Lao Peoples Democratic Republic （Lao PDR）

THE PROJECT FOR IMPROVEMENT OF ROAD MANAGEMENT CAPABILITY IN LAO PDR

FINAL REPORT

May 2018

Japan International Cooperation Agency（JICA）

International Development Center of Japan Inc.
Oriental Consultants Global Co., Ltd.

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Abbreviation

AASHTO:	American Association of State Highway and Transportation Officials
AC:	Asphalt Concrete
ADB:	Asian Development Bank
BOQ:	Bill of Quantity
BOT:	Build-Operation-Transfer
CaRoL:	Capacity enhancement of Road management in Laos (nickname of the project)
CCTV:	Closed-Circuit Television
CFA:	Cement Foamed Asphalt
CO2:	Carbon Dioxide
C/P:	Counterpart
DBST:	Double Bituminous Surface Treatment
DDG:	Deputy Director General
DFID:	Department for International Development, UK
DG:	Director General
DOH:	Department of Highway, Thailand
DOP:	Department of Personnel, MPWT, Lao PDR
DOR:	Department of Roads
DOT:	Department of Transport, MPWT, Lao PDR
DPC:	Department of Planning and Cooperation, MPWT, Lao PDR
DPWT:	Department of Public Works and Transport
DRIMS:	Dynamic Response Intelligent Monitoring System
GIS:	Geographic Information System
GOL:	Government of Laos
GPS:	Global Positioning System
GPX:	GPS Exchange Format
H.Q.:	Head Quarter
ICT:	Information and Communication Technology
IDCJ:	International Development Center of Japan Inc.
IRAMS:	Integrated Road Asset Management System
IRI:	International Roughness Index
JCC:	Joint Coordinating Committee
JICA:	Japan International Cooperation Agency
JIS:	Japanese Industrial Standards
KfW:	Kreditanstalt für Wiederaufbau
LRD:	Local Road Division, DOR, MPWT, Lao PDR
LTEC:	Lao Transport Engineering Consult
MAC:	Maintenance Activity Code
MCA:	Multi Criteria Analysis
MLIT:	Ministry of Land, Infrastructure, Transport and Tourism, Japan
MOF:	Ministry of Finance
MPI:	Ministry of Planning and Investment
MPWT:	Ministry of Public Works and Transport

NEXCO:	Central Nippon Expressway Limited
NKC:	Noukham Construction Co., Ltd.
NR:	National Road
OCG:	Oriental Consultants Global Co., Ltd.
OJT:	On the Job Training
OPWT:	Office of Public Works and Transport
OS:	Operating Software
PBC:	Performance Based Contract
PC:	Personal Computer
PCU:	Power Control Unit
PDM:	Project Design Matrix
PIARC:	Permanent International Association of Road. Congress
PMO:	Prime Minister's Office, Lao PDR
PO:	Plan of Operation
PPP:	Public–Private Partnership
PRoMMS:	Provincial Road Maintenance Management System
PTRI:	Public Works and Transport Research Institute
PTTI:	Public Works and Transport Training Institute
PWRI:	Public Works Research Institute, Japan
QGIS	Quantum Geographic Information System
RAD:	Road Administration Division, DOR, MPWT, Lao PDR
RD:	Record of Discussion
RMF:	Road Maintenance Fund
RMS:	Road Management System
SEACAP:	South East Asia Community Access Program
SDMT	Survey Design and Material Testing
SIDA:	Swedish International Development Cooperation Agency
SWG:	Sub-working Group
TED:	Technique and Environment Division, DOR, MPWT, Lao PDR
TOT:	Transfer-Operate-Transfer
TWG:	Technical Working Group
USD:	United State Dollar
VIMS:	Vehicle Intelligent Monitoring System
VOC:	Vehicle Operating Cost
WB:	World Bank
WBS:	Work Breakdown Structure
WIM:	Weigh In Motion
WKK:	World Kaihatsu Kogyo Co., Ltd.

CHAPTER 1. INTRODUCTION

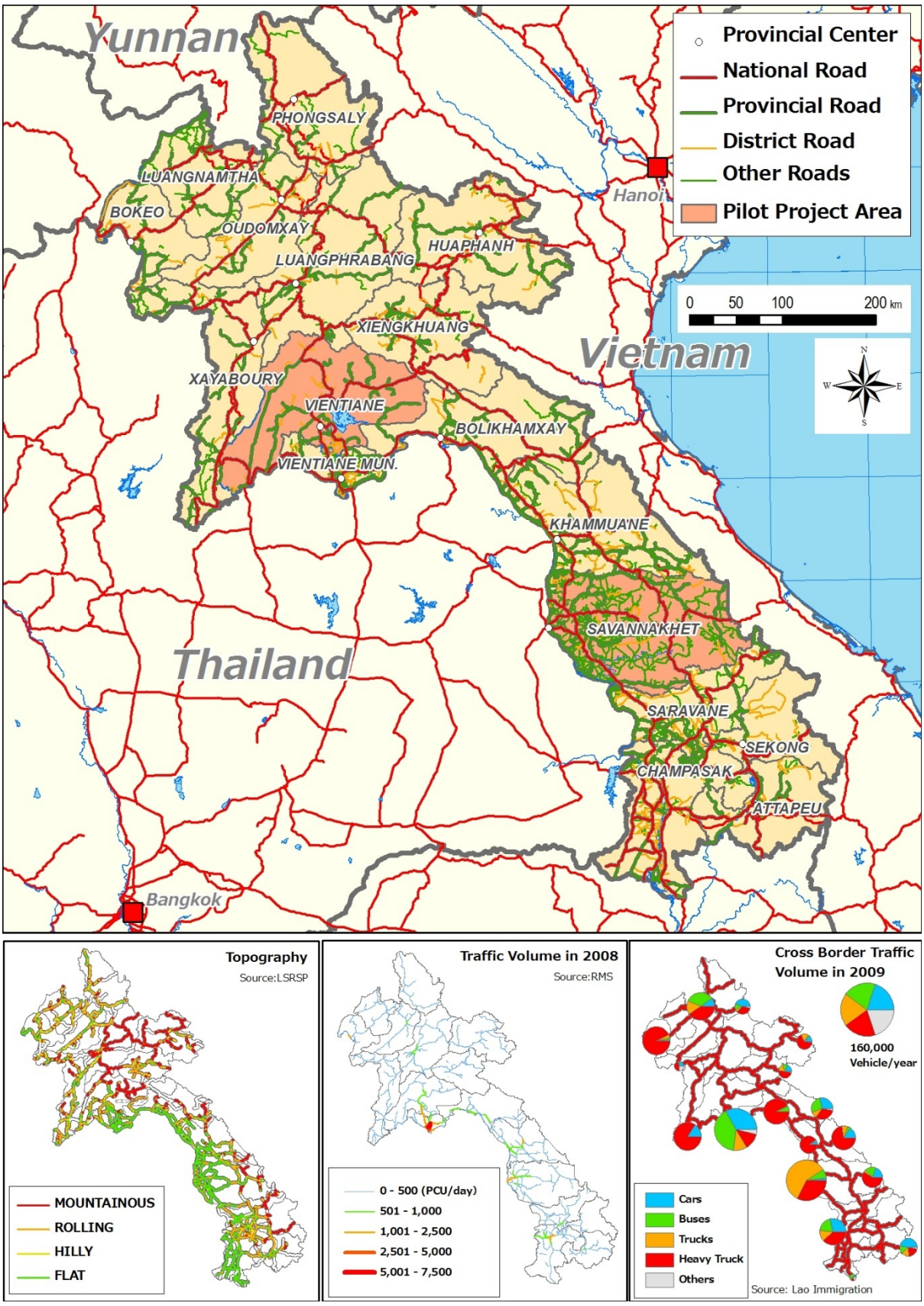
1.1 Outline of the Project

1.1.1 Background of the Project

Lao PDR is a land-locked country and its transport infrastructure and system heavily rely on road transport to carry both goods and passengers to/from neighboring countries. The road transport in Laos is reported to carry 80% of total domestic cargos and 85% of total passengers transported in entire Laos. The Lao Government heavily channels its investment to development of national trunk roads, and, accordingly, 70% of 7,200 km national roads have already been paved.

Due to financial constraints, the Lao Government has been encouraged to pave the national roads by Double Bituminous Surface Treatment (DBST) for the last decades (Accordingly, 90% of the paved national roads are paved by DBST). Having said so, the national roads are being paved by Asphalt Concrete (AC) under the bilateral and multilateral donors' projects, including that at NR-3, NR-4 and NR-9. Pavement of the national roads is being deteriorated and quite a number of potholes and cracks are observed, due to a lack of local planning/ technical/financial capability in road management and maintenance. And which contributes to hindering provision of safe and reliable transport system and hence development of regional economic activities.

In the last decade, the World Bank (WB), together with other multi-lateral and bilateral donors, has been making great efforts for capacity development of the road maintenance and management in Laos, through provision of technical and financial supports. In 2010, the WB completed Road Maintenance Program Phase-II and channels its supports to wider sector approach project, entitled Lao Road Sector Project and less supports will be made towards road maintenance per se. Under the recognition that road maintenance in Laos still requires continuous supports, the Lao Government officially requested Japanese Government for a technical cooperation program, entitled, the Project for Improvement of Road Management Capability, to develop planning and technical capability of road maintenance works in Laos.



