to enhance the PDCA cycle management of the road maintenance, intending to apply the right work to the right place at the right timing. In this way, it ensures the best economy over a long period of road maintenance. DRVN is now recommended to strengthen its human resource development programs in order to enhance efficiency, safety and economy of the national road maintenance and management.

### **8.9.2 Problem Identification and Solution on the DRVN Human Resource Development**

The Project has been observing the current status of the DRVN human resource development programs. Based on the current status survey (refer to the Appendix 8.1), the Project identified the points to be improved further. The followings are the summaries of these points. Recommendations on the enhancement of the human resource development program will be considered based on the problems identified.

- (1) Officer training has been already institutionalized and implemented within the DRVN, but the Business Sector Training and Advanced Technology Training are not available at this stage. It is required to review the current human resource development programs of DRVN and modernize these programs.

In order to implement RAM for the expanding national road network with a limited number of officials/staff, it is vital for the DRVN to enhance the road management capacity (Business Sector Training), specifically for the DRVN Department officials (staff). Also, it is essential to enhance engineering capacity of the advanced technologies for the road maintenance and management and it should be fully utilized, specifically by the RMBs and the SBs.

- (2) Technology transfer was carried out to the DRVN officials/staff while international donors were implementing technical cooperation projects for the DRVN. However, due to insufficient technology transfer and lack of sustainable training after the projects, at this stage, introduced advanced technologies have become inoperable. It is important to develop sustainable training system and to continue technical transfer even after the project.

Since 2000, international donors have supported the DRVN on the modernization of the road maintenance and management, such as pavement management system and database system. These technologies are currently in operable.

- (3) University of Transport Technology and Northern College under the DRVN have provided the training programs for the road maintenance companies including the Road Repair and Maintenance Company (RRMC), Vietnam Expressway Company (VEC), etc. However, both of them have never been applied to the DRVN staff training.

Now is the time to review the DRVN overall training program in compliance with their current business style to make the best use of the existing institutional resources as to modernize their developed human resources.

- (4) Due to the limited number of the officials/staff at the DRVN Personnel Department, it is challenging for the Department to get deeply involved in the training programs, especially in the diverse coordination and the manpower logistic work. It is, therefore, required to establish a management system including its supporting system for the successful implementation of the human resource development programs.

### **8.9.3 Development of Future Training Programs**

In this section, recommendations on the enhancement of the human resource development programs of the DRVN are pointed out in line with the problem identification discussed in the previous section.

#### **(1) Clarification of DRVN Policy on Human Resource Development**

Road infrastructure is an indispensable social infrastructure that supports not only the road traffic, but socio-economic activities of the nation. In this regard, the road administrators have responsibilities to keep them in good condition at any time. However, the road maintenance technology is not a prevailing technology in the general market; therefore, the road administrators should develop their own human resources by themselves in order to meet these demands. It is recommended that the DRVN clarify the policy prior to formulating their human resource development programs.

#### **(2) Clarification of Purposes of DRVN Human Resource Development**

As to formulate human resource development programs, it is recommended to set 2 objectives;

##### **1) To enhance PDCA management capacity for DRVN officials/staff;**

- Planning capacity
- Road facility inspection capacity
- Evaluation planning capacity
- Data processing and maintenance capacity
- System management and operation capacity

##### **2) To enhance field management capacity and supervision capacity of outsourcing work for RMB and SB officials/staff.**

- Road facility inspection capacity
- Road maintenance and repair capacity
- Data management capacity

### **(3) Development of Training Programs**

In order to enhance the road maintenance and management capacity of the DRVN officials/staff, the Project proposes that the DRVN take initiative to formulate the compulsory training programs suited to their business practices, and to legalize them as formal and regular training programs. Recommended programs are shown below **Table 8.9.1**, **Table 8.9.2** and **Table 8.9.3**.

#### **1) Administration (Officer) Training**

It is a training program formulated in line with the position or work experiences of each official (staff). In general, this training is given to the officials (staff) who took new position in the organization. DRVN already has the compulsory Officer Training Program, almost equivalent to this administration training. Thus, this existing training program should be maintained with necessary review and improvement.

#### **2) Business Sector Training**

It is recommended to develop the following 2 training courses for the said training.

##### **a) For DRVN officials/staff and manager class officials (staff) of RMBs/SBs**

It shall improve the practical management skills for the DRVN major business sectors such as the Road Maintenance Management, Traffic Safety and Management, Information Management, Construction Management, Transportation, Vehicle Management, etc. The trainings shall be provided based on the business sector requirements including business structure, roles and responsibilities, outputs, and so forth. Especially, the officials/staff who newly entered into the respective business sector should attend this training.

##### **b) For officials/staff in charge of site management at RMBs/SBs**

It shall improve practical technologies of the road maintenance and the traffic management, such as the road inspection/survey, maintenance and repair, traffic counting, quality management/acceptance of outsourcing works and data management required by the local RMBs and SBs.

#### **3) Advanced Technology Training**

In recent years, evolution of the information technology has been advancing rapidly, and information technology has already become vital for the road maintenance and management. It is therefore desirable for the DRVN actively apply these technologies for improvement of the efficiency and economic situation of the road maintenance and the traffic management. In this regard, it is recommended to organize the cross-sectional training programs, and to provide those on the application of the selected technologies. Furthermore, it is also recommended to conduct trainings for the officials/staff of the DRVN Departments and the RMBs/SBs who actually use these technologies. The proposed technical trainings are shown below;

- Pavement Condition Survey
- PMS and Bridge Management System (VBMS)
- Application of IT Technology to Road Maintenance
- Road Facility Inspection and Diagnosis
- Data Registration to Databases (PMoS, Pavement Condition Data Display System)

#### **4) Self-learning System**

The Project has developed the computer software listed below in order to support preparation of the Five- Year Pavement Repair Plan, PMS data processing and pavement monitoring during the routine road maintenance. The Project has also conducted the training courses aiming to transfer the technologies to the DRVN and the RMB/SB officials/staff during the project period. However, it is also essential to continue the trainings even after the project completion. As such, the Project has developed the video clips to facilitate implementation of the lecture trainings and self-learning (E-learning system).

- Web-based PMS Data Input System
- Web-based PC Data Display System
- Web-based PMoS System
- Web-based PMS Operation System
- Web-based Data Analysis System
- Web-based Maintenance Technology Information System

**Table 8.9.1 Target of Training and Implementation Methods**

Training Type	Training Course	Target of Training	Frequency	Days / course	Lectured by;
1. Administration (Officer) Training	Apply DRVN existing system				
2. Business Sector Training	(1) Road Maintenance Management Training	To enhance PDCA cycle management capacity including planning and road maintenance management to keep road and traffic service levels in good conditions. Training course for DRVN officials/staff.	Once/year	2 days	DPI/RMMD/ Experts
	(2) Traffic Safety and Management Training	To enhance traffic management capacity including traffic safety, traffic survey, problem identification and solution finding to minimize the negative effects given to road traffic. Training course for DRVN officials/staff.	Once/year	2 days	Traffic Safety Dept/ Experts
	(3) Information Management Training	To enhance information management capacity to maximum use of database and information technologies into daily road asset management. Training course for DRVN officials/staff.	Once/year	2 days	TSEID Information Center/ Experts
	(4) Road Maintenance and Traffic Management Training	To enhance the management capacity of road maintenance and traffic management in the field. Training course for RMB and SB officials/staff.	Once/year	2 days	DRVN Departments
3. Advanced Technology Training	(1) PMS	To enhance operation capacity of PMS system including data processing and plan formulation.	Once/year	1 day	DPI/TSEID/ IT Consultant
	(2) VBMS	To enhance operation capacity of BMS system including data processing and plan formulation.	Once/year	1 day	TSEID/ IT Consultant
	(3) Road Database Management	To enhance operation skill of road DB system including data registration, update and maintenance.	Once/year	1 day	TSEID/ IT Consultant
	(4) Road Facility Inspection And Diagnosis Technology	To enhance road facility inspection skills by road facility including survey, diagnosis and repair work selection.	Once/year	1 day	RMMD/TSEID/ Experts
4. E-learning System (Self-learning)	(1) Web-based PMS Data Input System	To enhance web-based software operation skills at any time with their own time schedule.	As required	As required	TSEID/ Information Center (Technical Support)

Note: DPI: Planning & Investment Department, RMMD: Road Maintenance Department, TSEID: Technology Science, Environment and International Cooperation Department

**Table 8.9.2 Lecture Contents by Training Type**

Training Type	Training Course	Lecture Contents
1. Administration (Officer) Training		<ul style="list-style-type: none"> <li>Apply existing system of DRVN</li> </ul>
2. Business Sector Management Training	(1) Road Maintenance Management Training (for DRVN officials/staff and RMB manager class officials/staff)	<ul style="list-style-type: none"> <li>Regulations</li> <li>Road maintenance policy</li> <li>Responsibility assignments</li> <li>Technical standards, guideline and manuals</li> <li>Five-year plan / Annual plan</li> <li>Planning processes &amp; time schedule</li> <li>PMS/VBMS functions</li> <li>Data processing and Databases</li> <li>Bridge/Pavement management</li> <li>Routine maintenance, periodic repair and investment projects</li> <li>Road patrol, road facility inspection and diagnosis</li> <li>Damages and deterioration</li> <li>Repair work selection</li> <li>Repair cost data management</li> </ul>
	(2) Traffic Safety and Management Training (for DRVN officials/staff and RMB manager Class)	<ul style="list-style-type: none"> <li>Regulations</li> <li>Responsibility assignments</li> <li>Traffic Management Policy</li> <li>Traffic control and surveillance</li> <li>Traffic safety</li> </ul>
	(3) Information Management Training (for DRVN officials/staff and RMB managers)	<ul style="list-style-type: none"> <li>Regulations</li> <li>Responsibility assignments</li> <li>Information management policy</li> <li>Systematization of road maintenance</li> <li>Architecture of DRVN information system</li> <li>Information system and equipment management</li> <li>DB management</li> </ul>
	(4) Road Maintenance and Traffic Management Training (for RMB/SB engineers)	<ul style="list-style-type: none"> <li>Regulations</li> <li>Responsibility assignments</li> <li>Road Patrol</li> <li>Road facility inspection, road maintenance and repair</li> <li>Contract management</li> <li>Inspection and maintenance work supervision</li> <li>Quality management / Acceptance</li> <li>Work zone labor safety</li> <li>Maintenance data registration</li> <li>Traffic count</li> <li>Over-loading vehicle control</li> </ul>
3. Advanced Technology Training	(1) PMS	<ul style="list-style-type: none"> <li>Regulations</li> <li>Pavement Condition Survey</li> <li>System operation guideline</li> <li>System structure</li> <li>Data processing</li> <li>System operation</li> </ul>
	(2) VBMS	<ul style="list-style-type: none"> <li>Regulations</li> <li>System operation guideline</li> <li>System structure</li> <li>Data processing</li> <li>System operation</li> </ul>
	(3) Road Database Management	<ul style="list-style-type: none"> <li>Regulation</li> <li>DB Operation Guideline</li> <li>Database structure</li> <li>Data registration</li> <li>Data update</li> <li>DB maintenance</li> <li>Responsibility assignments</li> </ul>

Training Type	Training Course	Lecture Contents
	(4) Road Facility Inspection and Diagnosis	<ul style="list-style-type: none"> <li>Regulations</li> <li>Road facility inspection guideline</li> <li>Inspection methods by structure</li> <li>Inspection results and diagnosis</li> <li>Data registration</li> <li>Responsibility assignments</li> </ul>
4. Self-learning System	(1) Web-based PMS Data Input System	<ul style="list-style-type: none"> <li>System operation</li> </ul>
	(2) Web-based PC Data Display system	<ul style="list-style-type: none"> <li>System operation</li> </ul>
	(3) Web-based PMS Operation System	<ul style="list-style-type: none"> <li>System operation</li> </ul>
	(4) Web-based PMoS System	<ul style="list-style-type: none"> <li>System operation</li> </ul>
	(5) Web-based Data Analysis System	<ul style="list-style-type: none"> <li>System operation</li> </ul>
	(6) Web-based Maintenance Technology Information System	<ul style="list-style-type: none"> <li>System operation</li> </ul>

**Table 8.9.3 Expected Trainees**

Training Type	Training Course	DRVN					RMBs/SBs	
		DPI	Finance Dept.	RMMD	TSEID	Traffic Safety Dept.	Management officials/staff	Engineers
1. Administration (Officer) Training	Apply DRVN existing system							
2. Business Sector Training	(1) Road Maintenance Management Training	X	X	X	X		X	
	(2) Traffic Safety and Management Training	X	X		X	X	X	
	(3) Information Management Training	X	X	X	X	X	X	
	(4) Road Maintenance and Traffic Management Training							X
3. Advanced Technology Training	(1) PMS	X		X	X			X
	(2) VBMS	X		X	X			X
	(3) Road Database Management	X		X	X			X
	(4) Road Facility Inspection and Diagnosis Technology			X	X			X
4. E-learning System (Self-learning)	(1) Web-based PMS Data Input System	X					X	
	(2) Web-based PC Data Display System							
	(3) Web-based PMS Operation System							
	(4) Web-based PMoS System							
	(5) Web-based Data Analysis System							
	(6) Web-based Maintenance Technology Information System							

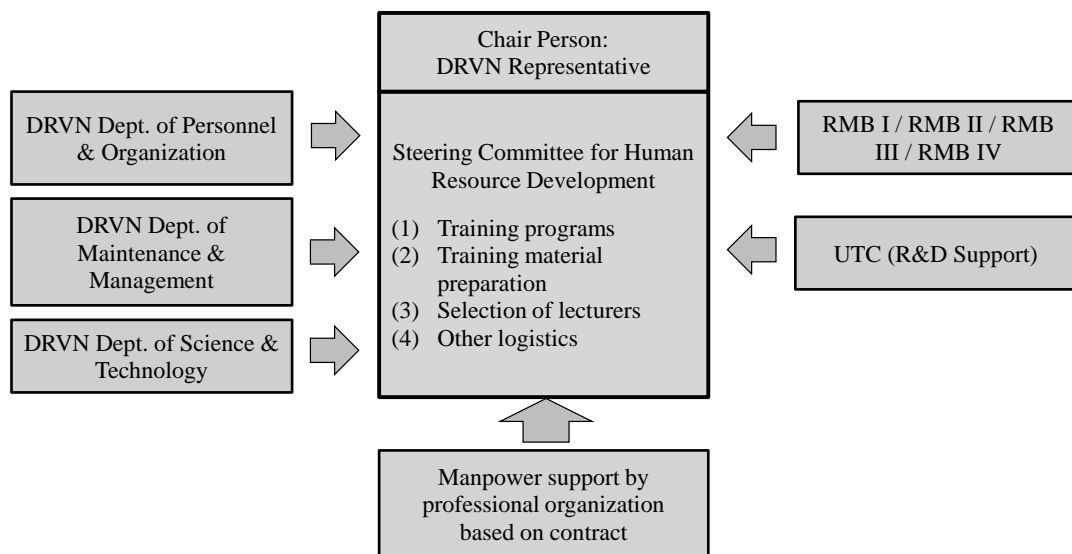
## 8.9.4 Management of Training Programs

### (1) Management Structure

For the successful implementation of the training programs, it is crucial to maintain sound cooperation with the related organizations including dispatch of the lectures. It is also

significant for the DRVN to take a leading role in the planning and implementation of the training programs. For this purpose, it is recommended that the DRVN set up a Steering Committee for Human Resource Development, and to manage the training programs under the leadership of a chairperson of the said Committee. The Steering Committee is a useful tool for the management of the project where a certain number of stakeholders gather, and plays a role for smooth implementation of the training programs.

On the other hand, the Committee is not expected to conduct labor tasks, such as training coordination, etc. Thus it is suggested that the DRVN set up a specialized supporting system for conducting such manpower tasks by applying the road maintenance fund, and contracting out such tasks to the external competent institution (s).



**Figure 8.9.1 DRVN Steering Committee for Human Resource Development**

**(2) Installation of Training Supporting System**

When carrying out the training programs, coordination becomes very much key factor. Training coordination and related tasks include the following logistic operations.

- Planning of training programs and training courses
- Development of training materials
- Selection of lectures and their invitation
- Adjustment of training schedule
- Liaison between lectures or/and trainees
- Arrangement of training rooms and facilities
- Arrangement of accommodation for trainees (when necessary)
- Settlement of travel costs for lecturers and trainees

Since the above logistic work is expected to increase as the number of training programs increases in the future, it requires establishing a proper training supporting system. In order to do so within the current DRVN, it is essential to strengthen the structure and the capacity of the Personnel and Organization Department of the DRVN, which might be challenging under the current state budget.



Thus, it is recommended that the DRVN conclude an outsourcing agreement with a competent institution and establish sound supporting system.

The followings are the recommended institutions (potential candidates):

- Universities and colleges such as UTC, UTT and Northern College
- Associations such as Road and Bridge Association, etc., or
- Establishment of DRVN its own training center

The Project recommends utilization of the UTC, UTT or Road and Bridge Association as a competent agency with qualified knowledge and experiences on the road administration and the road maintenance.

Once the logistic work is handed over to the external competent agency, the DRVN should be able to concentrate on the management tasks, accumulation of know-how on human resource development of their officials/staff, and be able to play a leading role in managing the training programs.

Human resource development is a paramount responsibility of the DRVN. Therefore, if the number of training programs is to be increased in the future due to the expansion of the national road network and the diversification of the DRVN responsibilities, the DRVN may go into the next stage of establishing its own training center and operating it with accumulated know-how. This shall be a future road map.

### **(3) Future Vision**

The roads in Viet Nam are currently managed by the various road operators; the PDOTs for the national and provincial road management, the VEC for expressway management. Also, recently, the BOT companies actively participate in the road maintenance and management in Viet Nam. However, unlike the DRVN, for such small operators, it should be relatively difficult for them to formulate their human resource development programs due to the constraint of the staff availability. As the road management environment has been rapidly changing, the MOT is requested to have a future vision of the human resource development for all organizations involved in the road maintenance and management. DRVN is expected to support these organizations to nurture human resources by applying accumulated know-how of the training programs. Existing training organizations, such as the UTT and Northern College, are also expected to provide trainings to the engineers involved in the road maintenance.

## **8.10 JICA HUMAN RESOURCE DEVELOPMENT PROGRAM (NEW PROGRAM)**

The Government of Japan has established “Cross-ministerial Strategic Innovation Promotion Program (SIP)” in 2013. It aims to promote advancement of science, technology and innovation in Japan. SIP leverages industry-academy-government cooperation to rapidly create basic research leading to concrete the exit strategies for the said aims to be materialized. As the basis of this exit strategy, SIP actively cooperates with key universities, regional universities, national research institutes and related ministries.

In line with SIP initiative with the concerned universities, there are 11 research topics including Research on Infrastructure Maintenance, and Renovation and Management.

JICA has been supporting human resource development on the RAM through SIP. Under this scheme, JICA offers 2 Programs:

- Program 1: Training in Japan specialized for RAM (Country-Focused Training)
- Program 2: JICA Scholarship Research Study in Japan on RAM

### 8.10.1 Country-Focused Training on RAM (Program 1)

#### (1) Objectives

Country-Focused Training in Japan is a JICA Program of Human Resource Development, which invites CPs or stakeholders to Japan and provides practical trainings on the RAM in collaboration with the University of Tokyo within the framework of JICA Project for Capacity Enhancement in Road Maintenance Phase II. In response to JICA's recruitment, the DRVN decided to apply for this training.

#### (2) Applicant

Middle class or younger practitioners dedicated to the inspection and maintenance of the national roads in Viet Nam (MOT, DRVN, RMBs, SBs, RTCs).

#### (3) Lecture Framework

- 1) Class room lectures on the following subjects;
  - Characteristics of bridge facility damages
  - Key points of facility inspection
  - Case studies of bridge repair and reinforcement work
  - Management of bridge structure
  - Exercise and analysis of bridge inspection data
  - Exercise on the future forecast of bridge maintenance budget
- 2) Visit MLIT and NEXCO-Central to learn RAM in Japan
- 3) Visit PWRI to learn R&D on RAM
- 4) Visit private companies to learn advanced road maintenance technologies in Japan

#### (4) Training Schedule

The Table below shows the training schedule.

**Table 8.10.1 Schedule for Country-Focused Training**

SQ No.	Day & Date		Training Course		Venue
			AM	PM	
1	2018/2/25		Introduction & current status of road infrastructure in Japan		JICA
2	2018/2/26	Mon	Characteristics of concrete structure and damages	Continue	JICA
3	2018/2/27	Tue	Characteristics of steel structure and damages given	Continue	University of Tokyo
4	2018/2/28	Wed	Key points of road facility inspection and diagnosis, and case studies of repair and	Continue/Exchange of Opinion	University of Tokyo

SQ No.	Day & Date		Training Course		Venue
			AM	PM	
			reinforcement work		
5	2018/3/1	Thu	case studies of repair and reinforcement work	Continue/Exchange of Opinion	University of Tokyo
6	2018/3/2	Fri	Management of road infrastructures	Continue/Exchange of Opinion	University of Tokyo
7	2018/3/3				
8	2018/3/4				
9	2018/3/5	Mon	<p>■ Visit Public Works Research Institute</p> <p>(1) Countermeasures against deteriorated road facilities</p> <p>(2) Research facility</p>	Continue (* Round trip between TSUKUBA	MLIT PWRI
10	2018/3/6	Tue	<p>■ Visit PASCO Company</p> <p>(1) R&amp;D on advanced road maintenance and management technologies</p>	Continue (* Move to NAGOYA from Tokyo (* Stay overnight at NAGOYA	PASCO Company
11	2018/3/7	Wed	<p>■ Visit NEXCO Central Company</p> <p>(1) All about expressway maintenance</p> <p>(2) Pavement maintenance (PMS, PC data application)</p> <p>(3) Human resource development of maintenance engineers</p>	Continue (* Stay overnight at NAGOYA	NEXCO Central Company
12	2018/3/8	Thu	<p>■ Visit NAGOYA University</p> <p>(1) Visit N2U Bridge facility (Model facility of concrete deterioration)</p>	Continue (* Move to KOBE from NAGOYA (* Stay overnight at Kobe	Nagoya University
13	2018/3/9	Fri	<p>■ Visit Honshu-Shikoku Expressway Company</p> <p>(1) Long span bridge maintenance</p> <p>(2) Bridge facility inspection</p> <p>(3) Facility Inspection and maintenance/repair technical standards and manuals</p>	Continue (* Return TOKYO from KOBE	Honshu- Shikoku Expressway Company
14	2018/3/10				
15	2018/3/11				
16	2018/3/12	Mon	Exercise on the analysis of road facility inspection data	Continue	University of Tokyo
17	2018/3/13	Tue			
18	2018/3/14	Wed			
			<p>- Use of actual bridge survey data obtained by Niigata Prefecture including relevant cities</p> <p>- Analysis of the trend of bridge deterioration</p> <p>- Development of approximate curve for bridge deterioration</p> <p>- Data mapping for bridge locations</p> <p>- Data Processing and analysis</p>		
19	2018/3/15	Thu	Exercise on the future forecast of bridge maintenance budget and bridge soundness assessment	Continue	University of Tokyo
20	2018/3/16	Fri			
			<p>- Lecture on the basic principle</p> <p>- System operation for 50 years</p> <p>- Study on how output changes when conditions change</p>		

SQ No.	Day & Date		Training Course		Venue
			AM	PM	
21	2018/3/17				
22	2018/3/18				
23	2018/3/19	Mon	■ Visit Pavement Material Company (NICHIREKI) (1) Pavement repair materials (2) Recycle technology	Continue	NICHIREKI Company
24	2018/3/20	Tue	Summary of training and presentation		JICA
25	2018/3/21	Wed	Back to Viet Nam		JICA

### (5) Training Participants

Fifteen (15) officials representing from DRVN headquarter, RMBs and SBs were participated the country-focused training.

**Table 8.10.2 List of Participants**

No.	Full name	Position	Organization
1	Doan Quoc Bao	Expert	Department of Planning and Investment, DRVN
2	Le Hoang Long	Expert	Department of Science, Technology, Environment and International Cooperation, DRVN
3	Nguyen Van Hoi	Deputy Chief of Traffic Safety Division	Road Management Bureau I
4	Tran Quoc Thanh	Senior Expert	Department of Road Management and Maintenance, DRVN
5	Luong Van Hung	Deputy Chief No.3	Construction Management Bureau, DRVN
6	Tran Thanh Tung	Director of Sub-Bureau I.2	Road Management Bureau I
7	Nguyen Quang Hung	Director of Sub-Bureau I.3	Road Management Bureau I
8	Ta Quang Vinh	Director of Sub-Bureau I.6	Road Management Bureau I
9	Luu Hung Son	Director of Sub-Bureau II.1	Road Management Bureau II
10	Le Van Hieu	Expert of Road Management and Maintenance Division	Road Management Bureau II
11	Tan Hoang Trung	Director of Sub-Bureau III.1	Road Management Bureau III
12	Tiet Dinh Quang	Director of Sub-Bureau III.2	Road Management Bureau III
13	Nguyen Danh Tien	Director of Sub-Bureau III.5	Road Management Bureau III
14	Pham Minh Trieu	Deputy Chief of Traffic Safety Division	Road Management Bureau IV
15	Hoang Van Phuong	Chief of Road Management and Maintenance Division	Road Management Bureau IV

### **8.10.2 JICA Scholarship Research Study in Japan on RAM**

Scholarship Research Study in Japan is a JICA Program of the Human Resource Development, which invites CPs or stakeholders to the universities in Japan, and helps supporting their research activities on the RAM.

The following is a brief outline of the program. Applicants who wish to participate in this program are requested to contact JICA Viet Nam Office.

#### **(1) Candidates of Application**

Candidates of this program are those who have fundamental knowledge on the RAM and who wish to conduct research activity on the RAM in Japan. In addition, applicants should belong to either one of the following categories;

- 1) Middle-class or younger road administrator among CPs and stakeholders of JICA Project for Capacity Enhancement in Road Maintenance Phase II who shall play a key role in the future RAM in Viet Nam (MOT, DRVN, RMBs, SBs, ITST, RTCs)
- 2) Middle-class or younger researcher currently involved in the research activity on the RAM at the Universities in Viet Nam (UTC, UTT).