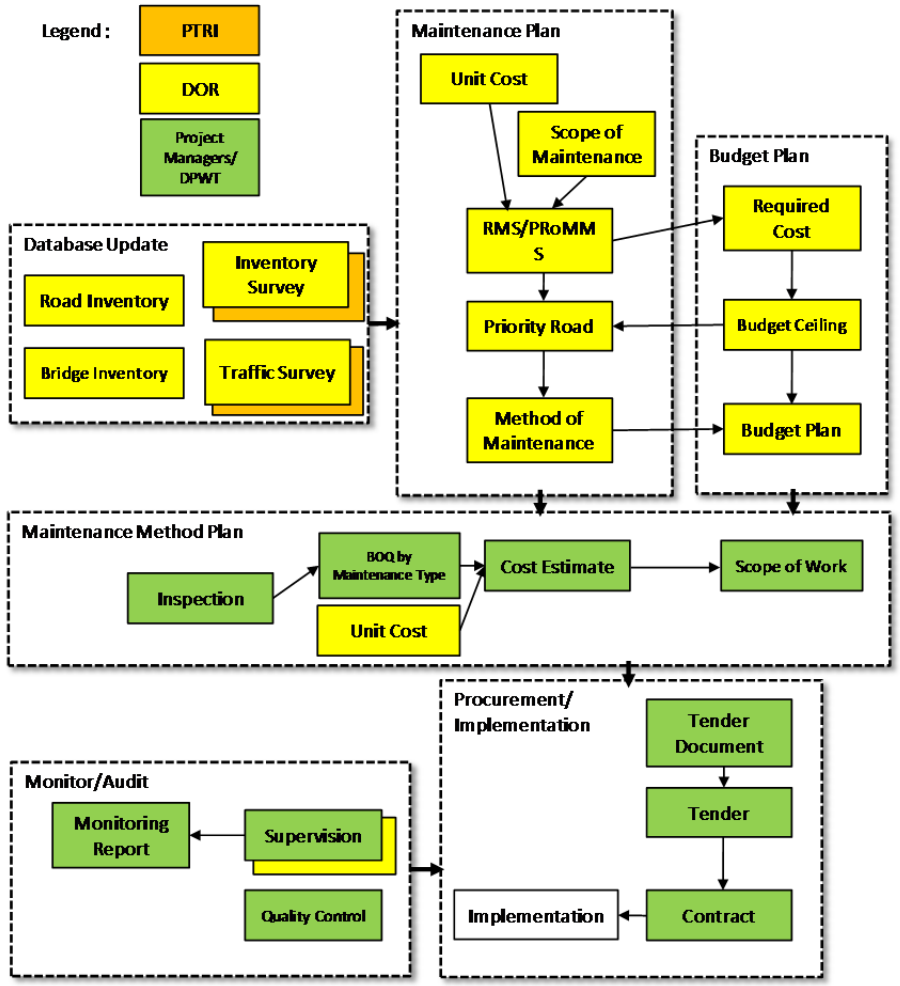
Source: JICA Expert Team

Figure 1.1.1 Location Map

1.1.2 Objectives of the Project

As discussed above, WB, together with other donors, has been supporting to develop individual/ financial/ institutional capability of road maintenance in Laos due to the limited budget for road maintenance and fragile institutional framework, however, there still need further supports to realize effective and efficient road maintenance system solely by local authority. To do so, i) improved management of road maintenance system and database, ii) sound planning for both road maintenance and budget, iii) effective implementation of road maintenance cycle (inspection, evaluation, implementation), and iv) appropriate procurement and auditing system to manage performance-based contract and sub-let rehabilitation works, all need to be improved and coordinated each other.

Accordingly, the overall approach, the Project accomplishes, is that self-reliant road maintenance cycle in Laos will be developed through providing technical and administrative supports in the course of the Project.



Source: JICA Expert Team

Figure 1.1.2 Road Maintenance Cycle in Laos

The overall goal and project purpose, described in the Project Design Matrix (PDM),

agreed in the Record of Discussion for the Project in July 2011 is that roads and bridges in Laos (in the pilot provinces) will be properly maintained. To accomplish this project goal and purpose, the Project is expected to deliver the following outputs: (i) maintenance planning ability for road and bridge maintenance is enhanced, (ii) technical manuals for road/bridge maintenance are prepared, (iii) capability of physical road/bridge maintenance work in the pilot provinces is enhanced, and (iv) capacity of over-loading control is enhanced.

1.1.3 Project Area

The project area is limited to two pilot provinces; Savannakhet and Vientiane Provinces, agreed in the Record of Discussion for the Project.

1.2 Project Design Matrix

Prior to commencement of the Project, the Detailed Planning Survey was conducted in February 2011, to scope the Project. The Project Design Matrix (PDM) (PDM ver. 0), which demonstrates the goal, purpose, output and activities of the Project, has been discussed and agreed, involving key stakeholders of Ministry of Public Works and Transport (MPWT), during the Detailed Planning Survey for the Project.

In the initial stage of the Project, existing situation survey and training needs survey were conducted by means of interviewing to the concerned agencies, including Department of Road (DOR), Public Works and Transport Research Institute (PTRI) and Department of Public Works and Transport (DPWT). The result of these surveys suggested key project outputs proposed to remain same, focusing the following three areas; (i) improvement and updates of RMS/PRoMMS and development of a road maintenance plan, (ii) development of technical manuals and (iii) conducting on-the-job training through routine maintenance works and rehabilitation works. Project activities were also reviewed and revised, by adopting project cycle approach, incorporating survey of baseline monitoring indicators and monitor and evaluation of these indicators as part of project activities. Based on the condition and training surveys, PDM was revised from PDM ver.0 to PDM ver.1 with numerical monitoring indexes.

On 20th Jan, 2012, the 1st Joint Coordinating Committee (JCC) meeting was held to discuss the PDM and the members of the JCC agreed with amendment of the PDM ver. 1. The amended PDM ver.1 shows as follows.

Table 1.2.1 PDM Ver.1 amended by 1st JCC Meeting

PDM ver 1
Overall Goal Roads and bridges in Laos will be properly maintained.
Project Purpose Roads and bridges in the pilot provinces will be properly maintained.
Output 1. Maintenance planning ability for road and bridge maintenance is enhanced. 2. Technical manuals for road/bridge maintenance are prepared. 3. Capability of physical road/bridge maintenance work in the pilot provinces is enhanced.
Activities

1-1.Review current situation and obtain baseline capabilities on maintenance planning works. 1-2.Improve data collection method/work for RMS/PRoMMS. 1-3.Improve and update RMS/PRoMMS and update database through the trial run in the pilot provinces. 1-4.Draft optimum road maintenance plan in the pilot provinces using RMS/PRoMMS. 1-5.Draft optimum road maintenance budget plan in the pilot provinces using RMS/PRoMMS. 1-6.Conduct on-the-job training for maintenance budget plan and database upgrade of RMS/PRoMMS. 1-7.Monitor progress of the activities and evaluate maintenance planning capabilities. 2-1. Review and revise existing technical manuals, including Condition Survey Manual, Inventory Manual and Slope Protection Manual. 2-2.Develop technical manuals, including Inspection, Evaluation and Repair Manuals. 2-3. Monitor utilization of technical manuals and evaluate their usage and relevance for its revision and finalization. 3-1. Review current situation and obtain baseline capabilities on physical maintenance works and formulate training plan and monitoring plan. 3-2. Conduct on-the-job training (OJT) to DPWT engineers in the pilot provinces on routine maintenance work, including inspection, small repair and quality control. 3-3. Evaluate OJT on routine maintenance work and improve training modules and training programs. 3-4. Develop an optimum institutional framework (e.g., informal task force, formal road maintenance unit) with charter of operations to conduct routine maintenance work. 3-5. Conduct a pilot project on repair work and improve capacities on supervision and quality control for rehabilitation of asphalt concrete pavement in Savannakhet Province. 3-6. Monitor progress of the activities and evaluate capabilities on physical maintenance works.

On 23rd Jan, 2015, the 6th JCC meeting was held to discuss the work plan in the 2nd Phase with the members. For taking account of the extended period of project, monitoring and evaluation indicators were discussed to be added in the PDM so as to check the progress and evaluate the performance of the Project. Therefore PDM was amended as PDM ver. 2, meantime the goal, output and activities were same as PDM ver.1.

On 17th September 2015, the 7th JCC was organized to discuss the PDM ver. 3 in order to add the activities related to overloading vehicle control in order to maintain improved condition of NR-9, which is vital for Laos in order for further development of East-West Economic Corridor. The members of JCC basically agreed with the amendment of the PDM. Accordingly, the Expert Team prepared PDM ver. 3, with additional activities and inputs as following table.

Table 1.2.2 PDM Ver.3 amended by 7th JCC Meeting

PDM ver. 3
Overall Goal Roads and bridges in Laos are properly maintained.
Project Purpose Roads and bridges in the pilot provinces are properly maintained.
Output 1. Maintenance planning ability for road and bridge maintenance is enhanced. 2. Technical manuals for road/bridge maintenance are prepared. 3. Capability of DOR/DPWT officers who are responsible for physical road/bridge maintenance work in the pilot provinces is enhanced. 4. Capacity of DOT/DPWT officers for over-loading control in the pilot province(s) is enhanced.
Activities 1-1. Review current situation and obtain baseline capabilities on maintenance planning works. 1-2. Improve data collection method/work for RMS/PRoMMS. 1-3. Improve and update RMS/PRoMMS and update database through the trial run in the pilot provinces. 1-4. Draft optimum road maintenance plan in the pilot provinces using RMS/PRoMMS. 1-5. Draft optimum road maintenance budget plan in the pilot provinces using RMS/PRoMMS. 1-6. Conduct on-the-job training for maintenance budget plan and database upgrade of RMS/PRoMMS. 1-7. Monitor progress of the activities and evaluate maintenance planning capabilities. 2-1. Review and revise existing technical manuals, including Condition Survey Manual, Inventory Manual and Slope Protection Manual. 2-2.Develop technical manuals, including Inspection, Evaluation and Repair Manuals. 2-3. Monitor utilization of technical manuals and evaluate their usage and relevance for its revision and finalization. 3-1. Review current situation and obtain baseline capabilities on physical maintenance works and formulate training plan and monitoring plan. 3-2. Conduct on-the-job training (OJT) to selected DOR/DPWT officers in the pilot provinces on maintenance work, including inspection, small repair and quality control. 3-3. Evaluate OJT on maintenance works and improves training modules and training programs. 3-4. Develop an optimum institutional framework (e.g., informal task force, formal road maintenance unit) with charter of operations to conduct maintenance work. 3-5. Conduct a pilot project on repair work and improve capacities on supervision and quality control for rehabilitation of asphalt concrete pavement in Savannakhet Province. 3-6. Monitor progress of the activities and evaluate capabilities on physical maintenance works. 4-1. Review current institutional framework for overloading control and suggest approaches to address institutional issues to develop sustainable overloading control. 4-2. Design, procure and install weigh bridges at one location along National Road No.9. 4-3. Develop operational manual(s) and conduct on-the-job training (OJT) for overloading control in the pilot province. 4-4. Develop regular check – reporting system and legal framework for strict enforcement on overloading control in the pilot province. 4-5. Disseminate the activities (4.1 to 4.4) to private trucking companies/forwarders/major shippers. 4-6. Assess progress of the activities and evaluate institutional capabilities for overloading control.