#### **(2) Accepting 3 Universities in Japan**

- 1) The University of Tokyo
  - International Center for Urban Safety Engineering, Institute of Industrial Science
- 2) Hokkaido University
- 3) Nagasaki University
  - Infrastructures Lifetime-extending Maintenance Research Center

#### **(3) Accepting Course (Common to the above 3 universities)**

Master's Course in principle (Doctor's Course is also available)

#### **(4) Enrolment Time**

April 2018 enrollment is available

#### **(5) Number of Applicants**

- 1) The University of Tokyo:                 Several
- 2) Hokkaido University:                 Several
- 3) Nagasaki University;                 Several

#### **(6) Preliminary selection by JICA**

Given information on the research topic addressed by the applicant, JICA shall play coordination with universities and find out an appropriate university that satisfies the research topic. The result of this preliminary selection shall be informed to the applicant as a JICA recommendation.

#### **(7) Formal Application by the Applicant**

Based on the JICA recommendation, the applicant is requested to fill out a formal application form which is prepared by the recommended university and submit it to the university.

**(8) Final Selection by the University**

Based on the formal application submitted by the applicant to the university, final selection shall be made by the university with their criteria. Brief university information is shown in 3.3 University Information.

**(9) JICA support**

When study in Japan is approved by the university, JICA will provide a scholarship to the applicant as shown in the following table. The scholarship shall be provided in accordance with the “Handbook for Knowledge Co-creation Program, August 2016, JICA”. The applicant is requested to submit the proposal of scholarship to JICA after the university approval.

**Table 8.10.3 Brief Information on Scholarship Coverage**

Items	Amount of payment
Examination/ Entrance/Tuition	Actual cost
Flight fee	Actual cost
Living Allowance	Pay by daily amount
Moving Allowance	Pay as lump sum
Outfit allowance (purchase necessary for living in Japan)	Pay as lump sum

**8.11 SUPPORT DRVN PUBLIC RELATIONS ACTIVITY**

**8.11.1 Introduction**

In addition to the capacity enhancement in the road maintenance, Public Relations (PR) are also an important activity for the DRVN to enhance quality of the road maintenance and management.

The former aims at systematizing the road maintenance and management technologies including the database system, PMS, VBMS, road inspection, maintenance and monitoring technologies. And also, it aims at developing human resources to accomplish the RAM and fully utilizing the advanced technologies in the road maintenance and management.

On the other hand, the latter aims at strengthening cooperation with the stakeholders which include; (1) ministry-level organizations to get support for the better institutional arrangement (Budget allocation, regulation arrangement, etc.); (2) public users to get cooperation on the event of maintenance work and accompanied traffic control in the field, and; (3) private companies which has high R&D capacity in developing advanced technologies which can be applied to the road maintenance and management. It is therefore very important for the DRVN to strength cooperation with these stakeholders by means of PR activities; in addition to the capacity enhancement of the DRVN’s human resources and maintenance technology.

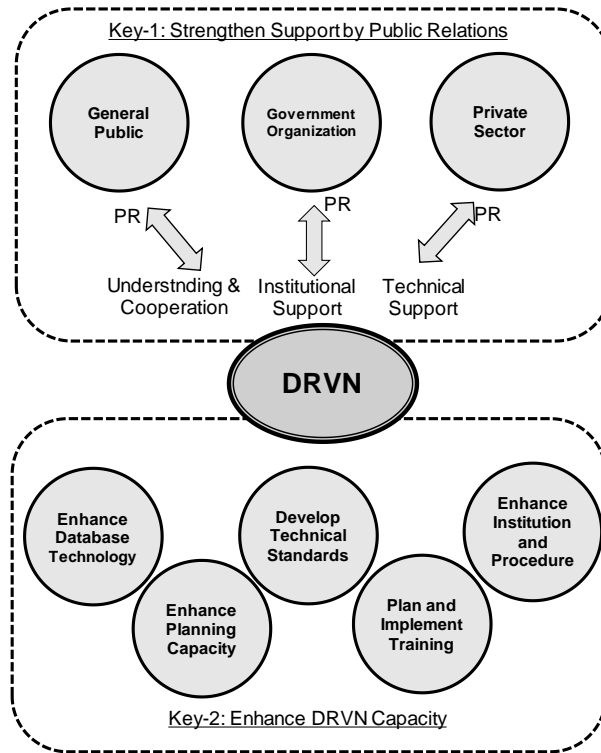


Figure 8.11.1 Key Activities for National Road Maintenance

### 8.11.2 Baseline Survey

Current PR activities under the DRVN have been studied. The survey has clarified mainly the following points (refer to the Appendix 8.1);

- Road Magazine, business unit under the DRVN, is responsible for the public relations of the DRVN activities.
- At the time of promoting the road maintenance funds, the DRVN conducted 2-3 year PR activities including the newspapers, discussion forum, and TV interviews.
- DRVN releases information such as administrative updates, results of analysis and updates of DRVN's website.
- DRVN conducts seminar and workshops addressing to the decision makers.
- Road Magazine short video clips on Road Data Centre, Traffic safety, Flood management.
- DRVN and the Road Magazine run respective websites.

### 8.11.3 Planning of PR activities

For the above reasons, the Project selected to develop the following 3 materials for the PR activity based on the discussion with the DRVN Working Groups. Implementation plans for developing these materials are stated hereinafter in the following sections.

- (1) To publicize the status of the national road maintenance to the government institutions and raise their further institutional support on the budget, institutions, regulations, R & D, etc.
  - Develop **Annual Report** and **Video Crip** for the road maintenance

- (2) To publicize importance of the road maintenance to the public road users of Viet Nam to promote their understanding and cooperation on the national road maintenance
- Develop **General Information Brochure**

To publicize the status of the road maintenance technologies to the private companies and raise their support on developing road maintenance technologies.

- Develop **Web-based Road Maintenance Technology Information System**

#### **8.11.4 Annual Report and Video Crip for DRVN activities**

**(1) Objective**

- To provide professional information on the national road maintenance and management to the decision makers and the professional government ministries involved in the activities of budgeting, institutional/regulation development, and R & D.

**(2) Target stakeholder**

- MOF, MPI, MOC, MOT, ITST etc.

**(3) Contents to be covered**

- Current status and issues of institution and administration on road maintenance
- Statistics on road and bridge managed by DRVN
- Road maintenance plans, strategy and activities under DRVN
- Need of road maintenance budget
- Need of Laws, Legislations, Standards, Guidelines and Manuals on Road Maintenance
- Comparative studies of road maintenance in developed countries.

**(4) Responsible Agency**

**1) Leading Agency**

- Department of Science Technology Environment and International Cooperation, DRVN
- Department of Road Maintenance Management, DRVN
- Personnel Department, DRVN

**2) Implementing Agency**

- Road Magazine

#### **8.11.5 General Information Brochure**

**(1) Objective**

- To get recognition and understanding on importance of road maintenance, and road maintenance activities carried out by DRVN
- To share issues and problems on road maintenance facing by DRVN
- To collect opinions and comments on road maintenance from Public

**(2) Target Stakeholder**

- General Public Road Users



**(3) Contents to be Covered**

- Current status and issues on road condition in Viet Nam
- Benefit of road maintenance to everyday life
- Contribution of road maintenance to social economic environments
- Contact point to get report on road damages etc. from public

**(4) Responsible Agency**

**1) Leading Agency**

- Department of Science Technology Environment and International Cooperation, DRVN
- Department of Road Maintenance Management, DRVN
- Personnel Department, DRVN

**2) Implementing Agency**

- Road Magazine

**(5) Product**

- Annual Report (“Roads in Viet Nam 2016”):
  - Vietnamese version: 5,000 copies
  - English version: 500 copies
  - DVD (Vietnamese and English): 5 copies
- General Information Brochure:
  - Vietnamese version 8,000 copies
  - English version: 2,000 copies
  - DVD (Vietnamese and English): 3 copies
  - Video Clip for PR (“Road Maintenance and Management in Viet Nam”)
  - DVD: 100 copies (Vietnamese version with English subtitle)

**8.11.6 Web-based Road Maintenance Technology Information System**

**1) Objective**

R&D function of the road operator is limited in the amount of the investment and the coverage of the subjects, thus it is important for the road operator to cooperate with the private sector and to make the best use of their technologies into the road maintenance and the management activities. With this, the road operators can concentrate on the money and the human resources to their own R&D activities.

The Web-based Information System for Road Maintenance Technology in the DRVN information network wide opens the opportunity for the private sector to participate in the road maintenance and management activities currently conducted by the DRVN.

**2) Target Stakeholder**

- Private companies involved in the road maintenance technology development

**3) System Outline**

- Communication system to be built in the DRVN web information system. The following shows the operation methods of this system and the schematic view of this system is shown in the Figure 8.11.2.

- DRVN is to invite the road maintenance technologies developed by the private companies through the DRVN web site, showing maintenance and repair technologies which DRVN wishes to call for a guideline to operate this system.
- Given this information, private companies, which have maintenance and repair technologies of those listed on the website and wish to conduct the sales promotion to the DRVN, are to respond to the invitation by filling the registration formats on the website.
- DRVN gathers information in the Database Format twice a month and evaluates against the needs of the DRVN. The companies with products matching the DRVN needs will be given presentation opportunities. Detailed procedures will be developed as an Operation Guideline and posted on the web site.
- Private company will conduct presentation to the DRVN.

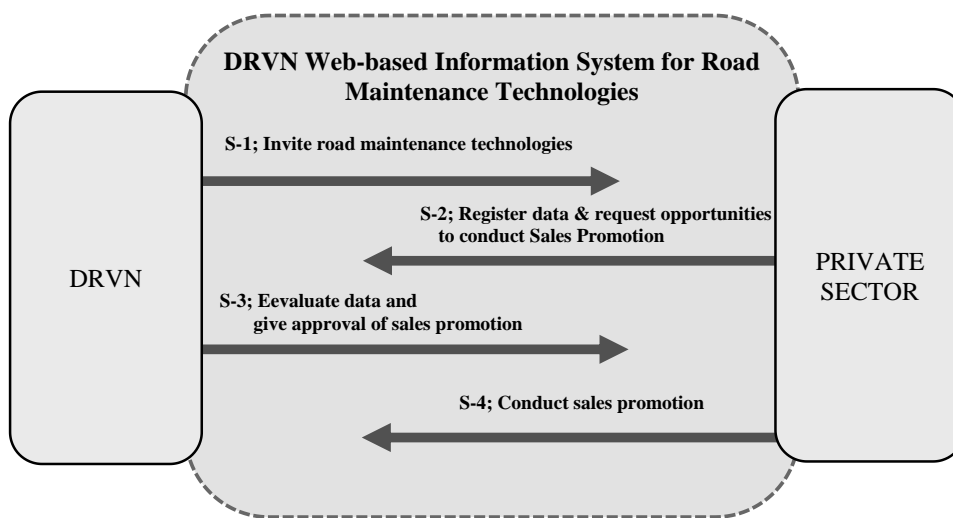


Figure 8.11.2 System Structure

(2) **Responsible Agency**

1) **Leading Agency**

- Department of Science Technology Environment and International Cooperation, DRVN
- Department of Road Maintenance Management, DRVN

(3) **Implementing Agency**

- SAO MAI SOFTWARE J.S.C (Computer software development was outsourced)

Based on the comparing price quotations obtained from several (usually at least 3) foreign and/or local suppliers to ensure competitive prices, SAO MAI SOFTWARE J.S.C. was appointed as a sub-contractor and contract was formed in the 5<sup>th</sup> of August 2016, and the completed their work at the end of December 2016.

## CHAPTER 9 PROCUREMENT OF EQUIPMENT

### 9.1 PREPARATION AND SUBMISSION OF REPORTS AND OUTPUTS OF TECHNICAL COOPERATION

#### 9.1.1 Reports

List of reports produced during the Project is shown in **Table 9.1.1**. Vietnamese translation are prepared at draft version of each report. In addition to below list, Work Plan and Progress Report will be prepared as ANNEX of Monitoring sheet.

**Table 9.1.1 Output Type, Submission Date and Number of Copies**

Type of Report	Submission date	Number of Copies
Monitoring Sheet Ver.1	At the commencement of the Project	English: 30 copies
Monitoring Sheet Ver.2	Submitted on 21 <sup>st</sup> October 2015	
Monitoring Sheet Ver. 3	Submitted on 25 <sup>th</sup> March 2016	
Monitoring Sheet Ver. 4	Submitted on 31 <sup>st</sup> September 2016	
Monitoring Sheet Ver. 5	Submitted on 22 <sup>nd</sup> January 2017	
Monitoring Sheet Ver. 6	Submitted on 29 <sup>th</sup> March 2017	
Monitoring Sheet Ver. 7	Submitted in September 2017	
Project Completion Report( include outputs of technical cooperation)	Beginning of February 2018	Japanese: 5 copies (main texts only) English: 30 copies CD-R: 9 copies

#### 9.1.2 Outputs of Technical Cooperation

As a part of Project Completion Report mentioned above, outputs of technical cooperation will be prepared as listed in below.

Measures	Outputs
Measure 1	<ul style="list-style-type: none"> <li>• PMS data (71 items)</li> <li>• Pavement Condition Database for RMB I (partly) RMB II, III, and IV roads</li> <li>• Web-based PMS Data Input System and Operation Manual</li> <li>• Video clip of operation of PMS data inputting system</li> </ul>
Measure 2	<ul style="list-style-type: none"> <li>• PMS Dataset</li> <li>• Annual and 5 Year Pavement Repair Plan for RMB I, II, III and IV Jurisdiction</li> <li>• Web-based System for Displaying Pavement Condition Data and Operation Manual</li> <li>• Web-based PMS Operation System and Operation Manual</li> <li>• Web-based Pavement Condition Data Analysis System and Operation Manual</li> <li>• Web-Based Pavement Monitoring System and Operation Manual</li> <li>• Video Clip for Operation of PMS related Systems</li> </ul>
Measure 3	<ul style="list-style-type: none"> <li>• Evaluation Report of Pilot Repair Works</li> <li>• Road Facility Inspection Guideline (Draft)</li> <li>• Road Routine Maintenance Manual (Draft)</li> <li>• Expressway Maintenance Manual (Draft)</li> </ul>
Measure 4	<ul style="list-style-type: none"> <li>• Draft plan for maintenance responsibility assignment</li> <li>• Draft amendment plan of regulations for responsibility assignment</li> </ul>

Measure 5	<ul style="list-style-type: none"> <li>• Training Programs and Training Materials</li> <li>• DRVN Annual Report</li> <li>• DRVN Promotional Video</li> <li>• General Information Brochure</li> <li>• Web-based Information System for Road Maintenance Technology</li> <li>• Operational Manual</li> <li>• Video Clip of Operation of Web-based Information for Road Maintenance Technology</li> </ul>
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### 9.1.3 Procurement Plan of Equipment and Machinery

#### 1) Equipment and Machinery Provided

**Table 9.1.2 List of Equipment and Machinery Provided**

Equipment and machinery	No.	Date of purchase	Detail
Projector	1	Purchased in April 2015	
Computer (including monitor, keyboard, mouse and UPS)	2	Purchased in April 2015	Procured for secretary and translator of the Project Team.
Computer for PMS (including monitor, keyboard, mouse and UPS)	10	2 computers purchased in December 2015 8 computers purchased in October 2017.	<ul style="list-style-type: none"> <li>• 2 computers for DRVN specifically for PMS planning has been handed over on December, 2017</li> <li>• 2 computers for each RMB specifically for PMS planning have been handed over in October, 2017.</li> </ul>
Application server	1	Purchased and installed to DRVN (September, 2016)	Database and PMS developed under the Project are installed into a server after operation check, and procured to DRVN headquarter to be utilized for training of Web Based System for Displaying Condition Survey Data and Operation system.
Database server	1		

#### 2) Equipment and Machinery Accompanied by Expert Dispatch

**Table 9.1.3 List of Equipment and Machinery Accompanied by Expert Dispatch**

Equipment and machinery	No.	Date of purchase
Color Printer	1	Purchased in June 2015
Projector Screen	1	Purchased in April 2015
Microsoft Office 2013	12	Purchased in April 2015
Norton Internet Security	12	Purchased in April 2015
Microsoft visual studio 2013	2	Purchased in April 2015
Win Pro	1	Purchased in April 2015

## 9.2 SUBCONTRACTS FOR DATA COLLECTION, SYSTEM DEVELOPMENT AND PR ACTIVITIES

The project has subcontracted the activities as shown in **Table 9.2.1**.

**Table 9.2.1 List of activities to be subcontracted**

Items	Subcontractor	Contracted date	Status
<b>Pavement condition survey</b>			
Pavement condition survey (Activity 1-2)	RTC Central, DRVN	Contracted on 7th of Oct. 2015. Amended contract on 20th Aug.2016.	Contract was completed on XX, 2017.
<b>PMS related Web-based System</b>			
Web-based PMS Data Input System (Activity 1-3)	SAOMAI Software J.S.C (Web based system Package 1)	Contracted on 20h of Oct. 2015	Contract was completed on 30th April 2016.
Web-based System for Displaying Pavement Condition Survey Data (Activity 2-4)			
Web-based PMS Operation System - for Strategic Budget Planning Model (Activity 2-5)	SAOMAI Software J.S.C (Web based system Package 2)	Contracted on 31st October 2016	Contract was completed on 30 <sup>th</sup> November, 2017
Web-based PMS Operation System - for Pavement Repair Work Planning Model (Activity 2-5)	SAOMAI Software J.S.C (Web based system Package 2)	Contracted on 31st October 2016	Contract was completed on 30th November, 2017
Web-based Analysis System for Pavement Condition Survey Data (Activity 2-6)	SAOMAI Software J.S.C (Web based system Package 2)	Contracted on 23 August 2017 with addendum on Package 2	Contract was completed on 30th November, 2017
Web based Pavement Monitoring System (Activity 2-7)	SAOMAI Software J.S.C (Web based system Package 2)	Contracted on 31st October 2016	Contract was completed on 30th November, 2017
<b>Public Relations</b>			
Development of annual report and video clip (Activity 5-3)	Road Magazine	Contracted on 30th June 2016	Contract was completed at the end of August, 2017
System Development of Web Based Information System Road Maintenance Technology In Vietnam (Activity 5-3)	SAOMAI Software J.S.C	Contracted on 5th August 2016	Contract was completed at the end of December 2016.
Development of General Information Brochure (Activity 5-3)	Road Magazine	Contracted on August 29, 2017.	Contract was completed on 29 November, 2017.

# APPENDICES

**APPENDIX-4 EXCLUDED ROAD SECTIONS FOR PAVEMENT SURVEY IN RMB**

No	Route Name	Location	Start point	End Point	Length (Km)	Lane	Lane Length (Km)	Note
<b>A. RMB IV</b>								
1	NH N1	An Giang	Km138+914	Km162+200	23.29	2.00	46.57	Handed over to PDOT
2	NH1- Branch	Tiền Giang	Km0+00	Km0+376	0.38	2.00	0.75	Handed over to Expressway Department
3	NH1- Branch	Tiền Giang	Km0+00	Km0+671	0.67	2.00	1.34	
4	NH1- Branch	Tiền Giang	Km0+00	Km0+167	0.17	2.00	0.33	
5	NH1- Branch	Tiền Giang	Km0+00	Km0+200	0.20	2.00	0.40	
6	NH1- Branch	Cần Thơ			9.85	2.00	19.70	
7	NH1- Branch	Vĩnh Long	Km5+00	Km4+910	4.41	4.00	17.64	Eliminated (Overlap 1A)
8	NH1- Branch	Cần Thơ	Km76+60	Km14+910	7.25	4.00	29.00	Eliminated (Overlap 1A)
9	NH 91B	Cần Thơ	Km0+00	Km2+000	2.00	4.00	8.00	BOT (Under construction)
10	NH 91B	Cần Thơ	Km2+000	Km15+793	13.79	2.00	27.59	
11	NH91	Cần Thơ	Km9+000	Km39+000	30.00	2.00	60.00	
12	NH91	Cần Thơ	Km45+118	Km51+140	6.02	2.00	12.04	
13	NH20	Đồng Nai- Lâm Đồng	Km0+00	Km75+600	75.60	2.00	151.20	
14	NH20	Đồng Nai- Lâm Đồng	Km75+600	Km76+700	1.10	2.00	2.20	
15	NH20	Đồng Nai- Lâm Đồng	Km76+700	Km79+800	3.10	2.00	6.20	
16	NH20	Đồng Nai- Lâm Đồng	Km79+800	Km98+000	18.20	2.00	36.40	
17	NH20	Đồng Nai- Lâm Đồng	Km98+000	Km108+846	10.85	2.00	21.69	
18	NH20	Đồng Nai- Lâm Đồng	Km108+846	Km123+105	14.26	2.00	28.52	
19	NH20	Đồng Nai- Lâm Đồng	Km123+105	Km159+500	36.40	2.00	72.79	BT (QĐ 3986/QĐ-BGTVT)
20	NH20	Đồng Nai- Lâm Đồng	Km159+500	Km172+000	12.50	2.00	25.00	
21	NH20	Đồng Nai- Lâm Đồng	Km172+000	Km176+500	4.50	2.00	9.00	
22	NH20	Đồng Nai- Lâm Đồng	Km176+500	Km199+000	22.50	2.00	45.00	
23	NH20	Đồng Nai- Lâm Đồng	Km199+000	Km202+134	3.13	4.00	12.54	
24	NH20	Đồng Nai- Lâm Đồng	Km202+134	Km206+000	3.87	2.00	7.73	
25	NH20	Đồng Nai- Lâm Đồng	Km206+000	Km210+000	4.00	4.00	16.00	
26	NH20	Đồng Nai- Lâm Đồng	Km210+000	Km219+115	9.12	2.00	18.23	
27	NH20	Đồng Nai- Lâm Đồng	Km219+115	Km222+820	3.71	2.00	7.41	
28	NH20	Đồng Nai- Lâm Đồng	Km222+820	Km230+300	7.48	2.00	14.96	
29	NH20	Đồng Nai- Lâm Đồng	Km230+300	Km234+000	3.70	4.00	14.80	
30	NH20	Đồng Nai- Lâm Đồng	Km234+000	Km235+315	1.32	4.00	5.26	
31	NH20	Đồng Nai- Lâm Đồng	Km240+000	Km262+500	22.50	2.00	45.00	
32	NH20	Đồng Nai- Lâm Đồng	Km262+500	Km268+000	5.50	2.00	11.00	

33	1A	Ninh Thuận	Km1525+000	Km1561+134	36.13	2.00	72.27	Eliminated (BOT)
34	1A	Đồng Nai	Km1770+734	Km1817+600	46.87	4.00	187.46	Eliminated (BOT)
35	1A	Đồng Nai	Km1817+600	Km1832+500	14.90	4.00	59.60	Eliminated (BOT)
36	1A	Đồng Nai	Km1832+500	Km1851+000	18.50	4.00	74.00	Eliminated (BOT)
37	1A	Đồng Nai	Km1871+800	Km1873+275	1.48	4.00	5.90	Eliminated (BOT)
38	1A	Long An	Km1940+000	Km1945+150	5.15	4.00	20.60	Eliminated (BOT)
39	1A	Long An	Km1950+939	Km1954+790	3.85	4.00	15.40	Eliminated (BOT)
40	1A	Tiền Giang	Km1987+560	Km2011+000	23.44	4.00	93.76	Eliminated (BOT)
41	1A	Tiền Giang	Km2011+000	Km2014+000	3.00	2.00	6.00	Eliminated (BOT)
42	1A	Hậu Giang	Km2078+318	Km2100+000	21.68	2.00	43.36	Eliminated (BOT)
43	1A	Sóc Trăng	Km2121+108	Km2124+108	3.00	4.00	12.00	Eliminated (overlap)
44	1A	Sóc Trăng	Km2169+041	Km2178+223	9.18	2.00	18.36	Eliminated (BOT)
45	1A	Sóc Trăng	Km2178+223	Km2179+575	1.35	2.00	2.70	Eliminated 2 lanes
46	1A	Sóc Trăng	Km2181+975	Km2186+000	4.03	2.00	8.05	Eliminated 2 lanes
47	50	Tiền Giang	Km35+123	Km36+300	1.18	2.00	2.35	Eliminated (BOT)
48	51	Long Thành	Km16+700	Km21+600	4.90	4.00	19.60	Eliminated (handed over to PDOT)
49	53	Trà Vinh	Km11+295	Km56+000	44.71	2.00	89.41	By 1236/QĐ-BGTVT (BOT)
50	53	Trà Vinh	Km61+100	Km63+300	2.20	4.00	8.80	Eliminated (Handed over)
51	53	Trà Vinh	Km134+000	Km135+600	1.60	2.00	3.20	Eliminated (overlap)
52	53	Trà Vinh	Km134+000	Km148+000	14.00	2.00	28.00	Eliminated (Soil surface)
53	53	Trà Vinh	Km112+100	Km114+000	1.90	4.00	7.60	Eliminated (overlap)
54	53	Trà Vinh	Km148+000	Km151+100	3.10	2.00	6.20	Eliminated (overlap)
55	53	Trà Vinh	Km163+350	Km166+858	3.51	2.00	7.02	Eliminated (overlap)
56	53	Trà Vinh	Km166+858	Km168+858	2.00	2.00	4.00	Eliminated
57	54	Trà Vinh	Km111+400	Km115+000	3.60	2.00	7.20	Eliminated (overlap)
58	60	Tiền Giang	Km0+00	Km3+000	3.00	4.00	12.00	Eliminated (handed over to PDOT)
59	60	Cần Thơ	Km60+700	Km70+700	10.00	2.00	20.00	Eliminated (Overlap NH 53)
60	60	Trà Vinh	Km101+600	Km103+600	2.00	2.00	4.00	Eliminated (Ferry station)
61	60	Trà Vinh	Km105+100	Km107+700	2.60	2.00	5.20	Eliminated (Ferry station)
62	61	Kiên Giang	Km39+500	Km46+694	7.19	4.00	28.78	Eliminated (4 lanes)
63	61B	Hậu Giang	Km15+460	Km18+750	3.29	2.00	6.58	Eliminated (Construction)
64	91	An Giang	Km113+071	Km114+000	0.93	2.00	1.86	Eliminated (overlap)
65	91	An Giang	Km125+000	Km127+160	2.16	2.00	4.32	Eliminated (overlap)
<b>Total</b>							<b>1659.89</b>	
<b>B. RMB III</b>								
1	HHV	Đà Nẵng	Km11+536	Km11+636	0.10	1.00	0.10	Actual lane number is 5
3	1D	Bình Định	Km1+700	Km9+150	7.45	2.00	14.90	managed by local government