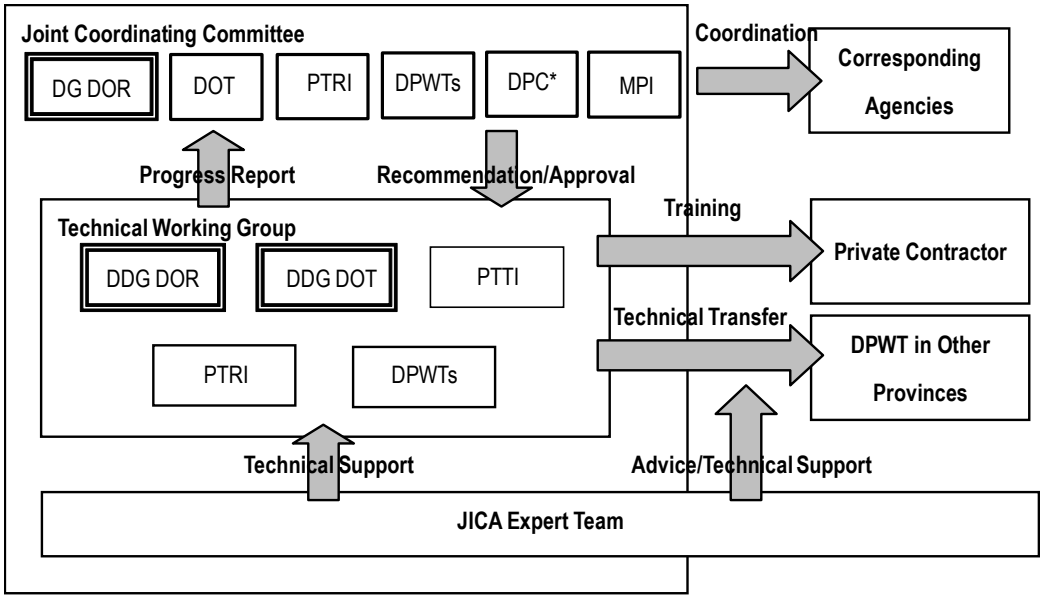
1.3 Project Period

As indicated in the Record of Discussion (RD) agreed in July 2011, the duration of the Project is 5 years from September 2011 until September 2016 originally. As explained in above section, the activities for over-loading control were added for improving road management and maintenance capability. Hence the project period was extended until May 2018. Correspondingly the RD and PDM were amended in November 2015.

1.4 Project Implementation Structure and JICA Expert Team

1.4.1 Project Implementation Structure

Soon after commencement of the Project, two groups were established: JCC and Technical Working Group (TWG). The JCC monitors the progress of the Project and provides recommendations, and sometimes, approvals, to the TWG, an implementing body in this Project. The JCC is composed of 6 members from Lao side, including Director General (DG) of the DOR, and the representative from the DOT, PTRI and DPWT as well as the Department of Planning and Cooperation (DPC) and Ministry of Planning and Investment (MPI), plus the Embassy of Japan and JICA from Japanese side. The TWG consists of 5 members, including Deputy Director General (DDG) of the DOR and DOT, and counterparts from DOR, DOT, PTRI, DPWTs in Vientiane and Savannakhet Provinces and Public Works and Transport Training Institute (PTTI). JICA Expert Team provides administrative and technical supports, mainly to the TWG members, during the course of the Project.



Source: JICA Expert Team

Figure 1.4.1 Project Implementation Structure

The main duties of counterparts (C/P) relevant to the project were explained in following table.

Table 1.4.1 Main Duties of C/P related to the Project

C/P	Main Duties
DOR	Update of National Road Database Operation of Road Maintenance System Road Improvement, Maintenance Plan and Budget Plan for National Roads National Road Improvement, Supervision of Repair Works and Monitoring
PTRI	Management of Road Maintenance System
DPWT	Update of Local Road Database Road Improvement, Maintenance Plan and Budget Plan for Local Roads Local Road Improvement, Supervision of Repair Works and Monitoring Routine Maintenance of National and Local Road and Monitoring
DOT	Over-loading Control
PTTI	Planning and Implement of Trainings

Source: JICA Expert Team

1.4.2 JICA Expert Team

The Expert Team consists of 13 experts in Phase 1 and 14 experts in Phase 2 from the International Development Center of Japan (IDCJ) and Oriental Consultants Global (OCG) as shown in the following table.

Table 1.4.2 Members of JICA Expert Team

Assignment	Name	Affiliation
Phase 1		
Team Leader/Road Management Expert	Kiminari Takahashi	IDCJ
Deputy Team Leader/Construction Management Expert	Masataka Fujikuma	OCG
Road Maintenance Expert (1)	Hiroaki Kobayashi	OCG
Road Maintenance Expert (2)	Voitto Kuronen	OCG
Bridge Maintenance Expert	Phamavanh Kongkeo	OCG
Contract Management Expert	Hiroshi Ueda /Makoto Nozawa	OCG
System Management Expert (1)	Yoshiyuki Arita	IDCJ
System Management Expert (2)	Kayoko Miyao	IDCJ
Human Resource Development Expert/Project Coordinator	Mihoko Ogasawara	IDCJ
Road Disaster Management Expert	Iwao Yokokawa	OCG
Natural Condition Expert	Kazuo Hirayama	OCG
Road Planning Expert	Hiroyuki Morimoto	OCG
Road Design	Makoto Nozawa	OCG
Phase 2		
Team Leader/Road Management Expert	Kiminari Takahashi	IDCJ
Deputy Team Leader/Construction Management Expert	Masataka Fujikuma	OCG
Road Maintenance Expert (1)	Hiroaki Kobayashi	OCG
Road Maintenance Expert (2)	Hiroshi Ueda	OCG
Bridge Maintenance Expert	Dr. Phamavanh Kongkeo	OCG
Contract Management Expert (1)	Makoto Nozawa	OCG
Contract Management Expert (2)	Vitto Kuronen	OCG

Assignment	Name	Affiliation
System Management Expert (3)	Olivier de Peyrelongue	IDCJ
System Management Expert (4)	Dr. Takafumi Nishikawa	IDCJ
Human Resource Development Expert/ Project Coordinator (1)	Mihoko Ogasawara	IDCJ
Human Resource Development Expert/ Project Coordinator (2)	Kayoko Miyao	IDCJ
Road Design/Cost Estimation Specialist	Lee Hong Gyu	OCG
Construction Supervision Specialist	Yuji Iwatsuki	OCG
Procurement Specialist	Hiroaki Kobayashi	OCG

The assignment schedule for each expert is shown in the following figures. A total of 105.7 person months, both in Laos and in Japan, was an input into the Project Phase 1 between September 2011 and October 2014 and a total of 73.9 person months in Phase 2 between December 2014 and May 2018.