4	HCM - East branch	Quảng Nam	Km1376+020	Km1377+621	1.60	2.00	3.20	Modify the lane separating point
5	HCM - East branch	Quảng Nam	Km1380+680	Km1381+696	1.02	2.00	2.04	Actual lane number is 2
6	HCM - East branch	Kon Tum	Km1436+200	Km1438+900	2.70	2.00	5.40	Actual lane number is 2
8	14	Đắk Nông	Km776+000	Km779+000	3.00	4.00	12.00	Handover to RMB III in 2013
9	19	Bình Định	Km15+000	Km17+027	2.03	2.00	4.06	Handover BOT 9/9/2015
10	19	Bình Định	Km50+000	Km51+152	1.15	2.00	2.30	Handover BOT 9/9/2015
11	19	Gia Lai	Km90+000	Km108+000	18.00	2.00	36.00	Handover BOT 31/8/2015
12	19	Gia Lai	Km135+400	Km135+500	0.10	2.00	0.20	Modify the lane integrating point
13	19	Gia Lai	Km152+300	Km152+470	0.17	2.00	0.34	Modify the lane integrating point
15	19	Gia Lai	Km167+010	Km168+000	0.99	2.00	1.98	Modify the lane integrating point
16	19	Gia Lai	Km219+000	Km222+000	3.01	2.00	6.02	Actual lane number is 2
17	19	Gia Lai	Km241+000	Km243+000	2.00	2.00	4.00	managed by local government
18	26	Khánh Hòa	Km3+411	Km11+504	8.09	2.00	16.19	Handover BOT (29/7/2015)
19	26	Đắk Lắk	Km91+383	Km98+880	7.64	2.00	15.29	Handover BOT(9/9/2015)
20	26B	Khánh Hòa	Km0+00	Km1+000	1.00	2.00	2.00	under management of Hyundai Vinasih
21	connecting route between Hải Vân Túy Loan tunnel and QL1	Đà Nẵng	Km0+00	Km1+760	1.76	4.00	7.04	Under construction
22	Branch	Quảng Nam	Km956+750	Km958+700	1.95	2	3.90	Already surveyed
23	Branch	Quảng Nam	Km964+060	Km965+037	0.98	2	1.96	Already surveyed
24	Branch	Quảng Ngãi	Km1092+577	Km1101+317	8.60	2	17.20	Already surveyed
25	Other roads						191.81	No information
<b>Total</b>							<b>347.83</b>	
<b>C. RMB II</b>								
1	1	Hà Tĩnh	Km514+643	Km514+800	0.16	2.00	0.31	Thay đổi lý trình vị trí nhập làn
2	1	Quảng Bình	Km625+873	Km626+110	0.24	2.00	0.47	Km 625+873 vị trí cầu Gianh
3	1	Quảng Bình	Km672+310	Km672+822	0.51	2.00	1.02	Trạm thu phí Quán Hàu
4	1	Quảng trị	Km724+460	Km727+536	3.08	4.00	12.30	Đang thi công toàn bộ mặt đường
5	1	Quảng trị	Km770+680	Km771+200	0.52	4.00	2.08	Đang thi công toàn bộ mặt đường
7	1	Quảng trị	Km779+162	Km780+100	0.94	4.00	3.75	Đang thi công toàn bộ mặt đường
8	1	TT Huế	Km794+760	Km797+000	2.24	4.00	8.96	Đang thi công toàn bộ mặt đường
9	1	TT Huế	Km810+072	Km811+740	1.67	4.00	6.67	Đang thi công toàn bộ mặt đường
10	1	TT Huế	Km862+900	Km865+305	2.41	4.00	9.62	Đang thi công toàn bộ mặt đường
11	1	TT Huế	Km867+743	Km868+100	0.36	2.00	0.71	Dự án BOT
13	1	TT Huế	Km872+560	Km873+054	0.49	2.00	0.99	Dự án BOT
14	1	TT Huế	Km883+280	Km883+700	0.42	2.00	0.84	Dự án BOT
15	1	TT Huế	Km886+460	Km886+890	0.43	2.00	0.86	Dự án BOT
16	1	TT Huế	Km890+200	Km892+700	2.50	4.00	10.00	Đang thi công toàn bộ mặt đường

17	1	TT Huế	Km892+700	Km893+180	0.48	4.00	1.92	Dự án BOT	
18	1	TT Huế	Km893+180	Km904+800	11.62	2.00	23.24	Dự án BOT	
19	7	Nghệ An	Km93+030	Km93+100	0.07	2.00	0.14	Thay đổi lý trình vị trí nhập làn	
20	7	Nghệ An	Km151+300	Km153+600	2.30	2.00	4.60	Thực tế chỉ có 2 làn	
21	7	Nghệ An	Km201+100	Km203+700	2.60	2.00	5.20	Thực tế chỉ có 2 làn	
22	8	Hà Tĩnh	Km18+000	Km18+250	0.25	2.00	0.50	Thay đổi lý trình vị trí nhập làn	
23	9	Quảng Trị	Km83+000	Km83+280	0.28	2.00	0.56	Thực tế chỉ có 2 làn	
24	9	Quảng Trị	Km83+280	Km84+000	0.72	4.00	2.88	Thay đổi điểm kết thúc tuyến QL 9	
25	10	Thanh Hóa	Km204+323	Km207+688	3.37	2.00	6.73	Bỏ đoạn cầu Phao Bút Sơn	
26	10	Thanh Hóa	Km220+415	Km222+032	1.62	2.00	3.23	Bỏ đoạn cầu Phao Thắm	
27	12C	Hà Tĩnh	Km19+500	Km19+700	0.20	2.00	0.40	Thay đổi lý trình vị trí nhập làn	
28	45	Thanh Hóa	Km59+960	Km61+133	1.17	2.00	2.35	Thực tế chỉ có 2 làn	
29	45	Thanh Hóa	Km74+100	Km75+400	1.30	2.00	2.60	Thực tế chỉ có 2 làn	
30	45	Thanh Hóa	Km76+500	Km76+600	0.10	2.00	0.20	Thay đổi vị trí điểm đầu tuyến	
31	45	Thanh Hóa	Km130+100	Km131+300	1.20	2.00	2.40	Trùng tuyến Hồ Chí Minh	
32	46	Nghệ An	Km60+070	Km60+750	0.68	2.00	1.36	Trùng tuyến Hồ Chí Minh	
33	46	Nghệ An	Km80+000	Km80+680	0.68	2.00	1.36	Thay đổi vị trí tách làn	
34	46B	Nghệ An	Km58+000	Km59+317	1.32	2.00	2.63	Thay đổi vị trí tách làn	
35	46B	Nghệ An	Km60+300	Km60+500	0.20	4.00	0.80	Thay đổi vị trí kết thúc tuyến	
36	49	TT Huế	Km14+564	Km15+210	0.65	2.00	1.29	Trùng Quốc lộ 1	
37	49	TT Huế	Km24+590	Km25+000	0.41	1.00	0.41	Trùng đường tránh Huế	
38	49	TT Huế	Km63+420	Km63+652	0.23	1.00	0.23	Thay đổi vị trí kết thúc đoạn tuyến	
39	HCM	Nghệ An	Km686+650	Km686+800	0.15	2.00	0.30	Thay đổi vị trí tách làn	
40	HCM	Hà Tĩnh	Km795+050	Km795+500	0.45	2.00	0.90	Thay đổi vị trí nhập làn	
41	HCM	Hà Tĩnh	Km826+500	Km826+560	0.06	2.00	0.12	Thay đổi vị trí tách làn	
42	HCM	Quảng Bình	Km939+450	Km939+553	0.10	2.00	0.21	Thay đổi vị trí nhập làn	
43	HCM (NT)	Quảng Trị	Km211+095	Km211+400	0.31	1.00	0.31	Thay đổi vị trí tách làn	
44	HCM (NT)	TT. Huế	Km345+325	Km345+624	0.30	2.00	0.60	Thay đổi vị trí nhập làn	
45	1- Đ. Nhánh	TT Huế	Km801+100	Km801+860	0.76	2.00	1.52	Bàn giao địa phương	
46	1- Đ. Nhánh	TT Huế	Km820+178	Km820+727	0.55	2.00	1.10	Trùng Quốc lộ 1	
47	1- Đ. Nhánh	TT Huế	Cầu Trường Tiền	Ngã 6 Hùng Vương	0.10	2.00	0.20	Thực tế từ Km 825+598- Km 826+520	
48	1- Đ. Nhánh	TT Huế	Km0+00	Km1+658	1.66	2.00	3.32	Bàn giao BOT	
49	1- Đ. Nhánh	TT Huế			0.39	1.00	0.39	Bàn giao BOT	
50	9 - Tránh Bắc	Quảng Trị	Km7+990	Km8+790	0.80	2.00	1.60	Trùng tuyến Hồ Chí Minh	
51	Other Roads						648.00	Không có số liệu tuyến	
<b>Total</b>								<b>782.19</b>	

## APPENDIX - 8

### A8.1 BASELINE SURVEY (CURRENT STATUS SURVEY)

#### A8.1.1 Legal Documents relevant to State Management of Education and Professional Training

Legal documents relevant to the state management of education and professional trainings are summarized in the below Table.

**Table A8.1.1 Legal Documents on Training**

Legal Documents		Doc no.
Laws	Law on Education	No.38/2005/QH11
	Amended Law on Education	No.44/2009/QH12
	Law on Government Organization	No: 32/2001/QH1
	Law on Cadres and Civil Servant	No. 22/2008/QH12
	Law on Public Employee	No: 58/2010/QH12
	Law on Enterprise	No. 68/2014/QH13
	Code of Labor	No.10/2012/QH13
	Law on Vocational Education <sup>1</sup>	No. 74/2014/QH13
Decrees	The Government Decree on Training and retraining to Cadres and Civil Servants	No.18/2010/ND-CP/2010
	The Government Decree on Recruitment, Recruitment, Employment and Management of Cadres and Civil Servant	No. 24/2010/ND-CP dated 15/3/2010
	The Government Decree on recruitment, Recruitment, Employment and Management of Public Officials	No. 29/2012/ND-CP dated 12/4/2012
Circular	Circular 03/3011/TT-BNV: Guide the Implementation of a number of Articles of the Government Decree No. 18/2010/ND-CP, March 2010 on Training, Fostering Public Officials (issued by the Ministry of Internal Affairs)	No.03/2011/TT-BNV dated 25/01/2011
	The Circular on Regulations, Training Guidelines, and Training of Officials (issued by the Ministry of Internal Affairs)	No. 19/2014/TT-BNV dated 04/12/2014

#### A8.1.1.1. Legal Documents on School Education and Vocational Training

The vocational training has three levels: preliminary program, secondary program and college program as stipulated in Law on Vocational Education. Professional Education includes professional upper secondary and vocational training.

Educational qualification requirements on patrolling, inspecting, and protecting road infrastructures are regulated under Circular No.47/2012/TT-BGTVT<sup>2</sup>. The road patrol workers must have vocational upper secondary diplomas or grade 5 workers or higher with legal knowledge and capacity to disseminate, guide and explain the law on road traffic. Patrol worker must have a college degree in road and bridge or higher.

<sup>1</sup> Where there is a difference between the provisions of Law on Vocational Education and other laws on the same content related to vocational training activities, it shall apply the provisions of this law - Article 91 of the Law on Vocational Training

<sup>2</sup> Circular No.47/2012/TT-BGTVT dated 12/11/2012 on regulating patrol, inspection of road infrastructure issued by the Ministry of Transport.

**Table A8.1.2 Categorization of Professional Education**

Category of Education		Duration	Requirement level for entry
Professional upper secondary Education		3 to 4 years	Lower secondary education diplomas
		1 to 2 years of studies	Upper secondary education diplomas
Vocational Training	College program	2 to 3 years	Upper secondary education diplomas
		1 to 2 years	Vocational upper secondary diplomas
	Vocational upper secondary program	3 to 4 years	Lower secondary education diplomas
		1 to 2 years	Upper secondary education diplomas
Preliminary vocational program	From 3 months to less than 1 year	Not noted	

Source: Law on Education (No: 38/2005/QH11), Law on vocational training (No. 74/2014/QH1)

### **A8.1.1.2. Legal Documents on Professional Training**

#### **(1) Legal Documents on Civil Servant Training**

The followings are included shows the trainings for the civil servants under the DRVN RMBs and SBs.

##### **1) Probation instruction**

Within 7 working days of a civil servant takes the post, probation instructor is assigned so that the civil servant in probation can acquire the institution relevant to the public officials, improve professional knowledge and the capability/practicing operational skills to meet the assigned tasks.

##### **2) Training and retraining of civil servants**

Training and retraining of the civil servants is delivered in two forms: (Clause 2 of Article 47 of the Law on cadres and civil servants No. 22/2008/QH12).

- Re-training by civil servant rank criteria
- Training and re-training by leading and management titles

Subjects of the training and retraining of the civil servants consists of:

- Political theory;
- Knowledge of the law; knowledge and skills of the state management and the professional management;
- Professional knowledge and skill;
- Computer science, foreign languages, and ethnic languages
- In addition, retraining in abroad is included (Article 6 of Decree No.18/ 2010/ND-CP).

#### **(2) Legal Documents on Public Officials Training**

Public officials of the RTCs are obliged to take the public official trainings stipulated in the above legal documents. The Law on Public Officials (No.58/2010/QH12) states the responsibilities of the training for the public official<sup>3</sup>s.

<sup>3</sup> Implementation of the training is delegated to the unit-employed public officials.

### 1) Probation instruction

Within 7 working days of a public official takes the post, probation instructor is assigned so that the civil servant in probation can acquire the institution relevant to the public officials, improve professional knowledge and the capability/practicing operational skills to meet the assigned tasks.

### 2) Training and retraining of Public Officials

Training and re-training are delivered in three forms:

- Re-training by professional titles (min 6 weeks to max 8 weeks)
- Training and re-training by capacity, leadership and management skills ( max 4 weeks)
- Re-training to supplement and update knowledge and skills necessary for professional activities

The subjects of the training and retraining of the public officials consists of:

- Political theory
- Professional knowledge and skill
- Knowledge of the law; knowledge and skills of state management and professional management
- Complementary knowledge by professional titles
- Knowledge of international integration

Re-training certificate is a part of a condition and criterion for appointment to or change of professional titles.

### (3) Legal Documents on Private Company Employee Training

Law on Enterprise (No.68/2014/QH13), Law on State Owned Enterprise (No.14/2003/QH11), and Labor Code 2012, state that training is delegated to each company.

#### A8.1.2 Strategy and Plan on Capacity Development of Transport Sector

The road maintenance requires professional trainings for the capacity development of the officials/staff cross widely from the civil servant to the company employee. Strategy and plan for overall capacity enhancement on the transport sector has been formulated by the Ministry of Transport (MOT) while overall training plan has been developed by the DRVN. However, neither specific strategy nor detailed plan addressing the capacity enhancement for the road maintenance has been developed.

**Table A8.1.3 Strategy and Plans relevant to Training**

Organization	Strategy and Plan	Document No.
Government	The Strategy on Development of Viet Nam Human Resources for 2011-2020	Prime Minister Decision No.579/QD-TTg
	Master plan on development of Viet Nam Human Resources for 2011-2020	Decision No.1216/QD-TTg
	Training Plan of Staff and Officials for 2011-2015	Prime Minister Decision No. 1374/QD-TTg

<b>Organization</b>	<b>Strategy and Plan</b>	<b>Document No.</b>
MOT	Human Resource Development Plan of Transport Sector for 2011-2020	Prime Minister Decision No.1576/QD-BGTVT
	Training and Retraining plan for Staff and Civil servants of Transport Sector for 2011-2015	Decision No.2379/BGTVT-TCCB
	MOT Annual Training Plan	
DRVN	Training and Retraining Plan of DRVN, 2011-2015	No.4485/TCDBVN-TCCB//2011
	Annual Training Plan	No.4427/TCDBVN-TCCB//2011

**(1) Strategy and Plan on Capacity Development of DRVN**

The DOP of the DRVN gathers training needs for the civil servants, and formulates an annual training plan, 5-year training and retraining plan which are submitted annually to the leading board of the DRVN<sup>4</sup>. Upon the approval of these plans, required budget for the trainings is allocated by the MOT. These plans are targeted only to the DRVN Offices, the DRVN Inspector and the Road Construction Management Bureaus, and shows the target number of the officials/staff to be trained by subject, civil servant ranks, management post, specialization, and working positions as stipulated under the legal documents.

Based on the training plans submitted by the managing agencies of the civil servants under the MOT, the MOT further develops an annual training plan and 5-year training and retraining plans for the staff and civil servant of Transport Sector.

**(2) Strategy and Plan on Human Capacity Development of RMBs**

RMBs do not formulate the annual training plan nor 5-year training and retraining plans. However, they have their plans to enhance the capacity development, not exclusively to the road maintenance.

**(3) Strategy and Plan on Capacity Development of SBs**

Although SBs do not have an official document, they have their plans to enhance capacity development in the road maintenance through 1) Conducting retraining for professional knowledge and skills; 2) Delivering professional training to meet the requirements of the road maintenance; and 3) Instructing the technical practices and the skills to perform the road maintenance tasks aiming to enhance professional knowledge, practical skills and professional skills.

**(4) Strategy and Plan on Capacity Development of RTCs**

On the basis of the functions and duties stipulated by the DRVN, the RTC Central conducts the staff trainings based on the job requirements and actual capacity of the officials/staff. The RTCs under the RMBs develop unofficial capacity development plans, and the road maintenance trainings are delivered based on the request of the DRVN.

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<sup>4</sup> Decision stipulating on functions, duties, authorities and organization structure of Organization & Personnel Department (No. 369/QD-TCDBVN)

### A8.1.3 Administrative Procedure for Training

Prior to the implementation of the trainings, a number of items are required to be approved by the Authorities (Article 10 of the Government decree No.18/2010/ND-CP/2010). This is an official procedure requires to grant certificate, and the DRVN has drafted the procedure of the training delivery, formulation of the training to appraise trainees, and required authorization<sup>5</sup>. Professional trainings not issuing certificate also require a DRVN official letter to request selection of the trainees from each subordinate agency of the RMBs, RTCs and SBs.

### A8.1.4 Responsible Assignment, Planning, Implementation and Monitoring of Training for School Education and Professional Training in Road Sector

Following section describes responsible assignment and a series of activities such as the training planning to monitor the school education, and the road maintenance agencies. The SBs are not mentioned since it has been newly establish and their process is still under development.

#### A8.1.4.1. Responsible Assignment, Planning, Implementation and Monitoring of School Education

##### (1) Responsible Agency for School Education and Vocational Training

Ministries who are responsible for the state management of the school education in the transport sector are the Ministry of Education and Training (MOET), the MOT, and the Ministry of Labor, and Invalids and Social Affairs (MOLISA). The MOET is responsible for the state management of all types of school education, whereas the MOT functions as a state management in the transport sector with the MOET for professional upper secondary education and vocational program for less than one year within the frame work of vocational training. The DRVN is delegated to be responsible for the school education under its management field.

##### (2) Implementation of Education and Vocational Training

MOT and the DRVN have established the school education and vocational training institutions. Institutions for the vocational training under the MOT can provide the vocational program as well as the profession upper secondary education and the college program.

**Table A8.1.4 Training Institutions under MOT / DRVN**

Category	MOT	DRVN
Professional upper secondary Education	<ul style="list-style-type: none"> <li>• Institute of Transport Administration and Management Cadres</li> <li>• College of Marine I</li> <li>• Transport Professional Technical School - Mekong River Delta Region</li> <li>• Road Transport Vocational School</li> <li>• Waterway Transport Vocational School</li> <li>• Viet Nam Maritime University</li> <li>• Viet Nam Aviation Academy</li> <li>• Ho Chi Minh City University of Transport</li> </ul>	

<sup>5</sup> The procedure of the training and refresher training for official/staff of DRVN based on ISO9001:2008

		<ul style="list-style-type: none"> <li>• University of Transport Technology</li> <li>• Transport College II</li> <li>• Transport College III</li> <li>• Transport College - Central Region</li> </ul>	
Vocational Training	Vocational upper secondary & college program	<ul style="list-style-type: none"> <li>• Central Vocational College of Transport 1</li> <li>• Central Vocational College of Transport 2</li> <li>• Central Vocational College of Transport 3</li> <li>• Road Transport Vocational Secondary School</li> <li>• Automobile Industry Vocational School</li> </ul>	<ul style="list-style-type: none"> <li>• Northern Transport Secondary School</li> <li>• Southern Transport Secondary School</li> </ul>
	Preliminary vocational program	<ul style="list-style-type: none"> <li>• Railway Vocational College I</li> <li>• Vinashin Vocational College</li> <li>• Transport Vocational School - Northern Region</li> <li>• Transport Vocational School - Southern Region</li> <li>• Shipbuilding Industry Vocational School II</li> <li>• Shipbuilding Industry Vocational School III</li> <li>• Vocational School of Road Mechanical</li> </ul>	<ul style="list-style-type: none"> <li>• Motor Vehicle Mechanic Vocational School</li> <li>• Thang Long Transport Vocational School</li> </ul>

Source: Ministry of Transport official website: <http://www.mt.gov.vn>

#### A8.1.4.2. Responsible Assignment, Planning, Implementation and Monitoring of Training under DRVN

##### (1) Responsible Agency for Training at DRVN

The DOP of the MOT is assigned to formulate a master plan of the civil servant training under the Transport sector<sup>6</sup>, including the management and the training planning, securing of the training budget, and the monitoring and evaluation of the trainings<sup>7</sup>. The DRVN is assigned to manage the trainings, monitor training quality, implement the trainings and the training budget and the report progress to the MOT for their management of the civil servant, implementation of the probation guidance, selection of the training to offer their staff, and encouragement to their staff to attend trainings<sup>8</sup>.

**Table A8.1.5 Organizations Involved in Civil Servant Training under DRVN**

Role and responsibility	Tasks	Assigned agencies under DRVN
Management of training <sup>9</sup>		<ul style="list-style-type: none"> <li>• DOP of DRVN</li> </ul>
Assigned training implementing body <sup>10</sup>	Organize implantation of professional knowledge and skill trainings for civil servants as well as others as assigned by authority	<ul style="list-style-type: none"> <li>• VARIES</li> </ul>
Management of training program <sup>11</sup>	<ul style="list-style-type: none"> <li>• Develop, appraise and evaluate training program, approve, promulgate and guide for implementation</li> </ul>	<ul style="list-style-type: none"> <li>• Assigned training institution/</li> <li>• DOP of DRVN/ in case of specialized subject such as road maintenance collaborating with Road Management/Maintenance Department</li> </ul>
Evaluation of training Quality <sup>12</sup>	<ul style="list-style-type: none"> <li>• Evaluate relevance of program contents</li> <li>• Capability of trainers, training methods</li> <li>• Assigned training body capacity</li> <li>• Civil servant learning knowledge and skill and application to tasks.</li> </ul>	<ul style="list-style-type: none"> <li>• DRVN</li> </ul>

<sup>6</sup> The Government Decree on Training and retraining for Cadres and Civil servant (No. 18-2010ND-CP).

<sup>7</sup> Decision stipulating on functions, duties, authorities and organization structure of Organization & Personnel Department (No. 369/QĐ-TCĐBVN)

<sup>8</sup> The Government Decree on Training and Retraining for Cadres and Civil Servant (No. 18-2010ND-CP).

<sup>9</sup> Article 26 of the Government Decree on Training and Retraining for Cadres and Civil Servant (No. 18-2010ND-CP).

<sup>10</sup> Article 13 of the Government Decree on Training and Retraining for Cadres and Civil Servant (No. 18-2010ND-CP).

<sup>11</sup> Article 9 of the Government Decree on Training and Retraining for Cadres and Civil Servant (No. 18-2010ND-CP).

<sup>12</sup> Maintenance Centre (maintenance vehicle, patrol car, disaster prevention division) Article 16 of the Government Decree on Training and Retraining for Cadres and Civil Servant (No. 18-2010 ND-CP).



**(2) Development of Training Program for DRVN**

In principal, training implementing institution develops training program, curriculum, and materials, trainer selection and training delivery. The DOP of the DRVN manages training program. In case of the specialized subjects such as the road maintenance, competent departments collaborate with the DOP. Training program, curriculum, and materials are submitted to the DRVN for their approval prior to the implementation.

The training program for the road maintenance has been absent in Viet Nam. Thus during the JICA Phase I Project, training program for the following three phases have been developed by the Project Team and submitted it to the DRVN.

- Phase 1: Trainings on the project outputs of “During the Project term”
- Phase 2: Trainings on the project outputs of “After the Project Completion” (1-2 years)
- Phase 3: Capacity development for the “Future” road administration (3-5 years after the project completion)

**(3) Implementation of Training at DRVN**

The training courses and the assigned organizations to conduct the trainings are informed by the MOT to the DRVN or directly assigned the training implementing organizations. Then the DRVN or the assigned organizations nominate the trainees or request the agencies and the units managing the officials/staff to nominate their trainees.

The school and the training institutions assigned for the civil servant training of the DRVN are summarized below. For the professional training on the road maintenance, currently the University of Transport and Communication (UTC) in collaboration with the University of Kyoto, Japan and JICA project have been assigned.

**Table A8.1.6 Training Institution of Civil Servant Training by Training Topic**

Training program	Assigned training implementation body for DRVN
Political Theory	Ho Chi Minh National Academy of Politics
Professional qualification and skill	1. University of Transport 2. Vietnamese Enterprise Development and Training Ltd., Com 3. Training and Management Development Institute of DAVILAW 4. Statistics Science Institution 5. University of Natural Science – National University 6. University of Economics – National University 7. Nguyen Trai University 8. Academy of Journalism and Communication 9. Viet Nam- Singapore Training Centre 10. Viet Nam Academy of Science and Technology 11. University of Culture 12. Institute for Justice 13. School for training and retraining cadres and civil servants – Ministry of Internal Affairs 14. Viet Nam Institute of Educational Science 15. University of Construction
Legal knowledge ; knowledge and skills of state management and professional management	1. National Academy of Public Administration 2. University of Labor and Social Affairs 3. Institute for Transport Administration and Management Cadres

Training program	Assigned training implementation body for DRVN
Computer science and Foreign languages	1. Language Link Viet Nam 2. Viet Nam- Singapore Training Centre 3. British Council 4. Training and Technology Transfer JSC 5. PNH Network Administration Training Centre

**(4) Monitoring of Training at DRVN**

The DOP of the DRVN submits a report on progress of the training implementation Evaluation of the training quality is also required.

**A8.1.4.3. Responsible Assignment, Planning, Implementation and Monitoring of Training in RMBs**

**(1) Responsible Agency for Training of RMBs**

At the RMBs, the trainings are generally managed by the Organization and Administration Department (DOA) of each RMB and implemented by the assigned schools and/or the training institutions. In terms of the training for the specialized topic, the DOA and/or the specialized Department in the field of each RMB manages.

**(2) Development of Training Program for RMBs**

Training programs include curriculum and materials for the trainings and the trainers are normally prepared by the implementing organizations. In case of the specialized subject like the road maintenance, the training program is developed by the DOA independently or in collaboration with the specialized Department such as the Road Management Maintenance Department, depending on the RMBs.

**(3) Implementation of Professional Training at RMBs**

Trainings are informed by the DRVN or directly by the assigned training implementing organizations to the RMBs. Accordingly, the RMBs or assigned organizations nominate the trainees. In case of the specialized subjects, the DOA alone or together with the Road Management Maintenance Department delivers trainings. School and the training institutions assigned for the civil servant training of the RMBs are the same as those for the DRVN.

**A8.1.4.4. Responsible Assignment, Planning, Implementation and Monitoring of Training in RTCs**

**(1) Responsible Agency for Training of RTCs**

In general, the ministries manage the retraining programs for the specialized subjects, including the training program, program evaluation, and etc.

Trainings at the RTC Central are managed by the DRVN and the RTC Central, and trainings are implemented by the assigned training institutions. Whereas, training of the RTCs under the RMBs are managed by each RMB and implemented by the assigned school and the training institutions. In case of the specialized training each RTC assigns the General Affair

Department/specialized Department in the field to manage and develop the training program. Training implementation is assigned to a school or training institutions or specialized department of the RTCs.

**(2) Development of Training Programs for RTCs**

At the RTCs, training programs include curriculum and materials for their trainings are generally developed by the implementing institution. The RTC Central also develops and delivers the training programs on the specialized professional knowledge and skills. Training program and materials are evaluated by the Council with cooperation of the Department of Personnel Organizations or the advisory units managing public officials. For the transport sector, the training material for the leaders and the manager level is managed by the MHA, and the training for the rest of the public officials is managed by the MOT.

**(3) Implementation of Professional Training at RTCs**

The trainings are implemented by the institution assigned by the MHA. Trainings at the RTC Central are informed by the DRVN or directly by the assigned training implementing organizations. Under the trainings funded by the RTC Central, the General Affair Department prepares a list of the officials/staffs to be trained upon request, and submits it to the RTC Director General for his/her approval. The ITST and JICA project are the main training implementers on the road maintenance related to the trainings for the RTC Central.

**A8.1.5 Training Implementing Organizations for Professional Training on Road Maintenance**

**A8.1.5.1. Academic Institutions**

**(1) Northern Transport Secondary Schools**

The school has the status of a preliminary vocational college under the DRVN. Currently full time training courses (1 to 2-year course, currently 3 courses) and short term courses (approximately 20 courses) are offered. Full time training courses are intermediate professional training; intermediate vocational training and preliminary vocational training specialized in the transport sector. Short term courses are provided by the schools which have the training for the road traffic inspectors, the chiefs of the road county, highway and expressway patrol officials/staffs. Moreover, the school also organizes courses linked with the UTC, the Central University of Construction, and the University of National Economy. The scale of enrolment – training since the establishment of the DRVN (1993) is as follows.

**Table A8.1.7 Training at Northern Transport Secondary Schools**

Training course	Target	Quantity	Frequency / Duration	Method
Intermediate Professional training 10 courses	Students graduating from high school or equivalent	2,000 students	24 months/course	Fulltime
Intermediate Vocational training: 34 courses	Students graduating from high school or equivalent	15,000 students	18 months/course	Fulltime
Preliminary vocational training: -03 months < training duration <12 months	Workers working at organizations which are inside or outside the road sector	1,600 workers	2 courses/year	Fulltime

Training course	Target	Quantity	Frequency / Duration	Method
Short-term + Professional retraining: -Training duration <3 months	Officials and workers working in road construction and management organizations	18,000 officials & workers	4 courses/year	Part-time

Source: DRVN

## (2) The University of Transport Technology (UTT)

In April 2011, the College of Transport was upgraded to the University of Transport Technology (UTT) under the MOT. By early 2016, the Master course has been opened. At present, the training is categorized into the post-graduate, graduate (engineer) and colleges, including the intermediate model, which allows college students to continue higher education from the college level to the university level.

## (3) The University of Transport and Communication (UTC)

The UTC has the mission of training the qualified technical staffs for the transport section and the country, who are dedicated to their jobs, creative and humane. Training scientific research, technology transfer and the other activities of the UTC is to bring the benefits with the best quality for the community and the society.

The UTC attaches their research to the tasks of the transport sector in order to timely advise and support solving the problems arising in the transport sector. Many research results in the fields of engineering and construction technology, automation, control have been applied, commercialized. UTC in cooperation with the MOT, DRVN and many other agencies draft and review multiple technical standards.

### A8.1.5.2. Research Institutions

#### (1) The Institute of Transport Science and Technology (ITST)

Institute of Transport Science and Technology (ITS) is one of the leading institutes among 42 national research institutes under the MOT.

The Table below shows training courses relevant to the road maintenance provided from 2013 to 2015. The trainers are from the ITST as well as the invited experts from the National University of Civil Engineering (NUCE) and the UTC. Some of those trainings are implemented having contract or charging training fees from the individual trainees. Currently the ITST provides trainings to the officials/staff of the DRVN, RMBs, RTC Central, and the RTCs.

**Table A8.1.8 Training Implemented between 2013-2015 by ITST**

No.	Training Courses	2013		2014		2015	
		No. of Course	No. of Attendants	No. of Course	No. of Attendants	No. of Course	No. of Attendants
1	Supervision Consultant	4	91	-	-	1	14
2	Road Traffic Safety Inspector	5	214	-	-	8	164
3	Short-term test	9	226	10	366	12	268
4	Specialized laboratories	-	-	-	-	1	11

No.	Training Courses	2013		2014		2015	
		No. of Course	No. of Attendants	No. of Course	No. of Attendants	No. of Course	No. of Attendants
5	Lab manager	4	31	3	64	8	65
6	SAMH and pile quality Inspection	1	10	-	-	1	12
7	Working safety and hygiene and environment	1	20	-	-	1	20
8	Site manager	-	-	1	45	-	-
9	Inspection and evaluation and certification of quality surety and appropriateness of the work quality	1	14	-	-	-	-
10	Quantity Surveyor	1	11	-	-	-	-
11	Traffic Control and Road Traffic Safety	-	-	1	44	-	-
12	Training on Vietnamese Standards	4	429	-	-	-	-
13	Technical measures for transition section between road and bridge (culverts) on the highway	-	-	2	97	-	-
14	Asphalt concrete and rutting	-	-	2	135	-	-
15	Improvement of knowledge on PPP	-	-	-	-	2	63
16	Safety for construction of overhead railway	-	-	-	-	2	94
17	Destructive test training	-	-	3	127	3	235
18	Traffic Work Quality Inspection	-	-	3	242	-	-
19	Emergency	-	-	3	271	-	-
20	Training on Tendering	1	60	-	-	-	-
21	Long – term laboratories	1	22	-	-	-	-
22	Training on Decree No. 15	5	250	-	-	-	-
<b>Total</b>		<b>32</b>	<b>1,378</b>	<b>28</b>	<b>1,025</b>	<b>38</b>	<b>926</b>

Source: ITST December 2015

### A8.1.5.3. Civil Servant Training Institutions

#### (1) Institute for Transport Administration and Management Cadres (ITAMC)

The Institute has been established to provide the trainings to the cadres, civil servants, and the public officials under the transport sector.<sup>13</sup> The institute develops the training programs including the training curriculum and the materials<sup>14</sup>. The following Table shows the training courses currently offered.

**Table A8.1.9 Training Plan of ITAMC (2015<sup>15</sup>)**

No	Training courses	Frequency/Duration		Target	Diploma/certificate
I	Political theory				
1	Administrative - Intermediate political theory	5 courses	12 months	Civil servants/Official employees	Graduate Degree
2	Political theory retraining for elite citizen	2 courses	1 month	Elite citizen	Certificate
3	Political theory retraining for new communist member	2 courses	1 month	Communist members	Certificate
II	Re-Training on State Management				
4	Expert rank retraining	3 courses	2 months	Expert ranked civil servants/Official employees	Diplomas
5	Chief expert rank retraining	4 courses	2 months	Chief expert ranked civil servants/Official employees	Diplomas
6	Training and retraining for the managerial levels of department/division	3 courses	2-3 months	Managerial staffs of department/division	Diplomas
III	Other training				
7	Retraining for managerial staffs of teams	2 courses	1 month	Managerial staffs of teams	Diplomas
8	Retraining for managerial staffs of enterprises	2 courses	2 months	-	Diplomas
9	Retraining for managerial staffs of enterprises and representatives for state equity at enterprise	2 courses	5-10 days	Managerial staffs of enterprises and representatives for state equity at enterprise	Certificate
10	Retraining for enterprise supervisors	2 courses	05 days	Supervision staff	Certificate

<sup>13</sup> Under the Government Decree on Training and Retraining for Cadres and Civil Servant (No.18-2010ND-CP)

<sup>14</sup> Article 9 of the Government Decree on Training and Retraining for Cadres and Civil Servant (No. 18-2010ND-CP)

<sup>15</sup> It is still applicable to date (as of December 2017).

No	Training courses	Frequency/Duration		Target	Diploma/certificate
11	English retraining for managerial/leadership staff	1 course	12 months	Managerial/leadership staff	Certificate
12	Retraining on drafting, processing legal texts	2 courses	02 days	Civil servants/Official employees	Certificate
13	Retraining on administrative communication skills	2 courses	03 days	Civil servants/Official employees	Certificate
14	Retraining on office organizational and operational skills	2 courses	03 days	Civil servants/Official employees	Certificate
15	Retraining on administrative skills	2 courses	05 days	Civil servants/Official employees	Certificate
16	Office culture	2 courses	02 days	Civil servants/Official employees	Certificate
17	Text drafting skills	2 courses	02 days	Civil servants/Official employees	Certificate

Source: ITAMC, December, 2015

#### A8.1.5.4. International Agencies and Companies

International agencies, such as JICA and WB, have been offering the trainings as a part of their technical transfer projects. International private companies also provide workshops on their specialized field of technologies and products.

#### A8.1.6 Training Resources

The DRVN has a large conference room and audio equipped meeting room, however does not have resource to implement training by themselves. In addition, training resources such as training material, manuals, and books in the road maintenance sector have not been accumulated in a particular department/unit within the road maintenance sector. The RMBs and RTCs have meetings rooms, projector and screen, but insufficient to organize trainings. The RTC Central generally provides training not using class rooms.

#### A8.1.7 Funds for Training

According to the annual training plan submitted to the MOT<sup>16</sup>, the DRVN and the RMBs receive the state funds for the training including the cost for the trainee allowance<sup>17</sup> as stipulated in the circular of the Ministry of Finance No.97/2010/TT-BTC<sup>18</sup>. The RMB I also uses their own funds for the training. Non-Business Unit of the RTCs self-finance their trainings. Or they arrange the financial support from the domestic and foreign organization and individuals under the law as stipulated in Decree No.29/2012/ND-CP. As shown in the below Table, training funds, training budget for the RTCs under the RMBs vary and very much limited.

**Table A8.1.10 Training Funds at Organizations (VND)**

	2011	2012	2013	2014	2015
DRVN	311,300,000	345,726,600	310,850,000	206,000,000	350,000,000
	State budget	State budget	State budget	State budget	State budget
RMB I	-	-	48,000,000	100,000,000	150,000,000
	-	-	RMB I fund + State budget	RMB I fund + State budget	RMB I fund + State budget

<sup>16</sup> Article 23, the Government Decree on Training and Retraining of Cadres and Civil servants (No.18/2010/ND-CP)

<sup>17</sup> Article 49 of Law on Career and Civil Servant, Article 35 of Law on Public Officials

<sup>18</sup> Ministry of Finance Circular No.97/2010/TT-BTC on "Work trip allowance and conference expenditures applicable to State Agencies and Public Non-Business Unit".

RMB II	14,000,000	2,500,000	14,378,000	15,875,000	16,307,000
	State budget	State budget	State budget	State budget	State budget
RMBIII	4,041,000	47,180,600	22,820,000	49,079,000	100,000,000
	State budget	State budget	State budget	State budget	State budget
RMBIV	0	0	0	0	0
	-	-	-	-	-
RTC Central	9,000,000	44,100,000	18,750,000	28,150,000	37,700,000
	RTC Central	RTC Central	RTC Central	RTC Central	RTC Central
RTC 1	6,700,000	15,320,000	-	32,000,000	8,500,000
	-	-	-	-	-
RTC 2	10,000,000	14,000,000	15,000,000	20,000,000	25,000,000
	-	-	-	-	-
RTC 3	5,000,000	84,865,000	64,580,000	93,600,000	-
	RTC3	RTC3	RTC3	RTC3	-
RTC 4	0	0	0	0	0
	-	-	-	-	-

NOTE: No data provided by RMB IV and RTC IV, December 2015

### A8.1.8 Current Status of Professional Training on Road Maintenance

Training offered relevant to the road maintenance in the last 5 years are summarized in the below section. Currently training program on the road maintenance is yet to be established under the road sector. The relevant trainings on the road maintenance offered are mostly by the international organizations as part of their technical transfer. Besides, various organizations under the MOT such as the ITST, academic institution of the UTC, and the road maintenance agencies of the RMBs and RTC Central also provides some trainings.

Abbreviations of the training style are explained below;

Training Style		Training Style		Training Style	
Seminar	: S	Workshop	:W	On the Job Training	OJT
Computer based	: C	Filed Based	:F	Lecture	:L
Oversea	: O				

#### (1) Training on Data Collection

Trainings on the data collection provided are surmised in the below Table. Besides, the RTC Central provides the irregular data collection trainings to the RTC Central, the RRMCs and the RRMUs.

**Table A8.1.11 Training on Data Collection**

Implementer	Funds	Contents	Style	Date	Duration	Target Group	No
DRVN		Technical transfer on pavement data processing and operation	F, C	07.2013	3 months	RTC Central	6
JICA Project (PASCO)	JICA	Technical transfer training on pavement condition survey and analysis	F, C	02.2014	2 months	RTC Central	10
JICA Phase 1 project	JICA	Introduction on pavement condition survey and analysis	OJT	25/26 02, 2014	2 days	RMBs, RTCs and SBs	16

#### (2) Training on Database System

The trainings on ROSY (Road System) operation have been conducted since 2005, however, the system did not transfer to the VRA (present DRVN) successfully. Since 2011, JICA Project for Capacity Enhancement in Road Maintenance (JICA Phase I Project) has been launched and is developing the database system for the DRVN. And the trainings have been provided regularly since 2013.

**Table A8.1.12 Training on Database System**

Implementer	Fund	Training	Style	Date	Duration	Target Group	No	
ISDP ADB	ISDP ADB	ROSY Operation	-	19-22.09.2005	3.5 days	VRA, RRMUs, PMU1	14	
SAPI JBIC	SAPI JBIC	ROSY Operation	-	27.11 2006	1 day	MOT, VRA, RRMUs, PDOTs, RTCs, RRMCS, PRRMCs	129	
JICA Phase I Project	JICA	Road database system (Act 1)	1	C	06.06.2013	1 day	DRVN, RMBs, RTCs, SBs	24
			2	C	20.06.2013	1 day	DRVN, RMBs, RTCs, SBs	18
			3	C	28.08.2013	1 day	DRVN, RMBs, RTCs, SBs	19
			4	C	04.03.2014	1 day	DRVN, RMBs, RTCs, SBs	20
		PMS/PMoS dataset CS development (Act 2.2a)	1	C	27.08.2014	1 day	DRVN, RMBs, RTCs, SBs	31
			2	C	05.03.2014	0.3 day	DRVN, RMBs, RTCs, SBs	20

### (3) Training on Pavement Management System

The trainings on the HDM-4 have been also conducted since 2005. However due to unsuccessful launch of the HDM-4, JICA Phase 1 Project has been developing Pavement Management System (PMS) to replace the HDM-4, and provides regular trainings to the DRVN. The UTC and the University of Kyoto in Japan have also providing trainings on the “Road Asset Management (RAM)” and the “Transport Planning “regularly (once a year).

**Table A8.1.13 Training on Pavement Management System**

Implementer	Funds	Training	Style	Date	Duration	Target Group	No.	
ISDP ADB	ADB	HDM-4	C	22-23. 09.2005	1.5day	VRA, RRMUs PMU1	14	
SAPI-2 JICA	JICA	HDM-4, Trace the SAPI-2 Trial Studies	C	12,02. 2009	1.0day	VRA, RTCs RRMU s, MOT	41	
UTC/Kyoto University	DRVN	Road Asset management	L	24-27 09.2012	4 days	DRVN	2	
UTC/Kyoto University	DRVN	Road Asset management	L	17-19.09.2013	3days	DRVN	3	
UTC/Kyoto University	DRVN	Transport Planning	L	17-19.09.2013	3days	DRVN	2	
UTC/Kyoto University	DRVN	Road Asset management	L	24-26.09.2013	3days	Civil servant, DRVN	1	
JICA Phase I Project	JICA	Introduction on pavement management system (KYOTO Model)	W	20.06.2012	0.5 day	DRVN, RMBs, RTCs, SBs	60	
JICA Phase I Project	JICA	Road maintenance planning (Act 2.2b)	1	C	27.08.2013	1 day	DRVN, RMBs, RTCs, SBs	31
			2	C	24-28.02.2014	5 days	DRVN, RMBs, RTCs, SBs	2
			3	C	05.03.2014	0.5 day	DRVN, RMBs, RTCs, SBs	16

### (4) Training on Bridge Management System

The training on the Viet Nam Bridge Management System (VBMS) has been provided since 2005 under the JBIC and the JICA Projects.



**Table A8.1.14 Training for Pavement Management System**

Implementer	Funds	Training	Style	Date	Duration	Target Group	No.		
The Enhancement of Bridge Management Capacity of VRA (Component BI)	JBIC	Training in Japan and Thailand	1	O	27.11.- 17.12. 2005	3 weeks	Senior mangers	5	
			2	O	16.07- 12.08. 2006	4 weeks	Senior Engineers	10	
		Bridge Management				17-18.08. 2005	2 days	Bridge management system team (RRMUs /PDOTs)	
		Bridge Inspection Skill	1	OJT		22-25 08. 2005	4 days	Technicians of RRMUs PRRMCs	40
			2	OJT		15-19 02. 2006	5 days	Technicians of RRMUs, PRRMCs	56
		Bridge Inspection		S		-	1 day	-	21 <sup>19</sup>
		Report on application of VBMS to VRA	1	W		-	2 days	VRA, RRMUs, RTCs, RRMUs, PDOTs, PRRMCs	65
			2	W		-	2 days		61
			3	W		-	2 days		67
			4	W		-	2 days		183
JICA	JICA	VBMS management software	W	07.2014		Civil servant, public Officials	32		
JICA	DRVN	VBMS management software and GIS	1	-	12.11.2014	1 day	DRVN	70	
			2	-	13. 11.2014	1 day	DRVN	62	
			3	-	24. 11.2014	1 day	DRVN	61	
			4	-	12. 11.2014	1 day	DRVN	63	

Source: Inception Report, Transport Sector Loan for National Road Network Improvement Phase I Component BII,

## (5) Training on Road Maintenance Technology

### 1) Training on Inspection

JICA Phase I Project conducted regular trainings for the road facility inspection, and JICA National Highway Network Project conducted regular trainings for the bridge inspection. Besides the ITST provides trainings to the public officials of the RTC Central and PMU3, the MOT also provides the trainings to the civil servants and the public officials. In addition, the RMB III provided professional skill trainings to the SBs.

**Table A8.1.15 Training on Inspection**

Implementer	Funds	Training	Style	Date	Duration	Target Group	No		
Transport sector loan for national road network development (Phase 1)	JICA	Site Inspection of Bridge	C, F	1	26-30.03.2012	5 days	RTCs, RMBs and DOTs	17	
				2	09-13.04.2012	5 days		53	
				3	16-20.04.2012	5 days		31	
				4	07-11.05.2012	5 days		18	
				5	25-29.06.2012	5 days		7	
JICA Phase I	JICA	Inspection Method (Act 3.1)	1	General guidance on inspection & manual	L	18.07.2013	0.5 day	DRVN, RMBs, RTCs, SBs	13
			2	Inspection on facilities	L	28.11. 2013	0.5 day	DRVN, RMBs, RTCs, SBs	7

<sup>19</sup> This figure is tentative.

Implementer	Funds	Training	Style	Date	Duration	Target Group	No
		/inspection technique	F	29.11. 2013	1 day	DRVN, RMBs, RTCs, SBs	17
		Overall road inspection technology	L	06.03.2014	0.5 day	DRVN, RMBs, RTCs, SBs	16
RMBII	SBs, RMB II	Professional skill training for sub bureaus	L	14-16.03.2014	3 days	Civil servant and public officials	20
ITST	Project	Non-destruction Laboratory		11. 2014	7 days	RTC Central	27
ITST	Project	Inspection		11. 2014	5 days	RTC Central	18
PMU3	RMBII	Retraining of Inspection skill	L	10-14.11.2014	5 days	Civil servant, public officials	9
MOT Inspection Board	RMBII	Professional Inspection Skill	S	17.07.2015	1 day	Cadres, civil servant, public officials	14

## 2) Training on New Technology

Many training courses on the pavement technology have been provided by the private companies as well as the JICA projects. The ITST also provides the trainings to the RMB III on the asphalt concrete.

**Table A8.1.16 Training for New Technology**

Implementer	Funds	Training	Style	Date	Duration	Target group	No
SAKAI, Road MM	SAKAI	Pavement Recycling	W	2008	-	DRVN, RRMUs, RRMCS	50
Hall brothers	Hall brothers	Pavement Recycling	W	2009	-	DRVN, RRMUs, RRMCS	50
Carbon Viet Nam JSC	Carbon Viet Nam JSC	Construction technology for road pavement structure	W	23.08.2011	0.5 day	DRVN, PMUs, RRMUs, RTCs, Schools, RRMCS, ITST, NRBA	130
Asia Pacific PTE LTD	Asia Pacific PTE LTD	Construction Technology	W	23.08.2011	0.5 day	MOT/DRVN	90
Hall Brother International	Hall Brother International	Pavement Repair Technology	W	10.2011	3 days	DRVN and others	1
UTC/Kyoto University	DRVN	Hot Asphalt Concrete Pavement Technology	W	20.09.2013		Civil servant	3
JICA Phase I Project	JICA	1 Pavement repair technology	W	15.05.2013	0.5 day	-	21
		2 Pavement repair technology	W	11.10. 2013	0.5 day	-	15
JICA	JICA	Feasibility study for private partners using ground anchor technology of japan to prevent landslides in ODA	O	14-25.04.2015	11 days	Civil servant	2
ITST	Administrative budget	Introduction to technological solution to the quality control of asphalt concrete and construction, and to bridge improvement and upgrading in Viet Nam	L	24-25.09.2014	2 days	RMB III	2
ITST	Administrative budget	Asphalt concrete, rutting and other remedies	L	11-12.09.2015	2 days	RMB III	2

## 3) Training on Road Maintenance Standard

Information provision on the update of the road maintenance standard has been carried out as classroom training, under the JICA Phase I Project.

**Table A8.1.17 Training for Road Maintenance Standard**

Implementer	Funds	Training	Style	Date	Duration	Target group	No.
JICA Phase I Project	JICA	General on routine maintenance standard and Japanese practices	1 L	24.07.2013	0.5 day	DRVN, RMBs, RTCs, SBs	31
		New routine maintenance standard on road maintenance	2 L	25.09.2013	0.5 day	DRVN, RMBs, RTCs, SBs	26
		Overall road maintenance technology	3 L	06.03.2014	0.5 day	DRVN, RMBs, RTCs, SBs	16

#### 4) Training on Construction

Many training courses on the construction including bidding, supervision, construction skills and etc., have been provided mostly targeting to the public officials of the RTCs by the various domestic training institutions.