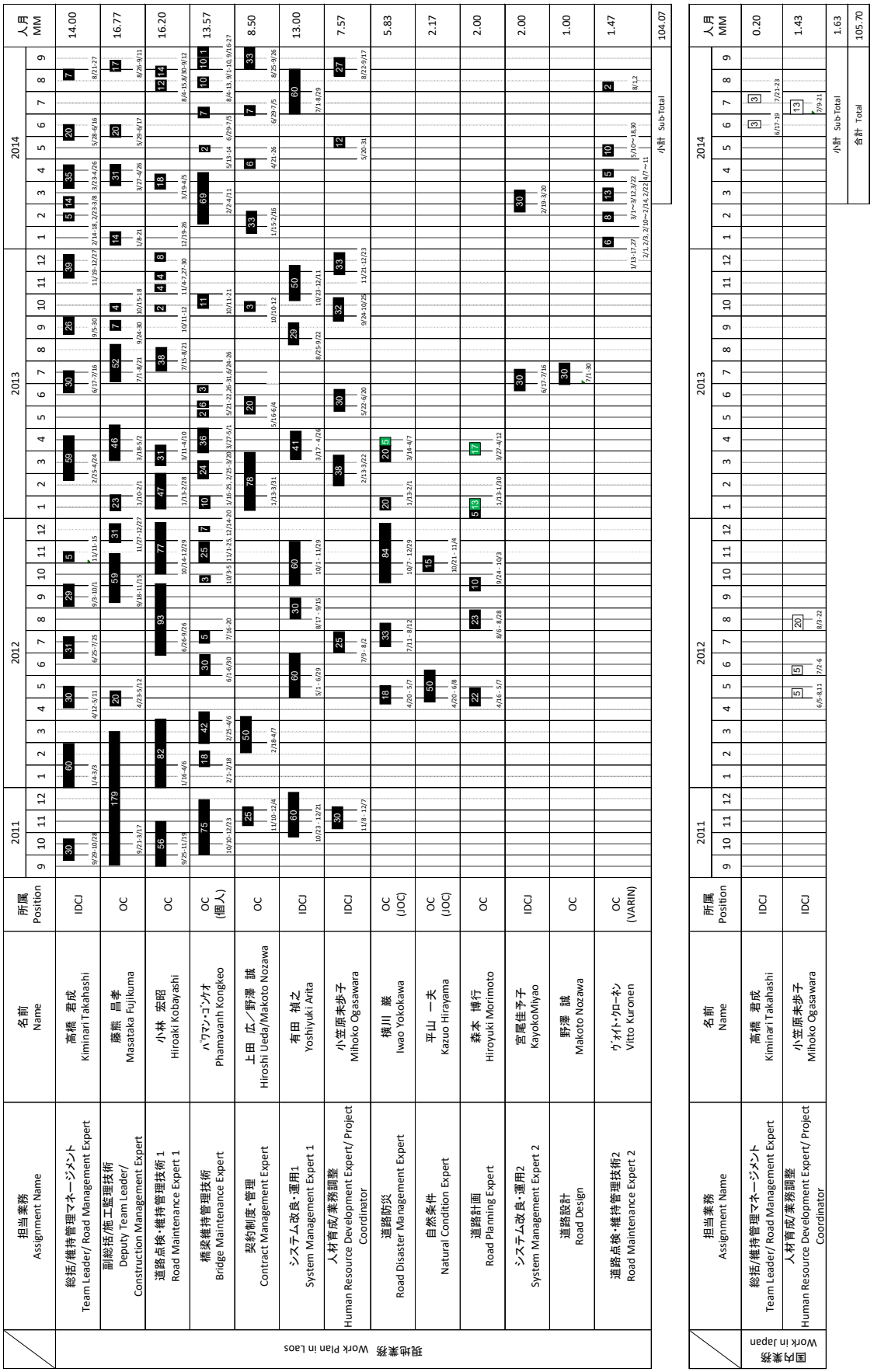


Figure 1.4.2 Assignment Schedule (Phase 1)

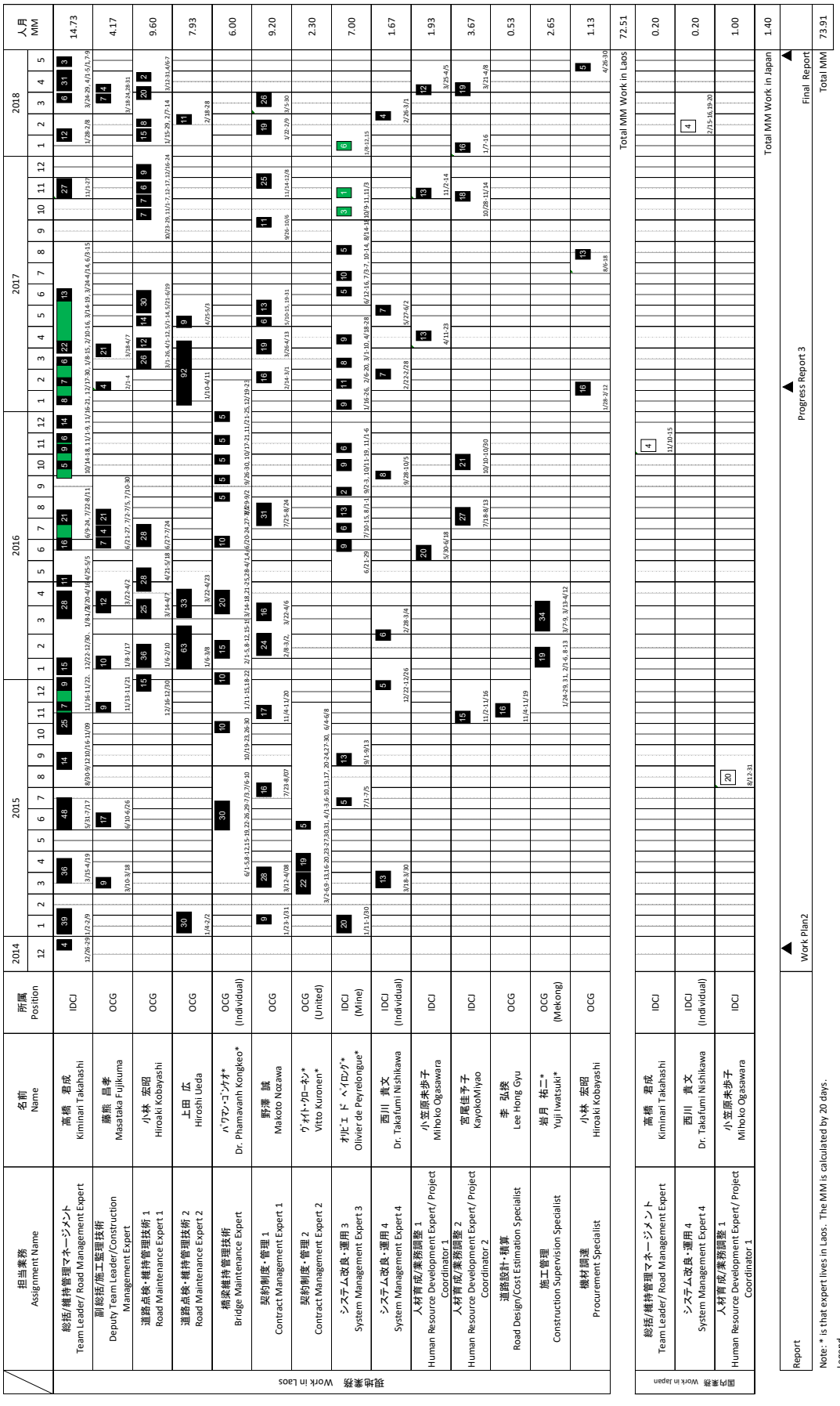


Figure 1.4.3 Assignment Schedule (Phase 2)

1.5 Project Implementation Schedule

The Plan of Operation (PO) is prepared, considering actual activities completed and their schedules.

Figure 1.5.1 Plan of Operation

CHAPTER 2. ACTIVITIES OF THE PROJECT

The major activities in the Project are described in the sections shown in following table.

Activities	2011	2012	2013	2014	2015	2016	2017	2018	Written Section
0. Discussion with the counterparts									**2.1**
1. Maintenance planning ability for road and bridge maintenance is enhanced.									**2.2**
1-1.Review current situation and obtain baseline capabilities on maintenance planning works.									2.2.1
1-2. Improve data collection method/work for RMS/PRoMMS.									2.2.2
1-3. Improve and update RMS/PRoMMS and update database through the trial run in the pilot provinces.									2.2.3
1-4. Draft optimum road maintenance plan in the pilot provinces using RMS/PRoMMS.									2.2.5
1-5. Draft optimum road maintenance budget plan in the pilot provinces using RMS/PRoMMS.									2.2.5
1-6. Conduct on-the-job training for maintenance budget plan and database upgrade of RMS/PRoMMS.									2.2.2
1-7. Monitor progress of the activities and evaluate maintenance planning capabilities.									2.2.6
2. Technical manuals for road/bridge maintenance are prepared.									**2.3**
2-1. Review and revise existing technical manuals, including Condition Survey Manual, Inventory Manual and Slope Protection Manual.									2.3.1
2-2.Develop technical manuals, including Inspection, Evaluation and Repair Manuals.									2.3.2
2-3. Monitor utilization of technical manuals and evaluate their usage and relevance for its revision and finalization.									2.3.3
3. 3. Capability of DOR/DPWT officers who are responsible for physical road/bridge maintenance work in the pilot provinces is enhanced									**2.4**
3-1. Review current situation and obtain baseline capabilities on physical maintenance works and formulate training plan and monitoring plan.									2.4.1
3-2. Conduct on-the-job training (OJT) to selected DOR/DPWT officers in the pilot provinces on maintenance work, including inspection, small repair and quality control.									2.4.2
3-3. Evaluate OJT on maintenance works and improves training modules and training programs.									2.4.3
3-4. Develop an optimum institutional framework (e.g., informal task force, formal road maintenance unit) with charter of operations to conduct maintenance work.									2.4.4
3-5. Conduct a pilot project on repair work and improve capacities on supervision and quality control for rehabilitation of asphalt concrete pavement in Savannakhet Province.									2.4.5 2.4.6
3-6. Monitor progress of the activities and evaluate capabilities on physical maintenance works.									2.6.2
4. Capacity of DOT/DPWT officers for over-loading control in the pilot province(s) is enhanced.									**2.5**
4-1. Review current institutional framework for overloading control and suggest approaches to address institutional issues to develop sustainable overloading control.									2.5.1
4-2. Design, procure and install weigh bridges at one location along National Road No.9.									2.5.1
4-3. Develop operational manual(s) and conduct on-the-job training (OJT) for overloading control in the pilot province.									2.5.2
4-4. Develop regular check – reporting system and legal framework for strict enforcement on overloading control in the pilot province.									2.5.3
4-5. Disseminate the activities (4.1 to 4.4) to private trucking companies/forwarders/major shippers.									2.5.4
4-6. Assess progress of the activities and evaluate institutional capabilities for overloading control.									2.6.2
5. Other Activities									**2.6**

2.1 Overall Project Progress

In order to involve a wide range of counterparts and confirm the project direction and approaches as well as seek for advices for project implementation, a series of meetings have been organized in appropriate timing where counterparts exchanged opinions on the plans and activities of the Project and shared them among concerned agencies. During the project period through Phase 1 and 2, nine-time JCC meetings and thirteen-time TWG meetings were organized as follows.