**Table A8.1.18 Training on Construction**

Implementer	Funds	Training	Style	Date	Duration	Target group	No
RRMU 2	VRBA	Construction Bidding	OJT	19-31.05.2008	12 days	RRMU 2	32
RRMU 2	VRBA	Construction quality survey	OJT	22.07-02.08.2010	10 days	RRMU 2/RRMCs	84
PMU, JICA	JICA	Technical transfer for Can Tho Bridge	S	10- 12. 2010	3 months	Science & Technology Dep, planning /Investment, Road Maintenance and Management	30
DRVN		Quantity Survey	-	22.01.2011	1 day	RTC Central	4
National traffic safety committee	National traffic safety committee	Cost appraisal audit, supervision, consultant, project	L	15.10.2011-15.11.2011	30 days	TSPMU, Planning and Investment Department from MOT, NTSC, RRTPA, TCQM	73
Da Nang University of Science and technology	RTC 3	Design, construction and acceptance of piling and underground works	L	2011	1 day	RTC 3	5
Viet Nam Society for Soil Mechanics & Engineering	DRVN	Design, construction and acceptance of piling and underground works	L, W	30-31.07.2011	2 days	RMB III	1
ITST	RTC 2	Trial evaluation of transport work quality course 4 and TNV class for construction of transport work	L	16-19.08.2012	3 days	RTC 2	14
Construction Cost JSC	RTC Central	Supervision consultant	-	09.2012	30 days	RTC Central	9
International Studies Development Institute	RTC 3	Project management consulting and pricing	L	2012	5 days	RTC 3	13
Hanoi institute of cadres Training and Research	RTC 3	Advance bidding	L	2012	5 days	RTC 3	2
Centre for quality management of construction	RTC Central	Quality inspection of construction works	-	03.2013	3 days	RTC Central	4
HICST	RTC 3	Construction supervision	L	2013	30 days	RTC 3	5
HICST	RTC 3	Project management manager	L	2013	5 days	RTC 3	3
HICST	RTC 3	Pricing skill	L	2013	10 days	RTC 3	3

Implementer	Funds	Training	Style	Date	Duration	Target group	No	
HICST	RTC 3	Basic bidding skills	L	2013	5 days	RTC 3	3	
Training and Education Science Institute	RTC3	Quality control of construction works	L	2014	6 days	RTC 3	7	
ITST	-	Quality verification of traffic works	-	4-8.12.2013	5 days	RMB III	2	
ITST	-	Professional skill on evaluating quality of transport works	F, L	4-7.08.2014	4 days	RTC 2	4	
MDTI <sup>20</sup> DAVD LAW	DRVN	Retraining on investment & construction project management skill	L	24-29.09.2014	6 days	DRVN	3	
MDTI-DAVDL AW	DRVN	Retraining on professional completion and settlement of construction investment capital	L	21-23.10.2014	3 days	DRVN	3	
MDTI-DAVDL AW	DRVN	Retraining on formulation, evaluation skills of investment projects	L	24-26.10.2014	3 days	DRVN	4	
MDTI-DAVDL AW	DRVN	Retraining on cost estimation of construction work	L	27-31.10.2014	4 days	DRVN	1	
MDTI-DAVDL AW	DRVN	Retraining on construction appraisal skill	L	28.10.2014-02.11.2014	5 days	DRVN	2	
HICST	RTC 3	Basic bidding skills	L	2014	6 days	RTC 3	30	
HICST	RMB II	Basic bidding skills	L	14-16.03.2014	3 days	Civil servant and public employee	1	
HICST	DRVN	Basic bidding skills	1	L	15-17.05.2015	-	Civil servant and public employee	2
			2	-	29-31.05.2015	-		5
UTC	RTC3	Professional design, production, quality control of hot asphalt	L	2015	2 days	RTC 3	9	

Note. Hanoi Investment Consulting and Science Technology: HICST

### 5) Training for Laboratory

The laboratory trainings are offered to the RTCs by the ITST regularly.

**Table A8.1.19 Training for Laboratory**

Implementer	Funds	Training	Style	Date	Duration	Target group	No
-	-	Laboratory management	-	01.07.2010	1 day	RTC Central	4
-	-	Assayer	-	01.07.2010	1 day	RTC Central	10
ITST	RTC Central	Laboratory	L	07. 2011	10 days	RTC central	6
ITST	RTC Central	Laboratory	L	01. 2011	10 days	RTC central	5
ITST	RTC 3	Laboratory	L	2011	3 days	RTC 3	5
ITST	RTC Central	Laboratory	L	03.2014	12 days	RTC central	12
ITST	RTC 3	Laboratory	L	2014	4 days	RTC 3	24
ITST	RTC Central	Laboratory	L	07.2014	5 days	RTC central	5
ITST	RTC Central	Laboratory	L	01. 2015	12 days	RTC central	2

<sup>20</sup> Institute for Management Development and training.

## 6) Training on Road Maintenance Institution

Mainly training courses have been offered on the national road maintenance and the expressway maintenance under the JICA Project.

**Table A8.1.20 Training for Road Institution**

Implementer	Funds	Training	Style	Date	Duration	Target group	No	
DRVN	DRVN	knowledge on protecting road transport environment	L	09-11.05.2012	3 days	Cadres, civil servant, officials, public	3	
DRVN	DRVN	knowledge on protecting road transport environment	L	11-13.12.2011	3 days	Cadres, civil servant, officials, public	3	
RMB I	JICA	Management and Maintenance of Highway System in Japan	L	07.09.2011-22.10.2011	-	Public official	1	
JICA Expressway Project	RMB III, JICA	Expressway Operation and Management	F	02-17.04.2011	16 days	Cadres, civil servant, officials, public	4	
JICA Expressway Project	JICA	Expressway Operation and Management	F	03..2013	10 days	RTC Central	3	
RMB I	JICA	Expressway Operation and Management	W/OJT	01-18.04.2013	18 days	Cadres, civil servant, officials, public	-	
JICA Phase I Project	JICA	Road Maintenance in Japan	1	O	2-15.12.2012	14 days	DRVN	5
			2	O	4-16.11.2013	12 days	DRVN	5
JICA Phase I Project	JICA	Road Maintenance Institution (Act 4)	1	W	28.06.2013	0.5 day	DRVN, RMBs, RTCs, SBs	45
			2	W	08.10.2013	0.5 day	DRVN, RMBs, RTCs, SBs	30
JICA	JICA	Trunk road management and maintenance	O	27.10.2014-13.12.2014	-	Public officials	1	

NOTE. JICA Projects on Capacity Enhancement in Expressway Operation and Management: JICA Expressway Project

## 7) Training on Traffic Safety

Based on the technical assistance on the traffic safety by the international organizations, such as SIDA, WB and JICA, regular trainings have been provided by the various institutions. Amongst those, recently the ITST provides qualification trainings.

**Table A8.1.21 Training for Traffic Safety**

Implementer	Funds	Training	Style	Date	Duration	Target group	No	
International traffic safety association	SIDA	Road safety audit	1	-	2006	-	Road and bridge of RMUs, RTCs, PDOTs	80
			2	-	2007	-		80
ITST	RTC Central	Evaluation of road traffic safety	L	6-10.10.2009	4 days	RTC2	2	
Consia Consultant	WB	Road traffic safety examiner class 1	L	09-10.2009, 03-04. 2010	6 times	DRVN, ITST, Road and Railway Police administration, Traffic safety	103	
Consia Consultant	WB	Road traffic safety examiner class 2	L	16-27.08.2010/16-27.08.2010, / 6-17.09.2010	11 days	RRTPA, RRMUs, PDOTs, RTCs, DRVN	53	
National Traffic Safety Committee	JICA	Traffic safety	S	25.09.2010-02.10-2010	7 days	Infrastructure and road safety department of	-	

<b>Implementer</b>	<b>Funds</b>	<b>Training</b>	<b>Style</b>	<b>Date</b>	<b>Duration</b>	<b>Target group</b>	<b>No</b>
						DRVN and others	
School for Transport Management Cadres	RMB II	Training on press profession for dissemination of law and ensuring traffic safety	L	14-19.11.2011	6 days	Cadres, civil servant, public employee	1
National Traffic Safety Committee	WB	Road traffic safety propaganda	L	08.2011	2 days	DRVN and others	
ITST	RTC Central	Traffic safety inspector	-	10.2012	8 days	RTC Central	8
ITST	RTC central	Traffic safety Inspector	-	11. 2013	8 days	RTC Central	3
ITST	Traffic safety funds	Traffic safety Inspector	L	22-28.11.2013	-	Civil servants, public official of DRVN, DOTs	46
JICA	JICA	Traffic safety	O	27.10.2013-03.11-2013	8 days	Civil servant	2
ITST	RMBII	Traffic safety ombudspersons	L	22-28.11.2013	7 days	Civil servants, public official of RMB II	3
University of construction	DRVN	Traffic safety inspector	L	17-23.10.2014	7 days	Civil servants, public official of DRVN, DOTs	42
ITST	RTC central	Traffic safety inspector		02.2015	8 days	RTC Central	14
ITST	Administrative budget	Traffic safety ombudsman	L	09-17.04.2015	8 days	Civil servants and public official of RMB III	-
DRVN	RTC3	Traffic safety ombudsman	L	2015	7 days	RTC 3	5
-	-	Road safety audit	-	-	8 days	RRMU 2, branch and labor unions	32

Table A8.1.22 List of Training Offered for Staff and Officials of DRVN Headquarter

Training Name	Category of Training	Training Style	Date/duration	Trainee No.	Trainers	Implementing Organization	Responsible Organization	Fund Source
<b>2012</b>								
Retraining course on "Capacity Enhancement in Project Management"	Training for civil servants and public employees	L	4 days (19/3/2012-22/3/2012)	2 trainees	Lecturers of ITAMC and specialists on project management	Institute for Transport Administration and Management Cadres	ITMAC	DRVN
Retraining course on "RAM"	Training for civil servants	L	4 days (24/9/2012 – 27/9/2012)	2 trainees	Lecturers of University of Transport and Japanese specialists	UTC and University of Kyoto - Japanese	UTC	DRVN
Training course on "Site Inspection of Bridge"	Training for civil servants, public employees of RTCs, RRM, DOTs	OJT (Computer-based training and Field training)	5 times: - 1st: 26-30/3/2012 - 2nd: 09- 13/4/2012 - 3rd: 16-20/4/2012 - 4th: 07-11/5/2012 - 5th: 25-29/6/2012	126 trainees 1st: 17 2nd: 53 3rd: 31 4th: 18 5th: 07	-	-	PMU6	Component B, TC Service, Transport Sector Credit Project to upgrade the national highway network (B2 – Phase I)
<b>2013</b>								
Training course on "RAM"	For civil servants and public employees	L	17/9/2013 – 19/9/2013	3 trainees	Lecturers of UTC /Japanese specialists	UTC / University of Kyoto, Japan	UTC	DRVN
Training course on "Transport Planning"	For civil servants and public employees	-	17/9/2013 – 19/9/2013	2 trainees	Lecturers of UTC /Japanese specialists	UTC / University of Kyoto, Japan	UTC	DRVN
Hot Asphalt Concrete Pavement Technology	For civil servants	W	20/9/2013	3 trainees	Local and International Professors and Specialists	UTC / University of Kyoto, Japan	UTC	DRVN
Training course on "Traffic Safety"	For civil servants	Oversea training	27/10/2013 - 03/11/2013	2 trainees	International specialists	JICA	-	JICA
Training course on "Capacity Enhancement in Road Maintenance"	For civil servants	Oversea training	04/11/2013 - 16/11/2013	5 trainees	International specialists	JICA	-	JICA
Training course for Road Traffic Safety Inspector	For civil servants and public employees of DRVN and DOTs	L (at Nam Dinh transport vocational upper secondary school)	22/11/2013 - 28/11/2013	46 trainees	-	Information & Training Centre	Institute of Transport Technology and Science	Extract from Fund for Traffic Safety (2013)
<b>2014</b>								
TC International Training Course on "RAM"	For civil servants	L	3 days (24/9/2014 - 26/9/2014)	01(Quoc Bao Team)	Local /International Experts from Japan, MOT, MOC and University of Transport	UTC and University of Kyoto - Japan	UTC	DRVN

Training Name	Category of Training	Training Style	Date/duration	Trainee No.	Trainers	Implementing Organization	Responsible Organization	Fund Source
Training course for Road Traffic Safety Inspector	For civil servants and public employees of DRVN and DOTs	L (at Thanh Hoa transport vocational upper secondary school)	17/10/2014 - 23/10/2014	42	Lecturers of University of Construction	University of Construction	University of Construction	DRVN
Retraining on "Investment & Construction Project Management Skill"	-	L	24/9/2014 - 29/9/2014	3	-	MDTI-DAVILAW	MDTI-DAVILAW	DRVN
Retraining on "Professional Completion and Settlement of Construction Investment Capital"	-	L	21/10/2014 - 23/10/2014	3	-	MDTI-DAVILAW	MDTI-DAVILAW	DRVN
Retraining on "Formulation, Evaluation Skills of Investment Projects"	-	L	24/10/2014 - 26/10/2014	4	-	MDTI-DAVILAW	MDTI-DAVILAW	DRVN
Retraining course on "Cost Estimation of Construction Work"	-	L	27/10/2014 - 31/10/2014	1	-	MDTI-DAVILAW	MDTI-DAVILAW	DRVN
Retraining on "Construction Appraisal Skill"	-	L	28/10/2014 - 02/11/2014	2	-	MDTI-DAVILAW	MDTI-DAVILAW	DRVN
Training program on VBMS Management Software and GIS map	-	-	04 classes: - Class 1:12/11/2014 - Class 2:13/11/2014 - Class 3:24/11/2014 - Class 4:12/12/2014	256 70 62 61 63	-	KEI	PMU 6	DRVN
Trunk Road Management and Maintenance (C)	For Public employees	Overseas training	27/10/2014 - 13/12/2014	01	Japanese specialists	-	-	JICA
<b>2015</b>								
Course on "Basic Bidding Skills"	For civil servants and public employees	L	- Phase I: 15- 17/5/2015 - Phase II: 29- 31/5/2015	02 05	MOT, MOC and MOF's specialists	Hanoi Investment Consultant & Training JSC	Hanoi Investment Consultant & Training JSC	DRVN
FS for private partners using ground anchor technology of Japan to prevent landslides in ODA projects	For civil servants	Overseas training	14/4/2015 - 25/4/2015	02	Japanese specialists	-	-	JICA

NOTE: University of Transport and Communication: UTC



**Table A8.1.23 List of Training Offered for Staff and Officials of RMB I**

Training Name	Category of Training	Training Style	Date/duration	Trainee / No.	Trainers	Implementing Organization	Responsible Organization	Fund Source
<b>2011</b>								
Management and Maintenance of Highway System in Japan	Public employees	L	07/9/2011-22/10/2011	1	-	RMBI	DRVN JICA	DRVN JICA
<b>2013</b>								
Capacity Enhancement in Expressway Operation and Management	Public employees	OJT	01/4/2013 to 18/4/2013	4	JICA	RMBI DRVN	DRVN JICA	JICA
OJT-The project for Capacity Enhancement in Road Maintenance	Public employees	OJT	-	2	JICA	RMBI, Technical Cooperation PMU DRVN	Technical Cooperation PMU, DRVB	Project
<b>2015</b>								
1 <sup>st</sup> WS of the project for Capacity Enhancement in Road Maintenance	Civil servant	W	27/7/2015	35	JICA DRVN	DRVN JICA	DRVN	Project

**Table A8.1.24 List of Training Offered for Staff and Officials of RMB II**

Training Name	Category of Training	Training Style	Date/Duration	Trainee/ No.	Trainers	Implementing Organization	Responsible Organization	Fund Source
<b>2011</b>								
Training course on press profession for dissemination of law and ensuring traffic safety	Cadres, civil servant, public employees	L	14/11/2011 – 19/11/2011	1	School for Transport Management cadres	School for Transport management cadres	DRVN	RMBII
Retraining course for business management staff	Cadres, civil servant, public employees	L	15/9/2011 (divided into three terms, each term lasted with 2 weeks)	2	Central Transport College	Central Transport College	DRVN	RMBII
<b>2012</b>								
Dissemination of knowledge on protecting road transport environment	Cadres, civil servant, public employees	L	09/5/2012 – 11/5/2012	3	ITST	ITST	DRVN	RMBII
Training on checking and monitoring new driving license	Cadres, civil servant, public employees	L	30/6/2012	2	DRVN	DRVN	DRVN	RMBII
Training on development of human resource database	Cadres, civil servant, public employees	L	20/12/2012	2	DRVN	DRVN	DRVN	RMBII
<b>2013</b>								
OJT – The project for Capacity Enhancement in Expressway Operation & Management	Cadres, civil servant, public employees	W	02/4/2013 – 18/4/2013	3	DRVN JICA	DRVN JICA	DRVN	Project

Training Name	Category of Training	Training Style	Date/Duration	Trainee/ No.	Trainers	Implementing Organization	Responsible Organization	Fund Source
Training of traffic safety ombudspersons	Cadres, Civil servant, public employees	L	22/11/2013 – 228/11/2013	3	Information and Training centre; ITST	Information and Training centre; ITST	Information and Training centre; ITST	RMBII
Retraining of legal documents and identifying method of work position at public business unit	Cadres, Civil servant, public employees	L	02/4/2013 – 03/4/2014	3	DRVN	DRVN	DRVN	RTC 2, RMB II
<b>2014</b>								
Bidding skill	Cadres, Civil servant, public employees	L	14/3/2014 – 16/3/2014	1	Hanoi Investment and Consulting JSC	Hanoi Investment and Consulting JSC	Hanoi Investment and Consulting JSC	RMBII
Profession skill training for Sub-bureaus	Cadres, Civil servant, public employees	L	16/4/-18/4/2014	20	RMB II	RMB II	RMBII	SBs. RMB II
Retraining of Inspection skill	Cadres, Civil servant, public employees	L	10/11/2014-14/11/2014	9	Project No.3	Project No.3	MOT Inspection board	RMB II
Transferring VBMS software	Cadres, Civil servant, public employees	W	07/2014	32	DRVN	DRVN	DRVN	RMB II
Training course on first aid for injury caused by traffic accident on the expressway	Cadres, Civil servant, public employees	L	17/11-19/11/2014	20	DRVN	DRVN	DRVN	DRVN; RMB II
<b>2015</b>								
Professional inspection skill	Cadres, Civil servant, public employees	S	17/7/2015	14	MOT Inspection Board	MOT Inspection Board	MOT Inspection Board	RMB II
1 <sup>st</sup> WS & OJT – The project for capacity enhancement in road maintenance Phase II	Cadres, Civil servant, public employees	W OJT	20/7/2015	20	DRVN JICA	DRVN JICA	DRVN JICA	DRVN

Table A8.1.25 List of Training offered for staff and officials of RMB III

Training Name	Category of Training	Training Style	Date/Duration	Trainee / No.	Trainers	Implementing Organization	Responsible Organization	Fund Source
<b>2011</b>								
Knowledge of road environment protection	-	L	3 days from December 11th, 2011	3	-	DRVN	-	State budget
Design, construction and acceptance of piling and underground work	-	L W	2 days from July 30th, 2011	1	-	Viet Nam Society for Soil Mechanics & Geotechnical Engineering	-	State budget
<b>2013</b>								
Field training for the technical cooperation project “Capacity Enhancement in Expressway O&M”	-	OJT (Field training)	16 days from April 2nd, 2013	4	-	DRVN – JICA Project Team	-	Organizer’s budget and RMBIII budget

Training Name	Category of Training	Training Style	Date/Duration	Trainee / No.	Trainers	Implementing Organization	Responsible Organization	Fund Source
<b>2014</b>								
Quality verification of traffic works	-	L	5 days from December 04th, 2014	2	-	Informatics & Training Centre - ITST	Informatics & Training Centre - ITST	Administrative Budget
Introducing technological solutions to the quality control of asphalt concrete and construction, and to bridge improvement and upgrading in Viet Nam	-	L	2 days from September 24th, 2014	9	-	ITST	ITST	Administrative Budget
Professional training on "Asphalt Concrete, Rutting and Other Remedies"	-	L	2 days from September 11th, 2014	2	-	ITST	ITST	Administrative Budget
Final Workshop of Project for "Capacity Enhancement in Road Maintenance"	-	W	1 days from March 7th, 2014	2	-	PMU – DRVN and JICA Project Team	-	Organizer's budget
Introducing Pavement Condition Technology under the project for "Capacity Enhancement in Road Maintenance"	-	L	2 days from February 25th, 2014	2	-	PMU – DRVN and JICA Project Team	-	Organizer's budget
<b>2015</b>								
Traffic Safety Ombudsman	-	L	8 days from April 8th, 2015	6	-	Informatics & Training Centre - ITST	Informatics & Training Centre - ITST	Administrative Budget

Table A8.1.26 List of Training Offered for Staff and Officials of RMB IV

Training Name	Category of Training	Training Style	Date/Duration	Trainee / No.	Trainers	Implementing Organization	Responsible Organization	Fund Source
<b>2014</b>								
Final Workshop of the project for capacity enhancement in road maintenance	Civil servants, public employees	W	1 days	4	JICA	DRVN JICA	DRVN	Project
<b>2015</b>								
1 <sup>st</sup> WS of the project for capacity enhancement in road maintenance	Civil servants, public employees	W	0.5 day	25	JICA	DRVN JICA	DRVN	Project
1 <sup>st</sup> OJT – PMS system - the project for capacity enhancement in road maintenance	Civil servants, public employees	OJT	0.5 day	23	JICA	DRVN JICA	DRVN	Project

**Table A8.1.27 List of Training Offered for Staff and Officials of RTC Central**

Training Course	Category of Training	Training Style	Date/Duration	Trainee No.	Trainers	Implementing Organization	Responsible Organization	Fund Source
<b>2011</b>								
Laboratory staff	Short term	Professional re-training	07/2011 10 days	6	Training and Information Centre	Training and Information Centre	ITST	RTC Central
<b>2012</b>								
Quality Inspection of Construction Works	Short term	Professional re-training	03/2012 3 days	4	Centre for quality management of construction works	Centre for quality management of construction works	Centre for quality management of construction works	RTC Central
Pavement Data Processing and Operation	Technology Transfer	Field + Data Analysis	07/2012 3 months	6	Japan	DRVN	DRVN	Project
Traffic safety inspector	Short term	Professional re-training	10/2012 8 days	8	ITST	DRVN	DRVN	RTC Central
Supervision consultants	Short term	Professional re-training	09/2012 30 days	9	Construction Cost JSC	Construction Cost JSC	Construction Cost JSC	RTC Central
<b>2013</b>								
Laboratory staff	Short term	Professional re-training	01/2013 10 days	5	Training and Information Centre	Training and Information Centre	ITST	RTC Central
OJT - Project for capacity enhancement in expressway maintenance and operation	Technology Transfer	OJT (Field training)	03/2013 10 days	3	Japan	DRVN	DRVN	Project
Traffic safety inspector	Short term	Professional re-training	11/2013 8 days	3	ITST	DRVN	DRVN	RTC Central
OJT - Project for capacity enhancement in expressway maintenance and operation	Technology Transfer	OJT(Field training)	03/2013 10 days	2	Japan	DRVN	DRVN	Project
<b>2014</b>								
Pavement Data Processing and Operation	Technology Transfer	OJT (Field training + Data analysis)	02/2014 2 months	10	Japan	DRVN	DRVN	Project
Laboratory staff	Short term	Professional re-training	03/2014 12 days	12	Training and Information Centre	Training and Information Centre	ITST	RTC Central
Laboratory staff	Short term	Professional re-training	07/2014 12 days	5	Training and Information Centre	Training and Information Centre	ITST	RTC Central
Non-Destruction Laboratory staff	Short term	Professional re-training	11/2014 7 days	27	Training and Information Centre	Training and Information Centre	ITST	Project

Training Course	Category of Training	Training Style	Date/Duration	Trainee No.	Trainers	Implementing Organization	Responsible Organization	Fund Source
Inspection	Short term	Professional re-training	11/2014 5 days	18	Training and Information Centre	Training and Information Centre	ITST	Project
<b>2015</b>								
Laboratory staff	Short term	Professional re-training	01/2015 12 days	2	Training and Information Centre	Training and Information Centre	ITST	RTC Central
Traffic safety inspector	Short term	Professional re-training	02/2015 8 days	14	ITST	DRVN	DRVN	RTC Central

Table A8.1.28 List of Training Offered for Staff and Officials of RTC 1

Training Name	Category of Training	Training Style	Date/Duration	Trainee / No.	Trainers	Implementing Organization	Responsible Organization	Fund Source
<b>2013</b>								
OJT- Project for Capacity Enhancement in Expressway Management and Operation	Civil servants, public employees	L OJT(Field training)	2/4-18/4/2013	1	JICA	JICA	RMBI	JICA
1 <sup>st</sup> Training course on Road Database – Strengthening road information system	Civil servants, public employees	L	06/06/2013	5	JICA	JICA	DRVN/ RMBI	Project
2 <sup>nd</sup> Training course on Road Database – Strengthening road information system	Civil servants, public employees	L	20/6/2013	4	JICA	JICA	DRVN/ RMBI	Project
Training course on Pavement Management System	Civil servants, public employees	L	27/08/2013	2	JICA	JICA	DRVN/ RMBI	Project
Training course on Road Database system	Civil servants, public employees	L	28/8/2013	4	JICA	JICA	DRVN/ RMBI	Project
Training course on Routine Maintenance Standards	Civil servants, public employees	L	25/9/2013	2	JICA	JICA	DRVN/ RMBI	Project
Pavement Survey – The project for Capacity Enhancement in Road Maintenance	Civil servants, public employees	OJT(Field training)	25/9/2013-26/9/2013	2	JICA	JICA	DRVN/ RMBI	Project
<b>2014</b>								
Technical Enhancement – the project for capacity enhancement in road maintenance	Civil servants, public employees	L	4/3/2014 – 6/3/2014	2	JICA	JICA	DRVN/ RMBI	Project
Records management and Archives	The course is provided by Viet Nam – Japan Advance Company	-	-	2	-	-	-	-
Annual seminar on quality assurance system	-	-	-	2	-	-	-	-
Course on Political theory (Course 2012 – 2014)	OJT	-	3 years	1	-	Institute of Politics – Region VI	-	-

Training Name	Category of Training	Training Style	Date/Duration	Trainee / No.	Trainers	Implementing Organization	Responsible Organization	Fund Source
Guidance on newly-issued standards in 2011	-	-	-	1	-	-	-	-
Training course for main experts	-	-	-	1	-	-	-	-
Course on online bidding	-	-	-	3	-	-	-	-
Guidance and retraining on trade union professional skills	-	-	-	4	-	-	-	-
Guidance on firefighting skills	-	-	-	7	-	-	-	-

Table A8.1.29 List of Training Offered for Staff and Officials of RTC 2

Training name	Category of training	Training Style	Date/duration	Trainee / No.	Trainers	Implementing Organization	Responsible Organization	Fund Source
<b>2009</b>								
Evaluation of Road Traffic Safety	Public employee	L	4 days (from 6-10/10/2009)	2	Information & Training Centre; ITST	ITST	RTC2	RTC2
<b>2012</b>								
Professional retraining on trial evaluation of transport work quality Course 4 and TNV class for construction of transport work	Public employee	L	3 days (from 16-19/8/2012)	14	Information & Training Centre; ITST	ITST	RTC2	RTC2
<b>2013</b>								
Capacity enhancement in expressway O&M	Public employee	OJT(Field training)	17 days (from 2/4-18/4/2013)	4	JICA consultant team	DRVN	DRVN	Funded by the Project *
<b>2014</b>								
Professional skill on evaluating the quality of transport works	Public employee	Site visit L	4 days (from 4/8/2014)	4	Information & Training Centre; ITST	ITST	-	Funded by the Project *
Some common tests for TNV	Public employee	L	5 days (from 9/12/2014)	10	Information & Training Centre; ITST	ITST	-	Funded by the Project *

\* Excluding travel &amp; accommodation cost

Table A8.1.30 List of Training Offered for Staff and Officials of RTC 3

Training Name	Category of Training	Training Style	Date/Duration	Trainee / No.	Trainers	Implementing Organization	Responsible Organization	Fund Source
<b>2011</b>								
Laboratory staff	Professional training	L	3 days	5	-	Info and Training Centre	ITST	RTC3

Training Name	Category of Training	Training Style	Date/Duration	Trainee / No.	Trainers	Implementing Organization	Responsible Organization	Fund Source
Design, construction and acceptance of pile foundation and underground works	Professional training	L	1 Day	5	Lecturers by Da Nang University of Science and Technology	Da Nang University of Science and Technology	-	RTC3
<b>2012</b>								
Professional training on project management consulting and pricing	Professional training	L	5 days	13	-	International Studies Development Institute	-	RTC3
Advanced bidding	Professional training	L	5 days	2	-	Hanoi Institute of Cadres Training and Research	-	RTC3
<b>2013</b>								
Project Management Manager	Professional training	L	5 days	3	-	CICST	Da Nang University of Science and Technology	RTC3
Bidding skills	Professional training	L	5 days	6	-	CICST		RTC3
Pricing skill	Professional training	L	10 days	3	-	CICST		RTC3
Construction supervision	Professional training	L	30 days	5	-	CICST		RTC3
<b>2014</b>								
Laboratory staff	Professional training	L	4 days	24	-	Info and Training Center	ITST	RTC3
Quality control of construction works	Professional training	L	6 days	7	-	Training and Education Science Institute	-	RTC3
Bidding skill	Professional training	L	6 days	30	-	Hanoi Consulting & Training JSC	-	RTC3
<b>2015</b>								
Certifications for traffic safety ombudspersons	Professional training	L	7 days	5	-	DRVN	-	RTC3
Professional Design - production-quality control of hot asphalt	Professional training	L	2 days	9	-	UTC	-	RTC3

NOTE: Centre for Investment Consulting & Science Technology (CICST)

**Table A8.1.31 List of Training offered for staff and officials of RTC 4**

Training Name	Category of Training	Training Style	Date/Duration	Trainee / No.	Trainers	Implementing Organization	Responsible Organization	Fund Source
<b>2015</b>								
1st WS of the project for capacity enhancement in road maintenance	Civil servants, public employees	W	0.5 day	1	JICA	DRVN JICA	DRVN	Project
1st OJT – PMS system - the project for capacity enhancement in road maintenance	Civil servants, public employees	OJT	0.5 day	2	JICA	DRVN JICA	DRVN	Project



## A8.2 CASE STUDY IN JAPAN

### A8.2.1 Organization and Staff involved in Road Maintenance

The following Table shows the agencies and the companies involved in the road maintenance in Japan.