Table 2.1.1 Joint Coordinating Committee and Technical Working Group

Date	Meeting	Venue
Phase 1		
Jan. 20, 2012	1st Joint Coordinating Committee	DOR
Feb. 24, 2012	1st Technical Working Group	DOR
May 31, 2012	2nd Technical Working Group	DPWT Vientiane
Jul. 19, 2012	3rd Technical Working Group	DPWT Savannakhet
Sep. 10, 2012	4th Technical Working Group	PTRI
Oct. 25, 2012	5th Technical Working Group	PTRI
Nov. 13, 2012	2nd Joint Coordinating Committee	DOR
Mar. 27, 2013	6st Technical Working Group	DOR
Jul. 15, 2013	7th Technical Working Group	DOR
Sep. 26, 2013	3rd Joint Coordinating Committee	DOR
Feb. 28, 2014	8th Technical Working Group	DOR
Apr. 3, 2014	4th Joint Coordinating Committee	DOR
July. 16, 2014	9th Technical Working Group	DOR
Sep. 19, 2014	5th Joint Coordinating Committee	DOR
Phase 2		
Jan. 23, 2015	6th Joint Coordinating Committee	DOR
Apr. 21, 2015	10th Technical Working Group	DOR
Sep. 17, 2015	7th Joint Coordinating Committee	DOR
Dec. 25, 2015	11th Technical Working Group	DOR
Aug. 5, 2016	12th Technical Working Group	DOR
Mar. 17, 2017	13th Technical Working Group	DOR
Apr. 6, 2017	8th Joint Coordinating Committee	DOR
Apr. 30, 2018	9th Joint Coordinating Committee	DOR

A summary of each meeting is described in the following sections.

2.1.1 Joint Coordinating Committee (JCC)

(1) 1st Joint Coordinating Committee (JCC)

In the 1st JCC, the Expert Team achieved consensus with Lao counterparts on the Project implementation plan and revised PDM. Furthermore, Lao counterparts and the Expert Team shared the idea that establishment of the maintenance unit in the implementing agency is vital to accomplish road and bridge maintenance timely and appropriately. It was also agreed that continual discussion shall be necessary between the counterparts and Expert Team in order to formulate a framework including human resource and

equipment, a practical action plan for establishment of the unit and allocation of adequate budgets.

Summary of 1st JCC

Date: From 9.00 a.m. to 11.00 a.m. on 20th of January, 2012

Venue: Meeting room of DOR

Attendants: 17 person from DOR, PTRI, DPWT Vientiane and Savannakhet Provinces, DPC, MPI, and JICA Laos Office

Agenda: 1) Discussion on Kick-off meeting
2) Work plan including PDM
3) Progress of the Project

(2) 2nd Joint Coordinating Committee (JCC)

In the 2nd JCC, On-the-Job Training (OJT) implementation plan was mainly explained and discussed. The following points were raised in the discussion: 1) selection of the project site, 2) the cost for spot improvement works at NR-9, 3) the budget borne by the Road Maintenance Fund (RMF), 4) amendment of the contract between the local constructor and DPWT Savannakhet, and 5) technical transfer of maintenance for AC roads.

Besides, rolling out of the Project and improvement of maintenance capacity to nationwide were also discussed. PTTI was appointed as a focal point of training institution and part of counterpart agencies which supposes to roll out the project approaches by means of preparation of the manuals, providing workshops as well as training programs prepared under the Project.

Summary of 2nd JCC

Date: From 9.00 a.m. to 11.30 a.m. on 13th of November, 2012

Venue: Meeting room of DOR

Attendants: 20 persons from PTRI, DOR, DPWT Vientiane and Savannakhet Provinces, PTTI, JICA Laos Office, JICA Experts (MPWT)

Agenda: 1) Discussion on Kick-off meeting
2) Work plan including PDM
3) Progress of the Project

(3) 3rd Joint Coordinating Committee (JCC)

In the 3rd JCC, rehabilitation of the remaining sections of NR-9 was discussed and confirmed to be implemented as part of Pilot Project, and the current condition and rehabilitation concept design of these sections were explained and discussed. In order to avoid duplication works on NR-9, it was agreed that further discussion on Pilot Project would be continued between Laos counterparts and the Expert Team.

On the subject of controlling overloading vehicles, three weight control stations along NR-9 were reported to be planned to reopen. Also, MPWT already proposed to obtain supports from three relevant ministries including Ministry of Agriculture and Forestry, Ministry of Industry and Commerce and Ministry of National Defense for reinstallation of

the weight stations. The progress of reinstallation of weight stations shall be shared among JCC members.

It was also agreed that the PDM does not require any revision even the Regional Office be newly established and be responsible for the maintenance works for all national roads. The project activities, counterparts and pilot provinces shall not be affected by establishment of the Regional Offices.

Summary of 3rd JCC

Date: From 9.00 a.m. to 12.00 p.m. on 26th of September, 2013

Venue: Meeting room of DOR

Attendants: 20 persons from PTRI, DOR, DPWT Vientiane and Savannakhet Provinces, PTTI, JICA Laos Office, Japanese Embassy, and JICA Experts (MPWT)

Agenda: 1) Review of previous meetings including JCCs and TWGs
2) Progress of the Project

(4) 4th Joint Coordinating Committee (JCC)

In the 4th JCC, the approach to control overloaded vehicles was discussed based upon the current situation of control system in Savannakhet Province. In this discussion, the Department of Transport (DOT), as an organization in charge to control overloaded vehicles, was proposed to be invited in the JCC in order to reduce the damage on national roads efficiently.

It was suggested that a long-term investment plan for road maintenance needs to be prepared since a shortage of road maintenance budget becomes a central issue for DOR and financing and budgeting road maintenance needs to be well planned. Funding mechanisms for sustainable maintenance were discussed and suggested such as increasing fuel levy, introducing Public–Private Partnership (PPP) and Pay Road System on international corridors.

It was also suggested that in preparation for Phase-2 Project, the schedule of the Project, revision of PDM and Pilot Project in Vientiane Province would continue to be discussed in JCC and TWG.

Summary of 4th JCC

Date: From 9.15 a.m. to 12.00 p.m. on 3rd of April, 2014

Venue: Meeting room of DOR

Attendants: 24 persons from PTRI, DOR, DPWT Vientiane and Savannakhet Provinces, PTTI, JICA H.Q., JICA Laos Office, and JICA Experts (MPWT)

Agenda: 1) Review of previous meetings including JCCs and TWGs
2) Progress of the Project
3) Review and recommendation of Intermediate Evaluation

(5) 5th Joint Coordinating Committee (JCC)

In the 5th JCC, countermeasures against overloaded vehicles were discussed as following points; 1) DPWTs confirmed to reopen operation of the weigh stations along the national roads in Sam Sang Workshop, 2) private sectors should be involved into the measures such as major trucking companies and operators, and 3) DOT should revise the law/regulations to control overloading trucks due to lack of proper legal framework to control overloaded trucks.

With regards to the activities in Phase 2, implementation of Pilot Projects in Vientiane Province was suggested since the certain gap of technical capacity between DPWT Vientiane and Savannakhet Provinces was identified. Furthermore NR-13 North, which is managed by DPWT Vientiane Province, required for urgent rehabilitation works because of increasing traffic volume and deterioration of the pavement. The meeting concluded PDM Version 2.0 needed to be revised in the 1st JCC in Phase 2.

Summary of 5th JCC

Date: From 9.00 a.m. to 11.30 p.m. on 19th of September, 2014

Venue: Meeting room of DOR

Attendants: 17 persons from PTRI, DOR, DPWT Vientiane and Savannakhet Provinces, PTTI, JICA Laos Office, and JICA Experts (MPWT)

Agenda: 1) Handover of Technical Manuals Version-01
2) Summary progress of each project activity
3) Overall achievement of the Phase 1 project
4) Lessons leant from the Phase 1 project and recommendations

(6) 6th Joint Coordinating Committee (JCC)

In the 6th JCC, the following issues were raised in the meeting and suggested to be addressed during the course of the Phase 2 Project; 1) system and operation capacity improvement including the training for GIS and HDM-4, 2) monitoring and feedback of technical manual version-1, 3) pilot projects and OJT in the pilot provinces.

With respond to the activities in Phase 2, the members of JCC discussed and confirmed that the Project Deign Matrix (PDM) ver. 2 of which the monitoring indictors were amended, following the comments made by the Mid-term Review Mission, is relevant to monitor and evaluate the progress of the Project. The PDM ver. 2 accordingly was accepted by the members of JCC.

Summary of 6th JCC

Date: From 9.00 a.m. to 11.30 a.m. on 23rd of January, 2015

Venue: Meeting room of DOR

Attendants: 18 persons from PTRI, DOR, DPWT Vientiane and Savannakhet Provinces, PTTI, JICA Laos Office, and JICA Experts (MPWT)

Agenda: 1) Project background
2) Issues arising and actions taken

3) Revisit of Phase 1 Project
4) Project outline – Draft Project Design Matrix
5) Project implementation plan

(7) 7th Joint Coordinating Committee (JCC)

In the 7th JCC, major progress of activities was discussed including system improvement, pilot PBC by using the revised specifications, and OJT and Pilot Project on NR-9 and NR-13.

In respond to the request from Laos side, additional activities related to overloaded vehicle control were discussed among JCC members. Both Laos side and JICA agreed to revise PDM and R/D in order to add Output 4 “Capacity of DOT/DPWT officers for over-loading control in the pilot provinces is enhanced”. Accordingly, the activities, project period and inputs of JICA Experts are amended as PDM ver. 3.

Summary of 7th JCC

Date: From 14.00 to 16.00 p.m. on 17th of September, 2015

Venue: Meeting room of DOR

Attendants: 18 persons from PTRI, DOR, DPWT Vientiane and Savannakhet Provinces, PTTI, JICA Laos Office, and JICA Experts.

Agenda: 1) Major progress of the Project
2) Discussion and agreement on revision of PDM and R/D
3) Others

(8) 8th Joint Coordinating Committee (JCC)

In the 8th JCC, major progress of activities was discussed including system improvement, finalization of manual, bridge maintenance, and overloaded vehicle control. Besides, the presentation including outline of terminal evaluation study, evaluation results, and conclusion was made by Terminal Evaluation Mission.

In respond to the suggestion from Laos side, a sub working group for revision of Technical Manual would be organized. Both Laos side and JICA agreed to establish an overloading control mechanism including full operation of pilot weigh scale by the end of the Project. Furthermore, necessities of concrete bridge inspection and external training in Japan and third countries were discussed.