- Ministry of Land, Infrastructure, Transport, and Tourism (MLIT)
  - Road Bureau of the MLIT
- Road Department of Regional Development Bureau (RDB)
  - National Highway offices under the RDB
  - Technical offices under the RDB
- Prefectures / Municipals (Local Government)
- Contractors and Construction Companies
- Expressway Agency (Nippon Expressway Company Limited: NEXCO)

**Table A8.2.1 Staff and Organization Structures on Road Maintenance in Japan**

Category	Organization		Staff status	Staff category	Responsibility	
Central Government	MLIT	Road Bureau of MLIT	Civil servant	Management /Professionals	Draft regulation, plan policies, and long term plans, prepare technical standards, prepare cost norm.	
		Regional agency (RDB)	Road Department		Management /Professionals	Conduct survey, design, and F/S, select contractors, sign contracts, and conduct construction work supervision.
			National Highway office	Civil servant	Management /Professionals	Supervise survey and planning, maintenance and repair work, rehabilitation and new construction of designated section of national highways
			Technical Office		Management /Professionals	Conduct survey and pilot studies on improvement of work execution technologies, machinery and machinery repair work, survey and experiment material resources, implement trainings on machine operation, coordinate on mobilization of machinery for disaster restoration etc.
Local Government	Prefectures/ Municipals	Road Department	Civil servant	Management /Professionals	Manage approval and demolition of national road and bridge, traffic safety, road maintenance and management under the jurisdiction,	
Private companies	Construction Companies		Enterprise staff	Management/Professionals	Conduct maintenance work under contract with RDB and Prefectures.	
	Expressway company	Headquarter	Enterprise staff	Management/Professionals	Administrative management of company including policy development in accordance with the state authority	
		Branch			Administrative management of company in the field of the subject under the Company, including contract management etc. in line with the headquarter policy	
		Construction Office			Construction of highway	
		Maintenance Customer Service Centre			Inspection and maintenance of highway	
subordinates		Subordinates includes; Highway engineering, Highway maintenance, highway patrol, highway auto service, etc.				

### A8.2.2 Legal Documents on Training for Road Maintenance

Relevant legal documents applied to the training for the officials/staff involved in the road maintenance in Japan are summarized in **Table A8.2.2**.

**Table A8.2.2 Legal Documents Relevant to Training on Road Maintenance in Japan**

	<b>Legislation</b>	<b>Reference</b>
1	Rules of the National Personnel Authority	Article 4, June 25th, 1981 amended March 18th 2009
2	Law on National Civil Servant	Article 3, 18, 71, 74, Oct 21st, 1947, Law No 120
3	Basic Act for Reforming National Civil servant system	Article 5 & 6, June 13th, 2008 Law No 68,
4	Ordinance of MLIT on MLIT Organizations	Article 199, Jan 6th, 2001 Ordinance No1, amended 28th June 2013, Ordinance No 52
5	Ordinance of MLIT on College for Land, Infrastructure, Transport and Tourism	Jan 6th, 2001 MLIT Ordinance No14, amended 29th June 2012, MLIT Ordinance No 63
6	Ordinance of Regional development bureau	Jan. 6 <sup>th</sup> , 2001 Ordinance No21
7	Law on Local Government officials and civil servant	Section 7, Dec.13th, 1950 Law No 261

**(1) Legal Document on Training for Civil servant of Central Government**

Civil servant training is stipulated in several legal documents. The MLIT as a state management for the infrastructure sector, has established College of Land, Infrastructure, Transport and Tourism (MLIT College) under the above listed Ordinances of the MLIT. The technical offices of the RDBs are to provide the trainings on the construction machinery and the equipment to the officials/staff that are in charge of planning, construction, river and road.

**(2) Legal Document on Training for Civil Servant of Local Government**

The local government is to provide necessary trainings to their civil servants under the separate Law on the Civil Servant of the Central Government, Law on the Local Government Officials and the Civil Servant, and monitored by the National Personnel Authority.

**(3) Legal Document on Training for Staff of Private Companies**

There is no legal document stipulating staff training of the private company. It is only the contract between the employee and the employer which can specify the training requirements. Besides some of the road maintenance work requires a certain qualification for the officials/staff, which includes taking exams and trainings.

**A8.2.3 Current Status of Road Maintenance Training****A8.2.3.1. Characteristic of Training on Road Maintenance in Japan**

- Training institutions for the professional officials/staff of the central and the local governments as well as the private companies involved in the infrastructure development are established to provide regular comprehensive administrative/management and technical trainings relevant to their managing field.
- Training implementing organizations are also established to provide those required trainings. There are mainly two types of such organizations: 1) specialized in administrative/ management trainings; 2) specialized in technical training. While the MLIT provides administrative/management trainings, the MLIT College provides regular intensive official trainings for the capacity development of the officials/staff of the MLIT. And also the MLIT College offers the trainings to the officials/staff of the local government and the private companies. Technical trainings are provided at the

RDB Technical Centres. NEXCO also has established their own training implementing organizations which are training centres and the technical training centres.

### **A8.2.3.2. Training at Road Maintenance Agencies**

Training institution of each agency is summarized below and in the **Table A8.2.3**.

#### **(1) Trainings at MLIT**

##### **1) Trainings at Road Bureau of MLIT**

Professional civil servants under the Road Department of the MLIT are offered regular comprehensive non-mandatory trainings on administration and management at the MLIT College. Besides, they can also take the training courses, workshops/seminars arranged by the various originations, as well as the trainings organized under the other ministries. Internal training is not offered.

##### **2) Training at Regional Development Bureau, under MLIT**

Professional civil servants of the RDB, the national highway offices, branch offices, and the technical offices under the RDB are offered trainings by the MLIT Colleges as well as by the internal and external trainings.

#### **(2) Training at Local Government**

Trainings for the professional civil servants of the local government are mainly provided by the external training institutes due to the difficulty to organize those at each authority level. Professional civil servants at the local government attend administration/management trainings at the MLIT College. In regard to the technical trainings, Japan Construction Training Centre (JCSC), the RDB Technical Offices and etc. accept the trainees from the local government. Some local governments also have training courses established in collaboration with the Universities to strengthen the capacity of their professional engineers.

#### **(3) Training at Expressway Agency**

NEXCO, has established its own training institution including its own training implementing organization, training program etc. and provides extensive trainings on the administrative/management and technical trainings on their management field. Trainings are offered by an NEXCO training centers/ Technical training centers as well as external training institutions, research institutions, MLIT College, etc.

#### **(4) Training for Consultants / Contractors**

Trainings at the private companies vary in their conditions and programs. There are no comprehensive road maintenance trainings for the contactors and the consultants provided by the MLIT. However, most of the companies develop their own training programs and offer as internal technical trainings. And also the staff is provided the opportunities to attend external

trainings organized at the JCTC, local government, RDB, and etc. Contractors are required to have qualification to carry out certain tasks in the road maintenance, having self-study, attending training courses and taking exams, which provided at the authorized intuition like the JCTC.

#### **A8.2.3.3. Training Implementing Organizations**

Main training institutions which deal with the road maintenance are listed below. These are demarcated by the targeted staff and the specialized field.

- MLIT College
- RDB
- Technical Centre of RDB
- JCTC
- Centre for Infrastructure Asset Management Technology and Research (CIAM)
- Training Centre of NEXCO Central
- Technical Training Centre of NEXCO Central (EMAC/N2U Bridge)

Table A8.2.3 Summary of Training Institution at Road Maintenance Agencies

	Outline	Training Organizations	Target Trainee	Training Topics	Training courses on Road related	Training style	Duration /Frequency	Consensus and Finance	
MLIT	Comprehensive State Management Training on infrastructure construction, operation, and maintenance in the field under the supervision of MLIT.	• MLIT College (Ministry attached agency)	<ul style="list-style-type: none"> <li>• Civil servants under MLIT and RDB</li> <li>• Local government officials (Prefectures, cities, towns and villages) and ministerial agency staff.</li> <li>• Agencies relevant to MLIT</li> </ul>	<ul style="list-style-type: none"> <li>• Urban planning</li> <li>• Housing</li> <li>• Disaster/Risk management</li> <li>• River management</li> <li>• Road management</li> <li>• GIS/Topographic survey</li> <li>• Information technologies</li> <li>• Railway management</li> <li>• Automobile</li> <li>• Port management</li> <li>• Civil aviation management</li> <li>• Transportation safety management</li> </ul>	<ul style="list-style-type: none"> <li>• 10 courses</li> <li>Road management</li> <li>Road structure 1&amp;2&amp;3</li> <li>Road maintenance</li> <li>Road planning 1&amp;2</li> <li>Road traffic safety 1&amp;2</li> <li>Road environment</li> </ul>	• Short term residential training course	1 - 2 weeks / min. once a year	Financial support from state (MLIT) budget Participants pay fees for textbooks	
	State Management & Professional/Technical Training on specific subjects under RDB	• RDB (Ministry attached agency)	<ul style="list-style-type: none"> <li>• Civil servants under RDB</li> <li>• Local government officials</li> <li>• Consultant&amp; Contractors</li> </ul>	<ul style="list-style-type: none"> <li>• State administration</li> <li>• General</li> <li>• Technical/ Professional</li> </ul>	<ul style="list-style-type: none"> <li>• Depends on RDB</li> <li>• Road maintenance and management</li> </ul>	<ul style="list-style-type: none"> <li>• Training course(Lecture /OJT)</li> <li>• Seminar</li> <li>• Technical Workshop</li> </ul>			Financial support from state (MLIT) budget
	Technical Training on subjects under RDBs	• RDB Technical Office • (Ministry attached agency)	<ul style="list-style-type: none"> <li>• Civil servants under RDB</li> <li>• Local government officials</li> </ul>	<ul style="list-style-type: none"> <li>• Basic technology</li> <li>• Professional technology</li> <li>• Field training</li> </ul>	<ul style="list-style-type: none"> <li>• Road facility maintenance (Bridge/Tunnel)</li> <li>• Survey</li> <li>• Site supervision</li> <li>• Civil engineering</li> <li>• Concrete inspection and repair</li> </ul>	<ul style="list-style-type: none"> <li>• Training course</li> <li>• Technical Workshop</li> </ul>	2-5 das / twice a year		Financial support from state (MLIT) budget
Local Government	Comprehensive State Management Training on infrastructure construction, operation, and maintenance in the field under the supervision of MLIT.	• MLIT College/RDB/RDB Technical Centre	As mentioned above						
	Comprehensive Regional Management Training on infrastructure construction and maintenance in the field under the supervision of Local Authority (Prefectures, cities/towns/villages)	<ul style="list-style-type: none"> <li>• Japan Construction Training Centre (JCTC)</li> <li>• (Prefecture-level trainings are integrated into one center)</li> <li>• (Incorporation Foundation)</li> </ul>	<ul style="list-style-type: none"> <li>• Local government officials</li> <li>• Consultants &amp; Contractors</li> </ul>	<ul style="list-style-type: none"> <li>• Business management</li> <li>• Project supervision</li> <li>• Soil and geology</li> <li>• Disaster prevention</li> <li>• Roads/Tunnel/Bridges</li> <li>• River and dam</li> <li>• Erosion control</li> <li>• Urban planning</li> <li>• Building facility</li> <li>• Land/ right-of-way acquisition</li> </ul>	<ul style="list-style-type: none"> <li>• 7 courses</li> <li>Road management</li> <li>Road Comprehension</li> <li>Rod planning</li> <li>Regional and municipal road</li> <li>Traffic safety on regional &amp; municipal road</li> <li>Pavement technology</li> <li>Road technologies</li> </ul>	<ul style="list-style-type: none"> <li>• Training course</li> <li>• Exam</li> <li>• Workshop</li> </ul>	1 -2 weeks/ once a year	Based on consensus of prefecture governors Financial support (Capital investment) from prefectures Training fees from participants (subsidies available form municipality)	
	Comprehensive Professional Training on Infrastructure asset management for regional experts	• CIAM (Local Government-Academic Collaboration)	<ul style="list-style-type: none"> <li>• Local government officials</li> <li>• Consultant&amp; Contractors</li> </ul>	<ul style="list-style-type: none"> <li>• Basic asset management</li> <li>• Infrastructure management design</li> <li>• Field training on inspection, maintenance</li> </ul>		<ul style="list-style-type: none"> <li>• Training course</li> </ul>	20 days /year		
NEXCO Central	Comprehensive Administrative/Management & Professional Training on subjects under NEXCO Central	• Training Centre	NEXCO Staff	<ul style="list-style-type: none"> <li>• Health and safety</li> <li>• Time management</li> <li>• Mental health</li> <li>• Construction</li> <li>• Maintenance and Management</li> <li>• Cooperate</li> <li>• Advanced engineering</li> <li>• Engineering</li> <li>• Career development</li> </ul>	<ul style="list-style-type: none"> <li>• 15 courses</li> <li>Inspection management capacity evaluation test</li> <li>Structure inspection</li> <li>Practical training on Facility</li> <li>Disaster management</li> <li>Road, estate management basic/Professional</li> <li>Traffic management</li> <li>Bridge management/operation</li> <li>Safety for electrician</li> <li>RIMS inspection/repair supporting system</li> </ul>	• Training course	1-2 times/year		
	Comprehensive Technical Training on subjects under NEXCO Central	• Electric Machine Architecture Communication (EMAC) / N2U Bridge (NEXCO - Academic Collaboration)	NEXCO Staff and related agencies/companies	<ul style="list-style-type: none"> <li>• E-MAC</li> <li>• Facility</li> <li>• Civil Engineering</li> <li>• Health and Safety</li> <li>• N2U Bridge</li> <li>• Basic</li> <li>• Inspection</li> <li>• Diagnosis and evaluation</li> </ul>	<ul style="list-style-type: none"> <li>• E-MAC: Electricity distribution system, Buildings, ETC facility, Facility display, Tunnel, Electricity/ lighting poles, Hand Hall, Structure investigation, Rope access, Hammering, Pavement, Slope</li> <li>• N2U Bridge Standards, Deterioration prediction, Explanation of bridge deterioration, Deterioration prediction, Flow of Bridge maintenance, Inspection Method, MLIT Inspection Guideline, Inspection equipment and machinery</li> </ul>	• Training course (Lecture/OJTs)	2-3 days/ 1-5 times year	No charges for NEXCO staff Training fees are collected from external participants	

#### **A8.2.3.4. Training under MLIT**

##### **(1) College of Land, Infrastructure, Transport and Tourism (MLIT College)**

MLIT College is a comprehensive training institution targeting the civil servants and the officials/staff involved in the state management of the MLIT. The College with two branches offer total of 198 residential courses to 8,446 officials/staff in 2015, among which 135 courses are professional trainings offered to 5,094 officials/staff.

##### **1) Characteristics**

Following shows the characteristics of the College.

- Training opportunities not only for the MLIT officials/staff but also for the local government officials/staff are offered<sup>21</sup>.
- High-level training programs on the state management organized by the MLIT are offered, inviting some academics and experts actively involved in the national road administration.
- Intensive training programs with accommodations are offered.

##### **2) Objectives**

It aims to provide the systematic training programs to those who are involved in the road administration, operation and management in cooperation with the external training institutes.

##### **3) Target Trainees**

Trainings are targeting the officials/staff of the MLIT, local governments, independent administrative institutions, and the other ministries. 70% of the participants are from the central government and 20 % are the officials from the local governments, and 10% are from the others. Each course is set further detailed criteria for the participants' work position and experiences.

##### **4) Training Program**

The College offers 3 training programs listed. **Table A8.2.4** shows the training plan for the year 2015.

- Training by Job Rank : Training provides the comprehensive state management training required for the civil servant under the MLIT.
- Training by Profession: Training provides the professional knowledge and skill and relevant administrative management according to the professional field and assigned department. These are required for the officials and the civil servants under the MLIT.
- Special training : Training to update on the latest issues on the administrative management.

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<sup>21</sup> Training Plan 2015, College of Land, Infrastructure, Transport and Tourism

Table A8.2.4 Training Plan in 2015 – MLIT College

Classification	Training Program	No of course	Origins and the number of participants					
			MLIT	Other Ministry	Local Govt.	Agency	Others	Total
Class-I officer	Training for new employer	1	132					132
	Professional training (Measurements, technologies)	3	72					72
	Administration & management	3	186		20	6	30	242
	Official position training	4	212					212
Class-II/III Officer	Training for new employer	3	402			2		404
	Professional training (Measurements, technologies)	3	36	1				37
	Administration & management	3	150					150
	Official position training	8	393	5		5		401
Common over Class I/II/III	New manager training	5	410					410
	Manager training	3	445					445
	Professional training (Measurements, technologies)	2	18					18
	Compliance trainer training	1	30					30
	Construction management training	2	54	2				56
	Management technology training	2	108	2				110
	Crisis and security management	7	129	1	30			160
General	International construction technology	2	38			2		40
	Public Private Partnership(PPP)/Private Finance Initiative(PFI)	1	12	1	16	1	5	35
	Special technologies	1	10					10
	Intensive training for selected subjects	1	150					150
	Others	1						
Business procedures, Tendering Construction & businesses	Construction system	7	147	7	14	4		172
	Tendering	2	62	1	16	1	5	75
	Construction businesses	2	37	2	31	5	10	85
	Cost saving	2	50	2	14	4		70
	Evaluation of technologies and contractor work performance	2	50	2	14	4		70
	Construction business	1	32	2	26			60
	Construction equipment and machinery	2	39	2	2	6		49
	Communication technology	2	58	2	6	10		76
Disaster/Risk management	Measures against earthquakes and tsunami	1	18	1	17	4		40
	Risk management	3	93	4	5	3		105
Land		4	119	6	60	8	6	199
City/ Regional		11	120	10	382	29	9	550
Housing		10	123	80	253	12	2	470
Estate		1	9	1	25			35
Risk Management		4	111	5	22	7		144
River		12	248	19	195	13		475
Road	Road administration	2	56	3	13	8		80
	Road structures	3	74	3	60	8		145
	Road planning	2	44	2	36	8		90
	Road traffic safety	2	50	2	68			120
	Road environment	1	18	1	7	4		30
GIS/Topographic	Topographic survey and mapping	6	45	6	171	12	4	238

Classification	Training Program	No of course	Origins and the number of participants					
			MLIT	Other Ministry	Local Govt.	Agency	Others	Total
survey	GIS	8	78	15	85	13	17	207

Source: Homepage information of College of MLIT, December 2015

Note: Duration of training courses per training

Training for Class-I officer: 3 days average (Professional training is 3.5 months)

Training for Class-II/III Officer: 5 days average (Professional training is 2.5 months to 1 year)

Common training over Class I/II/III: 3 to 9 days

General training: 3 to 4 days

Training of Business procedures, Tendering and Construction businesses: 4 to 5 days

Training of disaster and risk management: 3 to 5 days

Road sector training: 4 to 10 days

GIS and topographic survey: 5 to 10 days

### a. Training Program on Road Maintenance

Training program in 2015 offered 10 courses on the road sector as shown below. Further details are in the following sections.

**Table A8.2.5 Training Plan 2015 on road related training course at MLIT College**

	Name of course	Target organization					Total	Duration (days)
		MLIT	Other ministry	Local Gov.	Agency	Others		
1	Road management	29	1				30	4
2	Road structure 1- manager	19	1				30	5
3	Road structure 2-assistant manager (design & construction)	25	1	25	4		55	12
4	Road structure 3-assistant manager (maintenance)	20	1	35	4		60	12
5	Road maintenance & management	27	2	13	8		59	11
6	Road planning (survey & analysis)	22	1	23	4		50	10
7	Road planning (function & operation)	22	1	13	4		40	10
8	Road traffic safety 1 (prevention)	25	1	34			60	4
9	Road traffic safety 2 (pedestrian / cyclist)	25	1	34			60	4
10	Road environment	18	1	7	4		30	10
	<b>Total</b>	232	11	184	4		474	

Source: Annual Training Plan 2015, College of land, Infrastructure, Transport and Tourism

### b. Training Course for Road Maintenance and Management

This 11-day residential course targets assistant manager level covering 3 essential fields for the state management of the road maintenance. Trainings are offered by the lectures, mock practice, and map exercises as appropriate to the contents. The course offers to the management and professional officials/staff was combined in 2013, considering that the administrative management official/staff can also acquire the basic understanding on the road maintenance.



**Table A8.2.6 Training course for Road maintenance & management**

Name of course	Road Maintenance and Maintenance					
Aim and focus point	To develop staff capacity on comprehensive knowledge on road maintenance Dispute on road maintenance and management Administration of road maintenance and management Professional knowledge on road maintenance and disaster management					
Targets	Staff from the MLIT, local government, agencies, etc. and at the same time who conduct tasks related to the road maintenance. Assistant manager officials/staff on the position equivalent Person with equivalent capacity as above					
Maximum participant	MLIT	Other ministry	Local Gov.	Agency	others	total
	27	2	13	8		50
Training duration	62.0 hours / 11 days			2 <sup>nd</sup> June – 12 <sup>st</sup> June 2015		
Curriculum	1.Lectures (41.0h) • Lecture (2.0h) • Dispute on road management (6.5h) • Road administration, (17.5h). • Road maintenance & disaster management (15.0h)					
	2.Reseach (13.0 hours)					
	3.Map exercise (5.5 hours)					
	4.Others ( 2.5 hours): Orientation, graduation, guidance, etc.					

Source: Annual Training Plan 2015, College of Land, Infrastructure, Transport and Tourism

### c. Training Courses for Road Structure

Training course on the road structure is 2-week residential course divided into further 3 courses according to the manager and assistant manager level. Subjects are on design, construction and maintenance, so as to enhance comprehensive knowledge.

**Table A8.2.7 Training Course for Road Structure-1 (Manager)**

Name of course	Road Structure <Manager level >					
Aim and focus point	To develop capacity of management level official/staff on comprehensive professional knowledge on road facility management and to apply making proper judgment required • Road structure inspection, diagnoses and maintenance • Selection of repair technology and methods Reinforcement of capacity on proper judgment at various occasions					
Targets	Professionals from MLIT and at the same time who conduct tasks related to road facility Position equivalent manager or official/staff Person with equivalent capacity as above					
Maximum participant	MLIT	Other ministry	Local Gov.	Agencies	others	total
	29	1				30
Training duration	35.0 hours / 5days			5th Oct – 9th Oct 2015		
Curriculum	1.Lecture (26.0 hours) • Current issues on Road administration etc. (4.0h) • Road facility and case studies (13.0h) • Road engineering, Pavement, and Tunnels (7.0h)					
	2.Research (5.0 hours): validity of technical standards					
	3.Others (2.5 hours): Orientation, graduation, guidance, etc.					