Summary of 8th JCC

Date: From 9.00 a.m. to 12.20 p.m. on 6th of April, 2017

Venue: Meeting room of DOR

Attendants: 27 persons from PTRI, DOR, DPWT Vientiane and Savannakhet Provinces, PTTI, JICA Laos Office, Terminal Evaluation Mission and JICA Experts.

Agenda: 1) Major progress of the Project
2) Terminal Evaluation
3) Others

(9) 9th Joint Coordinating Committee (JCC)

In prior to the 9th JCC, JCC members received and reviewed the Project Completion Report. Following the contents of the Project Completion Report, JCC members discussed the project achievements in (i) system improvement, (ii) manual development, (iii) pilot projects and (iv) overloading control, made during the entire project period.

During the JCC meeting, the Chairperson and participants pointed out importance of rolling out the project output and confirmed part of these outputs, including road management system, technical manuals and specifications, would be applied to the ADB and World Bank's projects. In the same meeting, JCC members discussed and agreed with relevance of the proposed Action Plan, which describes tasks of each C/P department and its implementation schedule, and it was confirmed that DOR will monitor and report the progress of tasks in the proposed Action Plan, to JICA Laos Office periodically.

Summary of 9th JCC

Date/time: From 9:00 a.m. to 11:40 a.m. on 30th of April 2018

Venue: Conference Room, DOR

Participants: 17 persons from DOR, DOT, PTRI, DPWT (Vientiane and Savannakhet), PTTI, JICA Laos Office, JICA Expert, Expert Team

Contents: (i) Matters arising and action taken
(ii) Report on Project Completion Report
(iii) Recommendation for achieving overall project goal

2.1.2 Technical Working Group (TWG)

In accordance with the agreement in 1st JCC, a series of TWGs were organized, chaired by Deputy Directors of DOR and PTRI.

(1) 1st Technical Working Group (TWG)

In the 1st TWG, the WBS of each project activity was explained. Hereafter progress and outputs of the Project shall be monitored by using WBS. Besides the implementation plan of technical transfer including trainees, approaches, and its schedule was confirmed. With regard to the OJT, the procedure and management of the project equipment were also discussed and agreed.

Summary of 1st TWG

Date: From 14.00 to16.00 p.m. on 24h of February, 2012

Venue: Meeting room of DOR

Attendants: 11 persons from DOR, PTRI, DPWT Vientiane and Savannakhet Provinces, and PTTI

Agenda: 1) Progress of each activity
2) Implementation plan of technical transfer

(2) 2nd Technical Working Group (TWG)

In the 2nd TWG, the progress of each project activity was explained and discussed. In particular, management of newly installed equipment was reviewed and confirmed. The budget plan and its allocation for road maintenance were also discussed. Other main discussions were as follows: 1) improve PRoMMS especially for data export and import, 2) request the WB and JICA for supporting data collection surveys and procurement of Vehicle Intelligent Monitoring System (VIMS)[1], 3) review and revise the contract of PBC, 4) confirm implementation of external training, and 5) prepare the implementation plan of OJT by using the project equipment and the budget.

Summary of 2nd TWG

Date: From 10.00 a.m. to12.30 p.m. on 31st of May, 2012

Venue: Meeting room of DPWT Vientiane

Attendants: 11 persons from DOR, PTRI, and DPWT Vientiane and Savannakhet Provinces

Agenda: 1) Progress of each activity
2) Implementation plan of technical transfer including maintenance of project equipment

(3) 3rd Technical Working Group (TWG)

In the 3rd TWG, the progress of each project activity was explained and discussed. Amongst them, implementation plan of the OJT and budget plan and cost for operation of the Project born between Laos and Japan were discussed. It was confirmed among the members that OJT plan and budget plan should be briefed to the Director General of DOR and the Minister to confirm allocation of the budget from the RMF. Furthermore, availability to obtain supports from other donors for OJT was considered.

Summary of 3rd TWG

Date: From 8.30 a.m. to11.00 a.m. on 20th of July, 2012

Venue: Meeting room of DPWT Savannakhet

Attendants: 19 persons from DOR, PTRI, DPWT Vientiane and Savannakhet Provinces, PTTI, and JICA Laos Office

Agenda: 1) Progress of each activity
2) Implementation plan for technical transfer of each activity

(4) 4th Technical Working Group (TWG)

In the 4th TWG, the progress of each project activity was explained particularly system improvement of Road Management System (RMS) and Provincial Road Maintenance Management System (PRoMMS). Furthermore, preparation of the TOR for establishment and operation of the maintenance unit was explained. Besides, the current condition of the technical assistance project for PTTI supported by Kreditanstalt für Wiederaufbau (KfW) was also briefed to the members.

[1] VMIS was former name of Dynamic Response Intelligent Monitoring System (DRIMS)

Summary of 4th TWG

Date: From 2.10 to 4.30 p.m. on 10th of September, 2012

Venue: Meeting room of PTRI

Attendants: 14 persons from PTRI, DPWT Vientiane and Savannakhet Provinces, PTTI, JICA Laos Office, and Nagasaki University

Agenda: 1) Progress of each activity
2) General explanation of VIMS

(5) 5th Technical Working Group (TWG)

In the 5th TWG, the progress of each project activity was explained and discussed. Mainly, discussion was made toward: 1) disseminating the manuals, developed by the Project, 2) utilizing International Roughness Index (IRI) as one of the monitoring indicators to evaluate the PBC, 3) examining the consistency of the maintenance manual and RMS/PRoMMS, 4) confirming the issues associated with the PBC, 5) confirming the present condition of the budget allocation for OJT including the Pilot Project, 6) preparing the action plan based upon the result of a series of trainings, and 7) achieving consensus on the agenda of the 2nd JCC.

Summary of 5th TWG

Date: From 9.00 to 11.30 a.m. on 25th of October, 2012

Venue: Meeting room of PTRI

Attendants: 17 persons from DOR, PTRI, DPWT Vientiane and Savannakhet Provinces, PTTI, and JICA Laos Office

Agenda: 1) Progress of each activity
2) Report of external training in Japan

(6) 6th Technical Working Group (TWG)

In the 6th TWG, the progress of each project activity was explained and discussed. Mainly, discussion was made toward: 1) revision of PBC and unit cost as baseline data for road maintenance system, 2) implementation of OJT in the remaining section of NR-9 by using the RMF, 3) upgrading Personal Computers (PCs) for operation of road maintenance system, 4) preparation of basic design for the remaining section of NR-9, with supports under the Project, and 5) additional procurement of AC materials for maintenance of the Pilot Project section on NR-9.

Summary of 6th TWG

Date: From 8.45 to 11.10 a.m. on 27th March 2013

Venue: Meeting room of DOR

Attendants: 17 persons from DOR, PTRI, DPWT Vientiane and Savannakhet Provinces, PTTI, JICA H.Q., JICA Laos Office and JICA Expert (MPWT)

Agenda: 1) Review of 2nd JCC and 5th TWG
2) Progress of each activity

(7) 7th Technical Working Group (TWG)

In the 7th TWG, the progress of each project activity was explained and discussed. Mainly, discussion went on following items: 1) current condition of preparation for road maintenance plan, 2) revision of unit cost, 3) data collection of PRoMMS, 4) revision of Performance Based Contract (PBC), 5) supporting for preparation of basic design on NR-9, 6) implementation of OJT in Vientiane Province, and 7) recommendation for sustainability of the Project.

Summary of 7th TWG

Date: From 8.45 a.m. to 12.10 p.m. on 15th of July 2013

Venue: Meeting room of DOR

Attendants: 16 persons from DOR, PTRI, DPWT Vientiane and Savannakhet Provinces, PTTI, and JICA Laos Office

Agenda: 1) Review of previous 6th TWG
2) Progress of each activity

(8) 8th Technical Working Group (TWG)

In the 8th TWG, the progress of each project activity was explained and discussed. Mainly, discussion focused on RMS surveys conducted by PTRI. In particular, three items were discussed and shared such as the survey schedule for RMS data, the RMS results and budget plan based upon the analyses by RMS survey. Besides, the members exchanged their opinions on the Pilot Projects in Savannakhet and Vientiane Provinces.

Summary of 8th TWG

Date: From 9.00 to 11.30 a.m. on 28th February 2014

Venue: Meeting room of DOR

Attendants: 13 persons from DOR, PTRI, DPWT Vientiane and Savannakhet Provinces, PTTI, and JICA Laos Office

Agenda: 1) Review of previous TWG
2) Progress of each activity

(9) 9th Technical Working Group (TWG)

In the 9th TWG, the progress of each project activity was explained and discussed. Mainly, discussion was centered on increasing the revenue from RMF and fuel tax in order to secure sustainable road maintenance budgets, and controlling over weight vehicles by means of installation of new weight bridge replacing existing broken-down weight scales. It was agreed that the system improvement of controlling over weight vehicles was considered essential and required to technical support from the Expert Team.

Summary of 9th TWG

Date: From 9.15 a.m. to 12.00 p.m. on 16th of July 2014

Venue: Meeting room of DOR

Attendants: 19 persons from DOR, PTRI, DPWT Vientiane and Savannakhet Provinces, PTTI, and JICA Laos Office

Agenda: 1) Review of previous TWG
2) Progress of each activity

(10) 10th Technical Working Group (TWG)

In the 10th TWG, the progress of each project activity was explained and discussed. Mainly, discussion was centered on increasing of fuel levy for the revenue of RMF from 420kip/litter to 520kip/litter effectively on Jan.30, 2015, restration of three weigh stations on NR-13, NR-9 and NR-3, Pilot Projects in Vientiane and Savannakhet Provinces. Laos side requested to extend the project until end of 2017 in order to proper management of road rehabilitation project on NR-9.