Source: Annual Training Plan 2015, College of land, Infrastructure, Transport and Tourism

**Table A8.2.8 Training Course for Road Structure-2  
(Assistant manager- design & construction)**

Name of course	Road Structure <Assistant Manager- Design and Construction>					
Aim and focus point	To develop capacity of management levels official/staff of comprehensive professional knowledge on road facility and apply to make proper judgment required. • Road structure planning, design and construction • Practical skill on design of road bridge					

Name of course	Road Structure <Assistant Manager- Design and Construction>					
Targets	Professionals from MLIT, local government, independent administrative institutions, etc., and at the same time who conduct tasks related road facility <ul style="list-style-type: none"> <li>• Assistant manager or official/staff on the position equivalent</li> <li>• Person with equivalent capacity as above</li> </ul>					
Maximum participant	MLIT	Other ministry	Local Gov.	Agencies	others	total
	25	1	25	4		55
Training duration	69.5.0 hours / 12days			6 <sup>th</sup> July – 17 <sup>th</sup> July 2015		
Curriculum	1. Lecture (47.5 hours) <ul style="list-style-type: none"> <li>• Current issues on road administration etc. (4.5h)</li> <li>• Technical standards, Outline on bridge, steel and concrete bridge, lower structures, accessories, Anti earthquakes (21.5h)</li> <li>• Bridge planning &amp; survey, construction/quality of steel/concrete bridge(14.5h)</li> <li>• Road engineering, pavement, and tunnels. (7.0h)</li> </ul>					
	2. Research (12.0 hours)					
	3. Site Visit (7.0 hours)					
	4. Others (3 hours): Orientation, graduation, guidance, etc.					

Source: Annual Training Plan 2015, College of land, Infrastructure, Transport and Tourism

**Table A8.2.9 Training course for Road Structure-3 (Assistant manager- maintenance)**

Name of course	Road Structure <Assistant Manager- maintenance>					
Aim and focus point	To develop capacity of management levels staff of comprehensive professional knowledge on road structures, especially on inspection, survey, diagnoses and repair works. <ul style="list-style-type: none"> <li>• Inspection, survey, diagnoses and repair works of road structure.</li> <li>• Practical skill on road bridge inspection</li> </ul>					
Targets	Professionals from MLIT, local government, independent administrative institutions, etc., and at the same time who conduct on tasks related road facility <ul style="list-style-type: none"> <li>• Assistant manager or officials/staff on the position equivalent</li> <li>• Person with equivalent capacity as above</li> </ul>					
Maximum participant	MLIT	Other ministry	Local Gov.	Agencies	others	total
	20	1	35	4		65
Training duration	67.0 hours / 12days			9 <sup>th</sup> Nov – 20 <sup>th</sup> Nov 2015		
Curriculum	1.Lecture (46.0 hours) <ul style="list-style-type: none"> <li>• Current issues on road administration etc., durability of concrete</li> <li>• Outline on road structure, bridge, damage and inspection, evaluation, repair, nondestructive testing etc.</li> <li>• Bridge management, damages of steel and concrete</li> <li>• Tunnel, pavement maintenance and management ( 9.5h)</li> </ul>					
	2. On site practice (7.5 hours): Nondestructive survey, Inspection					
	3. Research (10.5 hours)					
	5.Others (3.0 hours): Orientation, graduation, guidance, etc.					

Source: Annual Training Plan 2015, College of land, Infrastructure, Transport and Tourism

## 5) Trainers

MLIT College does not have in-house trainers, instead, invites experts from the field including the MLIT, academics, and associations so that various leading professional knowledge and skills are provided.

## 6) Training Style

Various methods of lecture, research, and practice are applied to the trainings so as to the trainees can participate the training actively. Also, residential training encourages the officials to learn various aspects of unity.

## 7) Qualification

At the end of the training, the trainees, who successfully attended sufficient number of classes and scored sufficient results, receive certification of completion.

## 8) Training Fees

Training fee including trainer cost, maintenance of building, and staff salary are covered by the state funds. Trainee's cost such as food, accommodations and materials are paid by the trainee, which most of the case, covered by each organizations or units.

## (2) Regional Development Bureau (RDB)

### 1) Characteristics

- Training program is organized at each RDB level
- Mandatory and non-mandatory trainings are offered.

### 2) Objectives

Training aims to enhance the professional and technical capacity of the officials/staff to execute works under the managing filed of the RDBs.

### 3) Targeted Trainees

Training is offered mainly to the officials under the management of the RDB including national highway office, technical office, and branches. Some of the trainings, mostly workshops, are offered to the officials/staff of the local governments, consultants and contractors.

### 4) Training Programs

Training programs vary amongst the RDBs but the most RDBs offer comprehensive training courses and professional/technical workshops. External trainings offered by the MLIT College, other ministries, JCLC and etc. Below shows example of the training provided at Kanto RDB.

#### a. Training Courses

Kanto RDB provides trainings according to the job ranks and professional fields (administration, general, professional).

**Table A8.2.10 Training Courses at Kanto RDB**

Target	Administration	General	Technical professional
Manager	Negotiation skill	<ul style="list-style-type: none"> <li>• Training to be trainer</li> <li>• Public relations</li> </ul>	<ul style="list-style-type: none"> <li>• Disaster assessment</li> <li>• Constriction auditor</li> </ul>
Assistant Manager	Administrative law Law and regulation	<ul style="list-style-type: none"> <li>• Professional skills</li> <li>• Health &amp; safety on construction</li> <li>• Training for newly assigned assistant manager (○)</li> </ul>	<ul style="list-style-type: none"> <li>• Advanced engineering (○)</li> <li>• Advanced machinery</li> <li>• Advanced electric &amp; communication</li> </ul>

Target	Administration	General	Technical professional
Officers		<ul style="list-style-type: none"> <li>• Training for mid-level officers (○)</li> <li>• Construction industry administration</li> <li>• Training at private company</li> <li>• Road maintenance &amp; management</li> </ul>	<ul style="list-style-type: none"> <li>• Intermediate engineering (○)</li> <li>• Quantity survey</li> </ul>
Newly employed	Administration (○) Construction Industry	<ul style="list-style-type: none"> <li>• Information security (○)</li> <li>• Training for newly employed (○)</li> </ul>	<ul style="list-style-type: none"> <li>• Introduction to construction skill (○)</li> <li>• Introduction to engineering (○)</li> </ul>

Source: Kanto RDB internal training program (<http://www.ktr.mlit.go.jp/soshiki/soshiki00000003.html>)

(○) is mandatory training.

### b. Technical Workshop / Seminar

Kanto RDB also organizes mainly 3 types of workshops, inviting the experts in the field.

**Table A8.2.11 Workshops Organized at Kanto RDB**

Type	Contents	Target	Qualification
Skill up seminar	Organized once a year and staff present their research topic	MLIT, local government, and relevant organizations	Certificate
Technical workshop	Focused on particular topic which experts are invited to provide up to date information in the field	Professionals under RDB	Certificate
Qualification Workshop	To provide qualification training on road patrol, road maintenance and road facility management	Consultant and contractors who assigned to projects on road maintenance	Certificate

### (3) Technical Office under RDB

#### 1) Characteristic

- Provide training to the officers under the RDB, as well as the local government officers.
- Focus on the training on the practical/technical knowledge and skills

#### 2) Training Programs

RDBs assign technical offices to provide trainings to all officials/staff under their subsidiaries. Programs are managed by each technical office and mostly offer the training courses, workshops, and seminars. As an example, the case of the technical office in Kyushu is shown below.

#### a. Training course (Class room training)

Training course are offered to the officials dividing by the job ranks, and the professional field, offering 17 training courses and 2 courses on the road maintenance and management. These trainings are also open to the local government officers.

**Table A8.2.12 Training courses at Technical Office of RDB**

Type	Contents	Target	duration	No of trainee
Road facility maintenance (Bridge)	Provide basic knowledge and skill required for routing inspection of road bridge and facility	RDB staff (Assistant manager level) Local Government	5 days /twice a year	30
Road facility maintenance (Tunnel)	Provide min. knowledge and skill required for routing inspection of tunnel	RDB staff (Assistant manager level) Local Government	5 days /twice a year	30

## b. Technical Workshop

Workshop is offered in the basic technology, professional technology and the field, aiming to strengthen the technical capacity of younger engineers.

**Table A8.2.13 Technical Workshop at Technical Office of RDB**

Type	Contents	Target	Duration
Basic technology	Aiming to strengthen technical capacity of younger engineers on measuring, concrete	young engineers	2 days
Professional technology	Aiming to strengthen technical capacity of younger engineers on site supervision on civil engineering and concrete inspection and repair.	young engineers	2 days
Field training	Aiming to strengthen technical capacity of younger engineers on bridge substructure, pavement improvement, and etc	young engineers	-

### A8.2.3.5. Training under Local Government

#### (1) Japan Construction Training Centre (JCTC)

##### 1) Characteristic

- Provide training opportunities to the officials/staff of the local government and agency as well as the consultants and contractors on the managing field of the MLIT
- Provide high-level training programs focusing on the professional and technical topic, inviting academics and experts actively involved in the field.

##### 2) Background of Foundation

The JCTC, a public foundation, was founded by the National Governor's Association in 1962 with an objective of strengthening management capacity of the local government officers in infrastructure construction, operation and maintenance. In 1983, JCTC strengthened its function, upon receiving request from Japan Association of City Mayor and National Association of Towns and Villages and now it expands its targets to the consultant and the contractors, to supplement trainings offered by the MLIT. It has been 50 years since its establishment, and about 180 thousand people have participated in its training programs.

##### 3) Objectives

To enhance professional/technical capacity of the local government officials/staff and the private company staff who are involved in the infrastructure development.

##### 4) Target Trainee

Trainings are targeting the local government officials, ministerial agency/public corporation staff and the consultants and contractors.

##### 5) Training Programs

The Center offers the following training courses, qualification exams, project supervision trainings, satellite trainings, and the trainings on the construction law.

- Public official training: targeting national and local governments, foundations
- General training: targeting officials as well as private companies

**Table A8.2.14 Training Courses in 2015**

No	Training field	Training Courses	Trainee No.	Duration	Target Trainees	
					G	G & P
1	Business management	Public works contracting system	40	3	X	
		Comprehensive evaluation tendering	40	3	X	
		Prevention of legal conflict in construction	40	4	X	
		Public works tendering system	40	3	X	
		Asset management	60	3		X
		PPP/PFI	40	3		X
		Lessons learnt from Audit Board inspection	40	2		X
		Presentation skill in construction	40	3		X
2	Project supervision	Cost estimate for public works	50	5	X	
		Construction work supervisor	50	5	X	
		Construction work quality control and inspection	40	4	X	
		Exercise on construction work implementation plan	40	3		X
		Construction work supervision	60	3		X
		Concrete work supervision	40	4		X
		Maintenance and repair of concrete structures	70	3		X
		Construction technologies for young engineer (Basics)	50	3		X
		Labor safety management during construction	40	3		X
		Temporary works	30	5		X
		Points of public works – Planning and design	50	4		X
		Points of public works – Construction work, supervision and inspection	50	4		X
		Basics of structure calculation	60	3		X
3	Soil and geology	Geological survey	40	3		X
		Geological design	40	4		X
4	Disaster prevention	Disaster restoration	50	5	X	
		Countermeasures right after large disasters	40	3		X
		Flood control	40	3		X
		Earthquake resistant design	40	3		X
		Slope protection	50	3		X
		Measures against land slides	40	4		X
5	Tunnel	NATM construction technology	40	5		X
6	Roads	Road administration- General	60	5	X	
		Road administration – Recent policy	40	3		X
		Road planning – Exercise	50	8		X
		City/town/village roads	50	4		X
		Traffic safety measures for city/town/village roads	40	5		X
		Road pavement technologies	60	3		X
		Road technologies – Special technologies	60	4		X
		Road facility maintenance	80	3		X
7	Bridges	Bridge design	50	9		X
		Bridge design and construction technology	40	3		X
		PC bridge technology	40	3		X
		Planning and maintenance of PC bridges	40	3		X
		Bridge maintenance repair	80	4		X
		Road bridge inspection at field	40	4		X
8	Land and	8 courses			X	X
9	River and dam	8 courses			X	X
10	Erosion control	3 courses				X
11	Urban planning	14 courses			X	X
12	Building facilities	20 courses			X	X

(Note) G: Central Government, local government agency, staff, P: Private company staff

### a. Training Courses for Road Maintenance

In total, 8 courses are offered on the road sector as shown above. The followings show further detailed training plan of the road administration and road facility maintenance trainings.

**Table A8.2.15 Training Plan for Road (State Management Training)**

Training course	Target stakeholders	No. trainees	Days	Subject covered	Trainers
Road Administration (General)	<ul style="list-style-type: none"> <li>Central government officials</li> <li>Staff involved in road maintenance</li> </ul>	60	5	<ul style="list-style-type: none"> <li>Key Note,</li> <li>Law and regulation on road</li> <li>Land acquisition</li> <li>Preventative measure for road</li> <li>Traffic control</li> <li>Road traffic management</li> <li>Approval of construction works</li> <li>Dispute and court cases</li> <li>Road Environment</li> </ul>	<ul style="list-style-type: none"> <li>Road Bureau, MLIT.</li> <li>RDB, MLIT</li> <li>Academics</li> </ul>
Road Facility Maintenance	<ul style="list-style-type: none"> <li>Central &amp; local government officials/ agencies/ private companies</li> <li>Staff involved in road facility maintenance</li> </ul>	80	3	<ul style="list-style-type: none"> <li>Issues on road facility maintenance</li> <li>Law and management relevant to routing inspection</li> <li>Repair of road facilities</li> <li>Case studies road accessories damage and maintenance</li> <li>Road maintenance plan</li> <li>Earthquake resistance for road bridge</li> <li>Bridge damage and repair</li> <li>Tunnel damage and repair</li> <li>Road works and maintenance</li> <li>Pavement management and maintenance</li> </ul>	<ul style="list-style-type: none"> <li>RDB, MLIT</li> <li>Public Works Research Institute, MLIT</li> </ul>
Road Bridge Inspection at Field	<ul style="list-style-type: none"> <li>Central &amp; local government officials/ agencies/ private companies</li> <li>Staff involved in road facility maintenance and already have basic knowledge and skill on routing maintenance of bridge</li> </ul>	40	4	<ul style="list-style-type: none"> <li>Issues on road facility maintenance</li> <li>Outline of OJT</li> <li>Non-destructive testing and demonstration</li> <li>OJT inspection on concrete and steel bridge</li> </ul>	<ul style="list-style-type: none"> <li>RDB, MLIT</li> <li>Public Works Research Institute, MLIT</li> </ul>

Source: JCTC 2015 Training Implementation Schedule

### b. Qualification Exams

As the accredited training institution by the MLIT, JCTC also runs following 4 types of qualification exams under the Construction Industry Act and Land Readjustment Act once a year at the main regions.

- Civil work construction management engineers
- Piping construction management engineers
- Landscape work construction management engineers, and
- Land use and construction management engineer

The regulation stipulates that the officials/staff with qualification are essential for the construction office, as well as the site supervision.

### c. Training for Project Supervisor

Construction industry Act<sup>22</sup> also stipulates that the projects over certain size are to assign “Construction Supervisors”, who has expertise knowledge and skills. The supervisor is to take training every 5 years under the accredited training institutions. This condition is also applied to the consultants and the contractors who carry out the road maintenance works. The Centre offers this stipulated training for the “Construction Supervisors”. Training is offered as 1 day (6 hours) training at the main regions (57 areas) and issues certificate for completion.

### d. Satellite Training

Some trainings in Tokyo are offered as live training to the region of 8 areas. This allows people who are in the regions to take part and also to allow them to participate in the discussions.

#### 6) Trainers

Trainers are invited from the RDBs, MLIT, academics and institutes. In case of the specialized subjects, trainings are implemented in cooperation with the expertise bodies in the fields.

#### 7) Training Fees

Trainees have to pay training fee to the JCTC, including the fee for the venue, accommodation and the meals. Local officials can apply subsidies from the Municipal Development Corporation.

## (2) The Center for Infrastructure Asset Management Technology and Research (CIAM)

This section presents an example of a joint training program on the infrastructure maintenance and the management developed by the local government and the academic institution.

Gifu University, in collaboration with Gifu Prefecture, offers a training program called “Maintenance Expert (ME) Training Program<sup>23</sup>”. This intensive training course offers general and advanced knowledge of the infrastructure maintenance targeting the engineers under the regional authorities and the regional construction industries. Some local governments such as Ehime, Yamaguchi have also adopted the method.

### 1) Objectives

This program aims to cultivate the human resources for the prefectural construction industries, which enable high levels of safety, security and regional activation. The followings show the objectives set for each target trainees.

<sup>22</sup>Amended in 20th December, 2008, (Law No. 114)

<sup>23</sup>“Challenges for More Efficient and Effective Asset Management and Governance For Infrastructure: Maintenance Expert Training Program In Gifu”, Kazuhide SAWADA, et al



- Prefectural officials/staff: settling a long-/medium-/short-term maintenance and management plan of the infrastructure at prefectural office or at Construction Research Centre of Gifu Prefecture.
- Engineers in the regional industries: playing a main role in the disaster prevention or the infrastructure maintenance works at his/her origin company, JV, or consortium, and endeavouring to guarantee the quality of the work of the regional construction companies and to deliver a technical proposal of good quality

## 2) Responsible agency

The training program is run by the CIAM which has been established specifically for this program under Gifu University. Besides this training, the center runs consultant service.

## 3) Target trainee

- Engineers from the local authorities with over 2 years of experience on the infrastructure maintenance
- Engineers from the regional construction industries with over 3 years of experience on the inspection, design, construction, infrastructure maintenance.

## 4) Training courses

“Maintenance Expert Training Program” is composed with 3 courses; 1) asset management, 2) applied infrastructure design, and 3) practical trainings. It runs twice a year for 20 days covering 80 lessons.

**Table A8.2.16 Training Courses for ME**

Courses	Subject covered
Theory on asset management	Introduction to asset management
	Data collection of asset management
	Theory of risk management
	Verification of risk management
	Financial theory
	Asset management
Applied design of infrastructure	Introduction to infrastructure design
	Design practice
	Infrastructure inspection/maintenance/reinforcement design
	Quality management practice
Practice on inspection, maintenance and reinforcement	Maintenance and repair theory
	Inspection and management practice
	Inspection, maintenance and reinforcement method practice
	Construction management theory

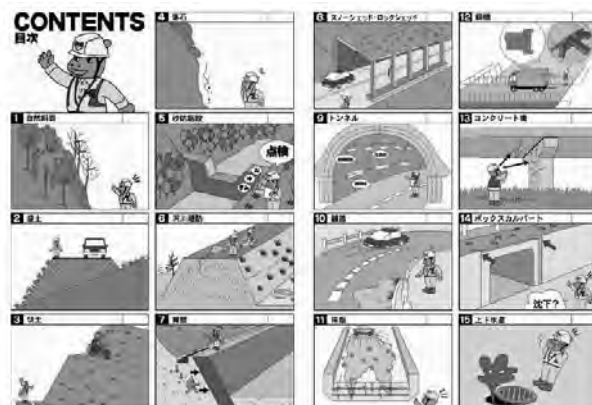
Source : “Challenges for More Efficient and Effective Asset Management and Governance for Infrastructure: Maintenance Expert Training Program In Gifu”, Kazuhide SAWAD, et. al

## 5) Trainers

Trainers are invited from the university, Gifu prefecture, infrastructure research Centre, and NPOs.

## 6) Textbook and Material

Textbook is developed by the ME Unit. It includes many graphics to make user friendly as well as visually understandable on the importance of maintenance and management. The textbook is also widely available at the bookshops, etc.



Source: ME Unit, CIAM

Figure A8.2.1 Example of Textbook

## 7) Qualification

Engineers, who successfully pass the final examination and submit sufficient reports, are granted a title of “Maintenance Expert” of the regional (Prefecture) level.

### A8.2.3.6. Training under NEXCO Central

The case study of the NEXCO Central is shown below.

Table A8.2.17 Training Plan on Training by Internal Training Implementing Organization

Training program	courses	Target organizations					Frequency (times/year)	Duration (days)	Trainee number (per training)	Training Organization
		Headquarter	Branch	Work Office	HSC	Subsidiaries				
<b>Management level based</b>										
E learning	6	X	X	X	X	X	1-2	20-30 min/ time	2,000-10,000	
Health and safety training	1	X	X	X	X	X	88	0.5	25	
Newly assigned	4	X	X	X	X	X	1-2	5-13	28-84	TC
Middle position at task	3	X	X	X	X	X	1-2	2-3	25-50	TC
Upper position at task	2	X	X	X	X	X	1	2	25	TC
Manager	2		X	X			1	3-4	50	TC
Manager II	2	selected					2	0.5 -1	10	TC
Centre Director	1			X	X		1	2	12-15	TC
Director	1	X	X				1	3	11	TC
<b>Region based</b>										
Evaluator, Mentor, Leadoff man	4						1-2	0.5-2	30-84	TC
Time management	4	X	X	X			1-2	0.5 -1	11 - 104	TC
Mental health	3	X	X	X			2-4	0.5	20 - 35	TC
others	2									
<b>Application based</b>										
Business skill	15	X	X	X	X	X	1-2	0.5 -2	20 - 100	TC
<b>Task based</b>										
Cooperate	5	X	X	X			1-4	1 -2	20 - 40	TC
Constr   Land	3		X	X			1	1 -3	10 - 15	TC

Training program		courses	Target organizations					Frequency (times/year)	Duration (days)	Trainee number (per training)	Training Organization
			Headquarter	Branch	Work Office	HSC	Subsidiaries				
Construction	construction management	3	X	X	X			1-2	2 - 3.5	20 - 30	TC
	Engineering basic	3	Newly assigned in engineering tasks					1-2	1.5 - 3	40 - 50	TC
	Inspection	4				X		2-4	1 - 3	10 - 30	TC
Maintenance and Management	Preventative measures	2		X		X		1	2.5	40	TC
	Estate management	2	X			X		1	1.5	10	TC
	traffic management	2	X	X				1-2	1.5 - 3	8-20	TC
	bridge management	2		X		X		1	2	20-40	EMAC
	electrician health and safety	2	X	X	X			3	1-2	20	EMAC
	RIMS inspection	1						5-10	05	25-30	TC
Others		3	X	X				1	1-2	10-15	TC/EMAC
<b>Professional based</b>											
Advanced engineering on bridge, tunnel, environment, civil engineering, pavement, transport		6	X	X	X			1	1-2	10-19	TC
Engineering on pavement, transport etc.		4	X	X	X			1	2-3	30	TC
<b>Career Development</b>											
Career Development		4	X	X	X	X	X	2-3	1-2.5	2-6	TC

TC: Training Centre, HSC: Highway Service and communication Centre

### 8) Training courses on road maintenance and management

Road maintenance and management are offered under the task based training.

**Table A8.2.18 Training course on Road Related at NEXCO Central**

Training type	Course	Target organizations	Target trainee	Frequency	Duration (days)	Trainee number	Training organization
Task based Training by Internal Training Institution							
Maintenance Management	Inspection management capacity evaluation test(civil engineering)	HSC	engineers	4	3	20/each	TC
	Inspection management capacity evaluation test(facilities)	HSC	engineers	2	2.5	10/each	E-Mac
	Structure inspection basics 1	HSC	Admin staff	2	1	24/each	N2U Bridge
	Practical training on Facility	B/O		1	2	15	E-Mac
	Disaster management I	B/HSC		1	2.5	40	Uni
	Disaster management II	B/HSC		1	2.5	40	Uni
	Road, estate management basic	B/HSC		1	1.5	10	TC
	Road, estate management professional	HSC		1	1.5	10	TC
	Toll fee	B/O	Those assigned	1	3	20	TC
	Traffic management	Traffic control center		2	1.5	8/each	TC
	Bridge management/operation basic	B/HSC		1	2	30	NEXCO RI
	Bridge management practitioner	B/HSC		1	2	20	NEXCO RI
	Safety for electrician (LV)	H/B/O	Facility staff	3	1	20/each	E-MAC
Safety for electrician (HV)	H/B/O	Facility staff	3	2	20/each	E-MAC	
RIMS inspection/repair supporting system	B/HSC		15	0.5	30/each	TC	

### (3) Electric Machine Architecture Communication (EMAC)

#### 1) Characteristic

- Provide technical training to the NEXCO Central Staff

## 2) Background

Knowledge and the skill on the repair has used to be obtained through the experiences. However, due to the good preventative maintenance, it is rare to have problems on site nowadays. Thus, the NEXCO established EMAC in 2014, and develop repairing skills.

## 3) Objectives

- Gain repairing skill on the road facilities.
- Gain habit on the health and safety
- Gain skills on the civil engineering

## 4) Training Program

3 training courses are offered; 1) Facility training, 2) Civil engineering training , and 3) Health and safety training.

**Table A8.2.19 Training course at EMAC**

Training courses	Objectives	Target	Subject
Facility training	Develop knowledge on each facility according to the trainee level.	NEXCO Central Staff and relevant companies	<ul style="list-style-type: none"> <li>• Electricity distribution system</li> <li>• Buildings</li> <li>• ETC facility</li> <li>• Facility display</li> <li>• Tunnel</li> <li>• Electricity/ lighting poles</li> <li>• Hand Hall</li> <li>• Structure investigation</li> </ul>
Civil engineering course	Improve knowledge on internal structure and system of civil engineering structure and improve quality of inspection	NEXCO Central Staff and relevant companies	<ul style="list-style-type: none"> <li>• Rope access</li> <li>• Hammering</li> <li>• Pavement</li> <li>• Slope</li> <li>• Exhibition area</li> </ul>
Health and safety course	Develop knowledge on health and safety so that capacity to prevent and aware dangers	NEXCO Central Staff and relevant companies	<ul style="list-style-type: none"> <li>• Case studies on past accidents</li> <li>• Speed experience using 3D video,</li> <li>• Mock scaffolding to experience danger</li> </ul>



**Figure A8.2.2 Image of E MAC**

**(4) N2U Bridge****1) Characteristic**

- The facility is established and operated in cooperation with the Universities
- Facility is composed with a real bridge structure
- Training is based on the practical hands on methods, and offered to the wider participants (outside NEXCO)

**2) Objectives**

The center aims to develop competent bridge maintenance engineers with sufficient knowledge and skills.

**3) Target Trainee**

NEXCO staff, MLIT local authority, and the private companies relevant to the road.

**4) Training Program**

3 training courses are shown below. Besides, the center provides a custom-made training, regional training based on the request.