Summary of 10th TWG

Date: From 9.00 to 11.30 p.m. on 4th of April, 2015

Venue: Meeting room of DOR

Attendants: 19 persons from DOR, PTRI, DPWT Vientiane and Savannakhet Provinces, PTTI, JICA H.Q, JICA Laos Office and JICA Experts

Agenda: 1) Review of previous TWG
2) Progress of each activity

(11) 11th Technical Working Group (TWG)

In the 11th TWG, the progress of each project activity was explained by the counterpart. The manual development was explained by PTTI and GIS training was DOR. After explanation, mainly discussion was centered on Pilot Projects in Vientiane and Savannakhet Provinces and overloading control. DOT appreciated with the provision of the weigh station along NR-9 under JICA supports and requested to provide a technical assistance to establish a sustainable institutional framework for overloading control.

Summary of 11th TWG

Date: From 9.00 to 12.00 p.m. on 25th of December, 2015

Venue: Meeting room of DOR

Attendants: 15 persons from DOR, PTRI, DPWT Vientiane and Savannakhet Provinces, PTTI, JICA Laos Office and JICA Experts

Agenda: 1) Review of previous TWG
2) Progress of each activity

(12) 12th Technical Working Group (TWG)

In the 12th TWG, the progress of each project activity was explained. A discussion was centered on maintenance system improvement and database update, PBC, rehabilitation of NR-9, recycling pavement method of NR-13N, and overloading control. Beside, the organization change of MPWT and coordination with the other projects supported by WB, ADB and KfW were explained.

Summary of 12th TWG

Date: From 10.00 a.m. to 12.00 p.m. on 5th of August, 2016

Venue: Meeting room of DOR

Attendants: 15 persons from DOR, PTRI, DPWT Vientiane and Savannakhet Provinces, PTTI, JICA Laos Office and JICA Experts

Agenda: 1) Review of previous TWG
2) Progress of each activity

(13) 13th Technical Working Group (TWG)

In the 13th TWG, the progress of each project activity was explained. A discussion was centered on maintenance system improvement and database update, Pilot Project on NR-9 and OJT, and introducing weigh scale for overloading control. Besides, extension of the project period was discussed in order to carry out capacity building of overload vehicle control and fully open the station.

Summary of 13th TWG

Date: From 10.00 to 12.00 p.m. on 17th of March, 2017

Venue: Meeting room of DOR

Attendants: 16 persons from DOR, PTRI, DPWT Vientiane and Savannakhet Provinces, PTTI, JICA Laos Office and JICA Experts

Agenda: 1) Review of previous TWG
2) Progress of each activity

2.2 Enhancement of Maintenance Planning Capability for Road/Bridge Maintenance

2.2.1 Review of Current Situation and Obtaining Baseline Capabilities on Maintenance Planning Works as of Commencement of the Project

The Expert Team carried out current situation survey from November 2011 to February 2012 in order to understand current situation of road and bridge maintenance planning and budgeting in all 17 provinces[2] and road maintenance system for local roads, namely, PRoMMS. Meanwhile a training needs survey was conducted at pilot provinces with the aim of understanding current capacity level and identifying the needs for trainings.

The road management and maintenance system/database in Laos is summarized in following table.

Table 2.2.1 Summary of Road Management and Maintenance System/Database

System and Application	Management and Operation of the System	Summary
RMS (Road Management System)	DOR	• 10 years road maintenance planning system that estimates road maintenance needs by using input data of traffic volume, surface condition, road roughness and selects the most appropriate way of repair works by section. • RMS is managed by PTRI • DOR updates the database for RMS every year and prepares the annual report by using RMS • RMS initially developed for the national roads • Current RMS allows PRoMMS data (for local roads) to analyze • The function of import from IRI data by VIMS (DRIMS) is added in RMS
PRoMMS (Provincial Road Maintenance Management System)	DPWT	• Road maintenance planning system for next year that selects the most appropriate way of repair works by using input data of traffic volume, surface condition, roughness of local roads • PRoMMS is managed by PTRI • DPWT operates PRoMMS including data collection and updates • DPWT does data collection and update meanwhile DOR imports the data from PRoMMS to RMS and then prepares the annual report
VIMS (Vehicle Intelligent Monitoring System)	DOR	• VIMS is the system that estimates the roughness in quantitative data called international roughness index, IRI • The IRI data prepared by VIMS is imported to RMS
GIS based road inventory	DOR	• GIS database including road inventory data of all roads in entire country • TED in DOR manages the GIS database including update

Source: JICA Expert Team

As a result of the current situation survey, following facts and issues were identified.

- The number of DPWT staffs who operate PRoMMS was identified from 1 to 4 person(s) in each province (an average of 2.1 persons per province).
- Staffs who can operate PRoMMS tend to work at various sections.
- Operating skills of PRoMMS were still inadequate, especially data analysis and reporting ability.

<u>Issues on maintenance system;</u>

[2] As of September 2014, one province is added and 18 provinces exist in total.

- PRoMMS was not compatible with the latest Operating Software (OS).
- An interface of PRoMMS is complicated and not user-friendly.
- Insufficient equipment for road inventory survey (trip meter, Global Positioning System (GPS), vehicle etc.)
- Unreliable data qualities due to distortion of survey results between surveyors.
- No regular updates of unit costs of maintenance works.
- Latest update through road inventory survey for all roads conducted in 2008

Issues on maintenance planning and budgeting:

- Time lag between inventory survey and actual maintenance work.
- The process of budget approval/allocation is likely to take long time even for the urgent requests.
- Check-and-balance function was not visible in the process of current road maintenance planning and budgeting.
- Budget for road maintenance was scarce especially for local road maintenance.

2.2.2 Improve Data Collection Method/Work for RMS/PRoMMS

Data Collection Method/Work for RMS

RMS and PRoMMS are the systems for road maintenance planning and budget allocation through analysis on RMS database containing various data such as inventory and condition of road and bridge. The data collection survey on the national road for RMS was carried out by PTRI, however the operational function of the system was transferred to DOR in April 2017.

In May 2012, the Expert Team drafted a data collection survey implementation plan and prepared cost estimate for data collection survey, during the period from 2013 to 2016. Frequency and scale of the survey are proposed by taking into account for data accuracy and timing of the survey.

Table 2.2.2 Proposed Survey Items and Frequency of RMS data Collection Survey

Survey	Survey Items	Frequency
Location Referencing	Road alignment, road number, road class, features, LRP's	Only after major improvement
Road Inventory	Surface type, pavement width, shoulder type, shoulder width, topography, photos	Only after major improvement
Bridge Inventory	Location data, bridge type, spans, span length (min, max), width of carriageway, wearing course type, max vehicle load, year of construction, photos	Only after major improvement
Paved Road Condition Survey	Surface integrity index, predominant defect, type of access constraint, predominant effect of constraint	Annually
Unpaved Road Condition Survey	Surface condition, predominant defect, type of access constraint, predominant effect of constraint	Annually
Bridge Condition Survey	condition rating of each element, condition rating of whole bridge, damage description, replacement needs of each element, proposed maintenance work in MAC	Annually

Survey	Survey Items	Frequency
Road Roughness	Average IRI per 100m[3]	Annually
Traffic Count	Classified counts of each link	Annually
Socio-economic Survey	Distance to market, population in catchment area, socio-economic indicators	5 years cycle

Source: JICA Expert Team

Proposed data collection survey plan and cost estimate were revised through discussions between PTRI and the Expert Team. The comments raised during the discussion were summarized below;

- The unit cost of surveyors was amended, following officially approved allowance and accommodation rate in Laos.
- The procurement cost of survey vehicles was excluded from the survey cost since survey vehicles were separately procured by the WB.

Based on the revised plan and cost estimate, the implementation plan and budget allocation plan for the data collection survey in 2012/2013 were prepared by PTRI in September 2012. Following that, PTRI submitted them to RAD and applied to MPWT and WB in October 2012. Since their budget was approved in February 2013, PTRI conducted the survey started from March and completed in May 2013. During this period, however, the traffic count survey was terminated temporarily due to delay of the budget allocation. The overall schedule was delayed approximately four-month behind from the initial plan.

- Road/ Bridge condition survey: 3rd week in March 2013 – 2nd week in April 2013 (1.25 months)
- Traffic count survey: 3rd week in March 2013 – 2nd week in May 2013 (1.25 months)
- Road roughness survey: 3rd week in April 2013 – 2nd week in May 2013 (1 month)

Road and bridge condition survey and the traffic count survey in 2014 were carried out in half scale of the survey, comparing to that in 2013. Based upon the discussion between PTRI and the Expert Team, the road condition survey and roughness survey were carried out at the beginning because results of these surveys were necessary to prepare the preliminary road maintenance plan and which was submitted to DOR by September 2014.

Table 2.2.3 Results of RMS Data Collection survey 2013-2016

Survey Type	Unit	2013	2014	2015	2016
Referencing and Inventories	Km	274	109	0	0
Paved Road Condition	Km	5,273	3,126	3,772	3,225
Unpaved Road Condition	Km	173	0	0	0
Bridge Condition	Nos	1067	582	1,327	1,134
Road Roughness	Km	5,273	5,338	5,859	5,859
Traffic Count	Nos	231	119	87	0
Socio-economic	Nos	7	0	0	0

Source: JICA Expert Team

[3] International indicator for flatness of the road surface defined by WB in 1986. The indicator is calculated by vertically displacement of virtual vehicle named as quarter car model at 80km/h driving speed. The unit is either mm/m or m/km. IRI of new surface road tends to range between 2.0 and 3.5, while IRI of old surface road ranges between 3.0 and 5.5.

In 2014, overall RMS data collection surveys were delayed by several reasons. At first the budget approval in 2014 was delayed same as previous years, and accordingly the surveys started from 4th week of April in 2014, which was approximately two months behind the original schedule. Furthermore, the survey was suspended temporarily due to organizational restructuring of PTRI. The survey restarted from 5th week in May and completed in early July in 2014. The traffic count survey was started from beginning of July and completed in September 2014.