**Table A8.2.20 Training course at N2U Bridge**

Training course	Objectives	Trainee number	Training duration	Frequency	Training fee
Basic course	<ul style="list-style-type: none"> <li>• To understand the flow of road maintenance and deterioration</li> </ul>	60 people/ time	2 days	2 times/ year	JPY 9,000 /person
Inspection course	<ul style="list-style-type: none"> <li>• To understand the inspection process based on the MLIT inspection guideline</li> </ul>	21 people/ time	3 days	5 times/ year	JPY 25,000 /person
Diagnosis and evaluation course	<ul style="list-style-type: none"> <li>• To understand the flow of deterioration, evaluation, repair selection, and maintenance planning</li> </ul>	20 people/ time	2 days	1 times/ year	JPY 20,000 /person

**Table A8.2.21 Basic Course**

	Contents	Training style
Day 1	<ul style="list-style-type: none"> <li>• Current status of bridge in Japan</li> <li>• Outline of bridge structure</li> <li>• Flow of bridge maintenance</li> <li>• Inspection method</li> <li>• Nondestructive inspection</li> </ul>	Lecture
Day 2	<ul style="list-style-type: none"> <li>• Explanation of bridge deterioration</li> <li>• Inspection equipment and machinery</li> </ul>	Practical training at N2U Bridge

**Table A8.2.22 Inspection Course**

	Contents	Training style
Day 1	<ul style="list-style-type: none"> <li>• Current status of bridge in Japan</li> <li>• Standards</li> <li>• Deterioration prediction (concrete)</li> <li>• Explanation of bridge deterioration</li> </ul>	Lecture
Day 2	<ul style="list-style-type: none"> <li>• Deterioration prediction (steel)</li> <li>• Flow of bridge maintenance</li> <li>• Inspection method (nondestructive inspection)</li> <li>• MLIT Inspection Guideline</li> <li>• Key points on inspection</li> </ul>	Practical training at N2U Bridge
Day 3	<ul style="list-style-type: none"> <li>• Case study</li> <li>• Inspection equipment and machinery</li> </ul>	Practical training at N2U Bridge

### 5) Qualification

Participants successfully completed inspection training and pass the exam will be provided “National Bridge Inspection Qualification”.



**Figure A8.2.3 Image of N2U Bridge**

## A8.3 COMMENTS AND SUGGESTIONS ADDRESSED BY TRAINEES DURING PROJECT TRAINING PROGRAMS

### A8.3.1 2<sup>nd</sup> Workshop and OJTs

The below table summarizes some of the main comments and suggestions from the participants:

**Table A8.2.23 Summary of Comments and Suggestions of 2<sup>nd</sup> WS&OJTs**

Items	Comments	Suggestions
<b>1. WS Contents/ Program</b>	<ul style="list-style-type: none"> <li>Limited examples of pavement deteriorations types.</li> <li>Rather focus on road maintenance than bridge maintenance.</li> <li>Inadequate data of crack, rutting and IRI.</li> </ul>	<ul style="list-style-type: none"> <li>More WS is expected.</li> <li>Time for discussion</li> <li>Foreign experiences in road management and maintenance</li> <li>WS should be provided for PDOTs</li> </ul>
<b>2. PMS/Web-based system</b>	<ul style="list-style-type: none"> <li>NH1 section under RMBII's jurisdiction increased from 2 lanes into 4 lanes.</li> <li>Data inputting has error. Data input by RMBs should be reviewed and if errors occur, correcting and presenting at the WS as an example</li> <li>How many years can the pavement survey data be used?</li> <li>Disadvantages of PMS software:               <ol style="list-style-type: none"> <li>The annual rainfall is restricted less than 1000mm</li> <li>When editing data, data is not sorted in order.</li> <li>Temperature data and rainfall data are unable to input manually but in ascending order, so it is time-consuming.</li> </ol> </li> </ul>	<ul style="list-style-type: none"> <li>Detailed instructions on how to collect data and input data in PMS, also presentation on PMS.</li> <li>The software should be updated regularly; the utilization of pavement survey data for formulation of road maintenance plan needs to be applied soon.</li> <li>Do test run on the web-based system and roadmap for test run.</li> <li>Provide supports regarding skills and finance for inspection team and data collection team to collect data for PMS.</li> <li>More computer practicing on data inputting &amp; PMS</li> <li>Examples of pavement survey data applied into practice.</li> </ul>
<b>3. Road Facility Inspection and Road Routine Maintenance Manual</b>	<ul style="list-style-type: none"> <li>The presentation raises awareness in inspection and diagnosis of damage.</li> <li>Most of bridge inspections are carried out by eye-observation, so proposing to introduce machine/devices assisting the patrol team.</li> </ul>	<ul style="list-style-type: none"> <li>Finalization and publication of routine road maintenance manual.</li> <li>Introduction of road routine maintenance manual and details of bridge inspection process.</li> <li>More training course on road facility inspection and incident prediction and application of data in formulating the maintenance plan.</li> <li>Give instruction on contents of road facility inspection guideline</li> <li>Necessary to formulate the bridge inspection plan (less than 300 m)</li> <li>Instruction on operating equipment and machines in road and bridge inspection.</li> </ul>
<b>4. Technologies</b>	<ul style="list-style-type: none"> <li>Many new technologies introduced in the WS</li> <li>The presentation on technological application did not show the feasibility and specifications of technologies applied to Vietnam, different regions and especially national roads.</li> </ul>	<ul style="list-style-type: none"> <li>Solutions and Technologies applied in pavement maintenance, especially bridge.</li> <li>Trial operation of using asphalt concrete with polymer additives for anti-rutting in jurisdiction area in RMBII.</li> <li>More details on NETIS and QCBS in Vietnam.</li> <li>Comparison and relevance of different technologies to regions in terms of quality, life expectancy and price). The results and comments on the application of new technologies into road maintenance in Vietnam.</li> </ul>
<b>5. On-site practice</b>		<ul style="list-style-type: none"> <li>On-site practice (such as pavement survey and bridge inspection) to apply the knowledge from the presentations in real situations.</li> </ul>

### A8.3.2 3<sup>rd</sup> Workshop and OJTs

The below table summarizes some of the main comments and suggestions from the participants:

**Table A8.2.24 Summary of Comments and Suggestions of 3<sup>rd</sup> WS&OJTs**

Items	Comments	Suggestions
<b>1. WS Contents/ Program</b>	<ul style="list-style-type: none"> <li>The workshop is useful and critical. More details should be provided and explained in the workshop.</li> <li>The workshop helps to improve the capacity in road management and maintenance, especially when the budget for maintenance of national highway is not enough.</li> </ul>	<ul style="list-style-type: none"> <li>The workshop is useful and critical in improve knowledge of DRVN, RMBs and SBs staff in transport infrastructure protection.</li> <li>The content shall be more detailed.</li> <li>Time should be spent for discussion after each presentation.</li> </ul>
<b>2. Road Facility Inspection and Road Routine Maintenance Manual</b>	<p><b>RMBI</b></p> <ul style="list-style-type: none"> <li>The contents are useful and critical.</li> </ul> <p><b>RMBII</b></p> <ul style="list-style-type: none"> <li>The system does not recognize some stations. Some stations have been changed and some roads have been changed to local roads</li> <li>There is no data on total traffic volume.</li> <li>The data is not finalized yet, which makes it difficult to use the system.</li> <li>In Maintenance history module, when exporting Excel file, the value of repair thickness is not displayed; the value of width of repair lane is also not displayed.</li> </ul> <p><b>RMBIII</b></p> <ul style="list-style-type: none"> <li>PMS helps the management to be more accurately and efficiently.</li> <li>The Inspection Guideline is useful for researching and referencing.</li> </ul> <p><b>RMBIV</b></p> <ul style="list-style-type: none"> <li>The OJT is in details and understandable, meeting the requirement of inspection works</li> <li>The guideline and manual is understandable and critical.</li> </ul>	<p><b>RMBI</b></p> <ul style="list-style-type: none"> <li>Maintenance for traffic safety facility (e.g. road signs, guardrail, etc.) shall be added to Road Routine Maintenance Manual.</li> </ul> <p><b>RMBII</b></p> <ul style="list-style-type: none"> <li>RTC2 shall be responsible for inputting data; SBs shall be responsible for providing data and monitoring RTC2's work. Because RTC2 is professional in survey and design.</li> </ul> <p><b>RMBIII</b></p> <ul style="list-style-type: none"> <li>The crack measurement by Square Grid 0.5x0.5m shall be applied for each specific section (100m, 200m, 500m, etc.) in order to evaluate the crack ratio at the section.</li> <li>All types of pavement damage should be included in the inspection guideline/ maintenance manual, and should be consistent with other programs.</li> </ul> <p><b>RMBIV</b></p> <ul style="list-style-type: none"> <li>The guideline and manual shall be updated regularly</li> </ul>
<b>3. Web-Based PMS Data Input System</b>	<p><b>RMBI</b></p> <ul style="list-style-type: none"> <li>Friendly user interface, however the language shall be consistent.</li> </ul> <p><b>RMBII</b></p> <ul style="list-style-type: none"> <li>The system does not recognize some stations. Some stations have been changed and some roads have been changed to local roads.</li> <li>There is no data on total traffic volume.</li> <li>In Maintenance history module, when exporting Excel file, the value of repair thickness is not displayed, the value of width of repair lane is also not displayed.</li> </ul> <p><b>RMBIII</b></p> <ul style="list-style-type: none"> <li>It is OK to input data for the right lane, but cannot input data for the left lane</li> </ul> <p><b>RMBIV</b></p>	<p><b>RMBI</b></p> <ul style="list-style-type: none"> <li>Data of pavement strength determined by FWD shall be added</li> <li>The data of station shall be added (e.g. Km...+...)</li> <li>The data of section/branch shall be added for more accurate and adequate information"</li> </ul> <p><b>RMBII</b></p> <ul style="list-style-type: none"> <li>RTC2 shall be responsible for inputting data; SBs shall be responsible for providing data and monitoring RTC2's work. Because RTC2 is professional in survey and design</li> </ul> <p><b>RMBIII</b></p> <ul style="list-style-type: none"> <li>The filter and search function shall be added into the pavement data display system as same as in the data input system. The current filter and search function is very difficult to use.</li> <li>The filter and search function shall be added into the</li> </ul>



	<ul style="list-style-type: none"> <li>The purpose of this system is good. The application of system in annual medium repair shall be considered. Inspection frequency shall be increased.</li> </ul>	<p>maintenance history.</p> <p><b>RMBIV</b></p> <ul style="list-style-type: none"> <li>The project should prepare more detailed manual, as same as the manual of VBMS.</li> <li>The function of putting data for road of district, commune, etc. shall be added.</li> </ul>
<b>4. Web-Based System for Displaying PMS Data</b>	<p><b>RMBI</b></p> <ul style="list-style-type: none"> <li>The system is detailed and clear</li> <li>Friendly user interface, easy to use</li> </ul> <p><b>RMBII</b></p> <ul style="list-style-type: none"> <li>The updated data is not accurate (exporting)</li> <li>This system is very critical. The road facilities inspection guideline and road routine maintenance manual are very useful.</li> </ul> <p><b>RMBIII</b></p> <ul style="list-style-type: none"> <li>Data displaying in map is easy to view.</li> <li>Module "Section information": lack of inputting function for non-motorized vehicle and median strip.</li> </ul> <p><b>RMBIV</b></p> <ul style="list-style-type: none"> <li>The system is not finalized yet.</li> </ul>	<p><b>RMBI</b></p> <ul style="list-style-type: none"> <li>Search function: The data of station shall be added (e.g. Km +...)</li> <li>The image and detailed information of road section shall be clearer.</li> </ul> <p><b>RMBII</b></p> <ul style="list-style-type: none"> <li>The system for displaying PMS data shall be updated regularly in accordance with road maintenance plan. The tables and reports shall be able to be exported in accordance with regulations of DRVN</li> <li>"Help" function should be developed for easy operation of the system. E.g.: abbreviation, capitalization, definition of term, etc.</li> </ul> <p><b>RMBIII</b></p> <ul style="list-style-type: none"> <li>The system shall help RMBs to obtain the information of road and bridge on national highway as the basis for annual repair planning and budget planning.</li> </ul> <p><b>RMBIV</b></p> <ul style="list-style-type: none"> <li>There should be definition of technical parameter (arrangement of pavement layers).</li> </ul>
<b>5. PMS Budget Simulation and Repair Work Plan</b>	<ul style="list-style-type: none"> <li>The system is not very practical to be applied in repair work planning.</li> <li>The language shall be consistent in exported Excel file.</li> </ul>	<ul style="list-style-type: none"> <li>The system shall help RMBs to obtain the information of pavement condition of national highway under jurisdiction.</li> <li>PMS Budget Simulation is not very clear; the content is too general.</li> <li>PMS Repair Work Plan is good and clear.</li> <li>The repair budget scenario is very clear. However, the algorithm to calculate damage speed and deterioration shall be introduced.</li> </ul>

### A8.3.3 4<sup>th</sup> Workshop and OJTs

The below table summarizes some of the main comments and suggestions from the participants:

**Table A8.2.25 Summary of Comments and Suggestions of 4<sup>th</sup> WS&OJTs**

Items	RMBS	Comments/Suggestions
<b>1. Computer-based PMS OJT</b>	RMBI	<ul style="list-style-type: none"> <li>PMS system is very useful and practical for road management (monitoring and archiving).</li> <li>Pavement condition changes often, so how long the surveyed data can be used? How often to conduct the survey?</li> <li>The data should be updated frequently to update the changes of section as soon as possible.</li> <li>Budget simulation is suitable for the report on budget estimation for road maintenance.</li> </ul>
	RMBII	<ul style="list-style-type: none"> <li>It is needed to standardize and Vietnamese all modules</li> </ul>
	RMBIII	<ul style="list-style-type: none"> <li>The system is very useful for long term planning.</li> <li>The system should be completed soon to apply into reality.</li> <li>The system should be displayed in Vietnamese for Vietnamese users. It</li> </ul>

Items	RMBS	Comments/Suggestions
		is necessary to add such item as traffic volume.
	RMBIV	<ul style="list-style-type: none"> <li>The PMS is clear and suitable to apply, should be applied in SBs.</li> <li>Some items are in English, they should be translated into Vietnamese</li> <li>Suitable to apply</li> </ul>
<b>2. Suggestions on further training</b>	RMI	<ul style="list-style-type: none"> <li>The WS provides fruitful insights into road management and maintenance. More workshops or experience exchange_in section management are appreciated.</li> <li>Annual WS about the capacity enhancement for officers in charge of road/bridge management and inspection is very necessary.</li> </ul>
	RMBII	<ul style="list-style-type: none"> <li>More WS and more videos taken from actual sites are appreciated.</li> <li>Propose the next training in 2018</li> <li>Intensive field training is necessary</li> </ul>
	RMBIII	<ul style="list-style-type: none"> <li>The system should be completed soon to apply into reality.</li> </ul>
	<b><u>RMBIV</u></b>	<ul style="list-style-type: none"> <li>More videos for presentation are appreciated.</li> </ul>

#### A8.3.4 5<sup>th</sup> Workshop & OJTs

The below table summarizes some of the main comments and suggestions from the participants:

**Table A8.2.26 Summary of Responses to Necessity for Post-Project Training**

Necessity for Post-Project Training	Yes	No	Total number of respondents	Total number of attendants
RMB I	17	0	17	42
RMB II	20	1	21	47
RMB III	25	1	26	41
RMB IV	22	1	23	35

**Table A8.2.27 Summary of Comments and Suggestions of 5<sup>th</sup> WS&OJTs**

<b>RMB I</b>	<ul style="list-style-type: none"> <li>Training and practicing should be provided for the grass-root level.</li> </ul>
<b>RMB II</b>	<ul style="list-style-type: none"> <li>Intensive training for road facility inspection is necessary; apart from training relating to pavement; training on other road facilities is also important.</li> <li>Training for all inspection staffs on road facilities inspection and how to update inspection data into software.</li> <li>Training on data analysis skills of all road works, auxiliary works and other works to prepare a maintenance plan suitable for current conditions in Vietnam.</li> </ul>
<b>RMB III</b>	<ul style="list-style-type: none"> <li>Propose training topic about preventing road facilities from deteriorations including Inspection and Maintenance of Road Facilities.</li> <li>Propose to have training course on data collection in PMS and proper practice to use the software effectively and precisely.</li> <li>It needs to have more topics about traffic safety in design, especially human being factor in design and operating vehicles on road.</li> </ul>
<b>RMB IV</b>	<ul style="list-style-type: none"> <li>Training on advance technologies.</li> <li>Training for road operators.</li> <li>Training on coding road data.</li> <li>Training to finalize sections of periodic repair.</li> </ul>

### A8.3.5 2<sup>nd</sup> & 3<sup>rd</sup> Intensive Training

The below table shows some of the main comments from the participants of the Intensive Training of Management on Pavement Condition Survey: Intensive Training (1):

**Table A8.2.28 Comments for 2<sup>nd</sup> Intensive Training (1)**

Agency	Comments
DPI	<ul style="list-style-type: none"> <li>Consider to create Vietnamese version for RI / PC data</li> </ul>
RMB II	<ul style="list-style-type: none"> <li>Interval time from data collection to planning is rather long, thus PC data gets old for planning.</li> <li>Survey section table is clear however, simpler method is needed.</li> </ul>
RMB III	<ul style="list-style-type: none"> <li>While training program is useful, one day is not sufficient to organize such training.</li> </ul>
RTC 2	<ul style="list-style-type: none"> <li>More training is necessary for the engineers of regional RTC.</li> </ul>
RTC 3	<ul style="list-style-type: none"> <li>More training is required for the engineers</li> </ul>

The below table shows some of the main comments from the participants of the Intensive Training of Technology Update on Pavement Condition Survey: Intensive Training (2).

**Table A8.2.29 Comments for 2<sup>nd</sup> Intensive Training (2)**

Agency	Comments
RTC 2	<ul style="list-style-type: none"> <li>Would like to have RTC-C data and application for further practice.</li> </ul>
RTC 3	<ul style="list-style-type: none"> <li>More training would help improve skills.</li> <li>Would like to know how to analyze when much dust is on the pavement.</li> <li>Would like to know how to analyze cracks in the wet section.</li> </ul>
RTC 4	<ul style="list-style-type: none"> <li>Understood the procedure for how to create PC data with safe method and save human resources for field work.</li> <li>Vehicle operation should be included.</li> </ul>

The below table shows some of the main comments from the participants of the Intensive Training of PMS System Administration: Intensive Training (3).

**Table A8.2.30 Comments for 3<sup>rd</sup> Intensive Training (3)**

Agency	Comments
DRVN's Departments (STE-ICD, DPI, RMMD)	<ul style="list-style-type: none"> <li>The training provided in-depth knowledge about the PMS administration system for relevant departments of DRVN.</li> <li>DRVN will continue to operate the software and the systems; and contact with the JICA Project Team if any errors occur.</li> <li>JICA Project Team will improve some minor issues detected and reported by DRVN during operation. For example: 1) Improving the "filter" function in the table; 2) Unifying the codes for maintenance measures to conform with the classification of repair; 3) The list of maintenance measures need to be displayed in colors when setting up repair matrix for better understanding.</li> <li>The observation of data transfer into the server computer requested by trainees was implemented during the training.</li> </ul>

### A8.3.6 3<sup>rd</sup> Training in Japan

The below table shows some of the main comments from the participants of the 3<sup>rd</sup> Training in Japan.

**Table A8.2.31 Comments for 3<sup>rd</sup> Training in Japan**

Item	Comments
Subjects that were specifically useful	<ul style="list-style-type: none"> <li>• “Road Inspection and Road Maintenance/Management in Japan”: Those can be applied to Vietnam.</li> <li>• “Road Maintenance System”: It can be applied to Vietnam.</li> <li>• “Road Surface Maintenance Technology”: Such new technology can be introduced to Vietnam</li> <li>• “Asset Management and PMS”: Asset management would be rational by putting priority</li> <li>• “Road Surface Maintenance Technology and it’s material”: It can be applied to Vietnam.</li> <li>• “Road Maintenance Institute”: It can lead to improve capacity of road maintenance and management as well as to manage and maintain the road properly.</li> </ul>
Subjects that were not covered but should have been included	<ul style="list-style-type: none"> <li>• “Construction restriction area along the road”: Useful for responsible work.</li> </ul>
Objective achievement	<ul style="list-style-type: none"> <li>• Out of 9, 6 participants consider that it has been fully achieved while 3 do so as achieved.</li> </ul>
Possibility to utilize knowledge/skills gained in Japan	<ul style="list-style-type: none"> <li>• Out of 9, 4 consider” those can be directly applied to work”, another 4 consider “those cannot be directly applied, however, can be adaptable to work”, while 1 thinks those can be of individual reference.</li> </ul>
Main findings and learnings which can contribute to tackle the issues in Vietnam	<ul style="list-style-type: none"> <li>• Pavement repair material and waterproof decking material: Introduced to the work in Vietnam.</li> <li>• Road maintenance and management system: Clear work demarcation is useful in Vietnam.</li> <li>• Maintenance plan and concept of preventive maintenance: Improvement for data accumulation/ analysis and maintenance plan.</li> </ul>
Suggestions	<ul style="list-style-type: none"> <li>• More video clips during lectures.</li> <li>• More discussions and site visits.</li> </ul>

## **A8.4 BASELINE SURVEY ON PUBLIC RELATIONS**

### **A8.4.1 Law and Regulations**

Following regulations applied to the public relations in Viet Nam.

- The provisions of the Press Law
- The provisions of the License published by the Ministry of Information and Communication

### **A8.4.2 Press Agencies of MOT and DRVN**

The MOT has nine press agencies, which are two newspapers<sup>24</sup> and seven magazines<sup>25</sup>.

MOT is currently rearranging all paper-based press agencies to unify into one press agency under MOT Decision<sup>26</sup> to improve the effectiveness of the management and development of the press system according to the guidelines of the Central Party Committee and the Government. Thus paper-based magazines ceased from 1st April 2015 for the rearrangement. The direct responsible agencies like DRVN in collaboration with the MOT press agencies are to transfer personnel including the editors and reporters of these magazines into the MOT's Transport Newspaper. The rest will be arranged by the responsible agency.

### **A8.4.3 Responsible agency of PR under DRVN**

Under the DRVN, Viet Nam Road Magazine, which is non-business unit, is responsible for the public relations and performs the tasks of the professional press, publicize, and disseminate information in the field of the road transport under the framework of the DRVN. DRVN main departments develop contents of the PR activities and contract out to the Road Magazine for the implementation as stipulated in the DRVN Decision No.1946/QĐ-CĐBVN<sup>27</sup> and DRVN Decision No.1218/QĐ-DRVN<sup>28</sup>. Some of the main roles and responsibilities assigned to the Road Magazine are shown below.

- To perform propaganda and dissemination of the policies of the Party and State's laws on the road transport; introduce achievements and results of scientific research, solutions, technologies and advanced models in the field of road transport;
- To organize the investigations, field surveys; detect timely society issues concerned and commend the advanced models in the field of road transport;
- To build contents of the DRVN's website

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<sup>24</sup> Transport newspaper under the MOT and railways newspapers under Viet Nam Railways Corporation

<sup>25</sup> Transport Magazine under the MOT, the Viet Nam Maritime Magazine under Viet Nam Maritime Administration, Viet Nam Aviation Magazine under Civil Aviation Administration of Viet Nam, and Viet Nam Road Magazine under DRVN, Inland Waterway Magazine under Inland Waterway Administration, Vehicle Register Magazine under Viet Nam Register Administration, Shipbuilding Industry magazine under Vinashin.

<sup>26</sup> MOT Decision, No.1010/QĐ-BGTVT issued by MOT dated 26/03/2015 on approving the plan to arrange newspapers and magazines under MOT

<sup>27</sup> DRVN Decision No.1946/QĐ-CĐBVN on stipulating the establishment of Viet Nam Road Magazine dated 10/09/2008

<sup>28</sup> DRVN Decision No.1218/QĐ-DRVN on stipulating the functions, duties, authority of Viet Nam Road Magazine dated July 26th 2012.

#### **A8.4.4 Current PR activities**

DRVN currently mainly conducts the following PR activities.

##### **A8.4.4.1. Press release**

- DRVN has appointed the Road Magazine to contact newspaper companies to publicize articles on DRVN on urgent announcement relating to the road sector to paper-based and digital-based transport newspapers/magazines of the MOT;
- DRVN releases information such as administrative update, result of analysis and update to DRVN's website;
- RMBs also release urgent announcement, route under traffic control, progress of construction

##### **A8.4.4.2. Articles**

Officials of the DRVN and the RMBs provide the articles on the scientific research and projects they involved to the professional magazines.

##### **A8.4.4.3. Viet Nam Road Magazine and Viet Nam Digital Road Magazine**

Road Magazine publishes the paper based magazine for 1200 copies/ monthly for 35,000 VND per copy. Currently, the Road Magazine runs only the digital magazine. For the details, refer to <http://duongbo.vn/>.

##### **A8.4.4.4. Brochures**

Brochures on the traffic safety, vehicle overload, technical norm, have been published by the Road Magazine.

##### **A8.4.4.5. Video Clip on Flooding, Road Maintenance, Transport Safety, etc.**

Road maintenance DVD was prepared by the Road Magazine in 2013 under the commission of the DRVN. It compiled information of JICA and WB projects aiming for the staff under the transport sector to understand the importance of the road maintenance.

##### **A8.4.4.6. DRVN Website**

DRVN also have its own website. For the details, refer to (<http://drvn.gov.vn>).

##### **A8.4.4.7. Interactive Feedback System on Traffic Safety**

DRVN has set up the Interactive Feedback System on the traffic safety.

#### **A8.4.5 Resources**

The Road Magazine has five staff and officials under the Unit. The video camera man, voice recording and others need to be outsourced.

#### **A8.4.6 PR Budget**

DRVN does not have budget for the PR and that of the Road Magazine comes from the DRVN commission.

#### **A8.4.7 Public Relations on Road Maintenance**

When the Road Maintenance Funds was launched, the DRVN conducted two-year extensive PR activity targeting wider stakeholders to get their understandings.

DRVN sees the necessity of enhancing public awareness on the road maintenance activities, its benefits, and effects to public through the PR.

#### **A8.5 ANNUAL REPORT**

Since November 2017, the DRVN has published the Annual Report covering the road operation, road maintenance policies, and so forth.

DRVN will be issuing such report once every 2 years.