In 2016, amongst inventory surveys for RMS, the traffic count survey was cancelled due to the limited budget, however the cancellation of traffic count survey would not influence the analysis on RMS because the historical data of the traffic count survey be utilized for 10 years projection.

In 2017, all of surveys were not implemented due to following reasons;

- Termination of Lao Road Sector Project Phase 1
- MPWT changed organization structure and responsibility of system operation was shifted from PTRI to DOR, and the persons/division in charge of system operation was not confirmed.

As of April 2018, it is expected to implement surveys in 2018, utilizing the fund from WB's Lao Road Sector Project Phase 2.

Data Collection Method and Work for PRoMMS

The data collection survey on local roads including provincial roads is carried out by DPWTs and Offices of Public Works and Transport (OPWTs) in each province with the supervision of Local Road Division (LRD). DPWT inputs collected data through PRoMMS and submits them to LRD. LRD compiles the data from all provinces and transfers as the PRoMMS database to PTRI[4]. Based upon the database of PRoMMS, PTRI imports them into RMS system in order to integrate them with the national roads data and to conduct required analyses. Results of the analyses are compiled into the reports submitted to DOR.

DPWT started the data collection survey on local roads in each province in January 2013 request by LRD. DPWT inputs the survey results into PRoMMS format and then submitted to LRD. PRoMMS data of 17 provinces transferred from LRD to PTRI in March 2013 and the quality of these data was checked under the support by the Expert Team. The results of error check by the Expert were summarized below.

- Errors were found in PRoMMS database in 13 provinces out of 17.
- In 4 provinces, total number of records in their PRoMMS data was decreased significantly compared to the result of previous survey in 2011/12.
- 2 provinces submitted same data of previous year without any update.
- In some provinces' data, errors occurred when the data import command carried out. This kind of error was caused by failure of error check function in PRoMMS due to incorrect data such as the allowable limit.

The Expert Team reported such problems and requested LRD to recollect and resubmit

[4] RAD and LRD merged into Regional Office due to the restructuring of DOR

complete PRoMMS data from DPWTs. On the other hand, the Expert Team revised the error check command in PRoMMS. Finally updated PRoMMS data from DPWT were submitted to LRD and transferred to PTRI in July 2013.

In September 2013, LRD integrated into Road Administration Division (RAD) by reorganization of DOR. Accordingly function of data collection for PRoMMS was also transferred from LRD to local consultants as road maintenance advisors hired by DOR. These consultants, who were assigned in the Lao Road Sector Project supported by the DOR and WB, are fully responsible for quality assurance of PRoMMS. The data collection and analysis was carried out by DPWT continuously. As of August 2014, it was reported that all PRoMMS data from DPWTs except Vientiane Capital were collected and transferred to PTRI.

In addition, it was found out that one of major reasons of difficulties of data collection with PRoMMS was insufficient road numbering system in Laos. DOR has responsibility to assign road number upon a request from Province but it is difficult to DOR providing road number because of the lack of suitable road numbering system. Due to this situation, a number of roads in Provinces exist without road number and these roads are not able to be inputted in PRoMMS, so Provinces submit annual road statistics without using PRoMMS. To solve this issue, PRoMMS was improved to input data without road number and assign temporary number in the system.

2.2.3 Improvement and Update of RMS/ PRoMMS

Through road management activities in PTRI, there were some improvement request of the RMS was reported and system improvement works were completed through the following revision works.

- Export function to Integrated Road Asset Management System (IRAMS)
- Export GPS coordinates of road alignment for IRAMS
- Export function in tablet version of RMS (offline version)
- Export function for PRoMMS (between different version system)
- Bridge location coordinate improvement for data input/ export to GIS system and IRAMS
- PRoMMS regional setting improvement
- PRoMMS system configuration to Windows 10
- Response to newly established Province “Xaisonboun” in the system
- Improvement of MCA analysis in RMS
- Bug fixing for road database
- Bug fixing for export function
- Development of user manual
- Develop new application to check PRoMMS data
- Accuracy measurement for VIMS[5]
- PRoMMS generates road statistics
- RMS export function to utilize data in GIS software

[5] VIMS was former name of DRIMS

- PRoMMS improvement to assign temporary road number (For road without official road number yet)
- VIMS was introduced as IRI survey equipment since it is found relatively actuate and less expensive system compared to other system which normally requires special equipped vehicle to measure IRI. IRI is an important indicator for the analysis by RMS. The Expert Team invited Dr. Nishikawa from Nagasaki University in Japan for making a demonstration of VIMS at PTRI. PTRI staff and the Expert Team discussed and concluded to procure and operate VIMS.
- Dr. Nishikawa demonstrated VIMS at PTRI during 10th-14th September 2012. PTRI and the Expert discussed and concluded for procurement of VIMS.
- Expert provided three sets of VIMS to PTRI in November 2012. During 12th-14th November 2012, Dr. Nishikawa, PTRI, the Expert and a software engineer who engaged improvement of PRoMMS/RMS discussed and agreed with modification of VIMS such as simplified format of VIMS for importing to RMS.
- Revised VIMS was demonstrated by Dr. Nishikawa during 18th-26th April 2013 involving PTRI and the Expert. The major improvement was that the output file of VIMS consisted of roughness (IRI) in every 100 meter with the road number and the link number together in order to match the data format of RMS. In the demonstration, VIMS was equipped on the vehicles, which were used for the surveys, and calibrated.
- Dr. Nishikawa provided technical supports in response to requests by Expert at the beginning of actual roughness survey during 26th – 29th May 2013.
- Dr. Nishikawa, PTRI, Expert and the software engineer discussed on further VIMS improvement and data transfer to RMS.
- Dr. Nishikawa provided VIMS ver 2.2.2 to PTRI and the Expert in August 2013. PTRI and the Expert requested Dr. Nishikawa to fix an error which was found during data import into RMS. Dr. Nishikawa provided revised version of VIMS in the following month.
- PTRI and the Expert reported to Dr. Nishikawa problems of VIMS during actual roughness survey and requested improvement. Dr. Nishikawa fixed the problems, tested and provided revised VIMS to PTRI and the Expert during 20th – 28th, November 2013.
- PTRI carried out roughness survey in 2014 between end of April and July 2014. In the survey implementation, PTRI pointed a few errors such as failure of speed calibration analysis on several PCs. The Expert has requested Dr. Nishikawa to check the cause of the problems.

2.2.4 Planning of Road Maintenance and Budgeting by using RMS and PRoMMS

(1) Training for Updating GIS Based Road Master Data

1) Background of GIS Training

In 7th JCC on 17th September 2015, it was discussed importance of updating GIS based road network data, which has not been updated since 2008, to fully operate road maintenance system such as PRoMMS and RMS. Currently GIS based road network data is managed by TED, however the capacity of GIS techniques in TED is limited, and reflecting requests made by DOR, the Expert Team organized a basic GIS training.

Following table shows road management system, users and their issues related GIS based road master data related road management system in Laos.

Table 2.2.4 Current Road Management System, Manager/User, Tasks/Issues

System	System Manager/User	Task/Issues
Road statistics	DPWT/DOR, DPC, PTRI	DPWT updates road information every year (nearly 10% increase by road length every year!). Only tabulated information provided. No GIS based info available.
GIS based road inventory	TED (DOR)/DOR, PTRI, other departments	TED (DOR) maintains GIS based road inventory. No updates since 2008 → Gap observed between road statistics and inventory
RMS	PTRI/ DOR, DPC	PTRI maintains system and updates database annually and provide asset report to DOR and DPC. Road ID and GIS info relies on DOR. → Gap among (i) road statistics, (ii) road inventory and (iii) RMS. No management of reference data: provinces/districts codes, road/link numbering
PRoMMS	DPWT/DPWT, DOR	DPWT maintains system and updates database. In practice, PTRI maintains system and DPWT functions only as data provider → Weak link between PRoMMS and actual planning. Gap between road statistics and PRoMMS
IRAM	Cabinet Office/ DOR, DPC, PTRI, other departments	Cabinet Office develops Maintenance Work Contracts Management System. The system also provides a web-based Network Asset Database, with data aggregated from RMS. System provides only platform (no analysis) and data updated by PTRI (planning), DOR (procurement and implementation) and evaluation.

Source: JICA Expert Team

2) Gaps of Road Length between DOR Statistics and TED GIS road network data

As mentioned in the previous section, there are some gaps between road length in road statistics by DOR and GIS road network data by TED as shown in Table 2.2.5. There are several reasons identified related to this issue;

- All roads are not inputted in the GIS format because of limited skilled staff and not enough geographic information about updating GIS data
- Road statistics data includes planned roads however GIS road network only includes existing roads
- Local roads under province are difficult to obtain enough geographic information and data to update road network by TED
- Provinces submit data without using PRoMMS

According to DOR statistics, a total road length is increasing almost 10% every year, and that needs to be addressed for proper management of road maintenance. In 2018, DOR requested DPWT to submit road statistics data from the provinces with only data format prepared by PRoMMS to solve this issue.

Table 2.2.5 Road Length by Province both Statistics and GIS data

Province No.	Province Name	(1)	(2)	(1) - (2)
		TED NR GIS data (km)	TED Statistics (km)	Balance
Province No. not available	Data doesn't have Province Name	683.71		
01	Vientiane Capital.	294.28	246.05	48.23
02	Phongsali	359.59	474.00	-114.41
03	Louangnamtha	463.48	299.68	163.80
04	Oudomxai	453.15	326.50	126.65
05	Bokeo	606.07	174.72	431.35
06	Louangphabang	445.35	605.20	-159.85
07	Xaignabouli	220.92	549.00	-328.08
08	Houaphan	803.30	445.00	358.30
09	Xiengkhouang	336.86	436.00	-99.14
10	Vientiane	338.99	449.11	-110.12
11	Bolikhamxai	535.31	604.95	-69.64
12	Khammouan	303.76	594.16	-290.40
13	Savannakhet	313.13	604.00	-290.87
14	Salavan	165.80	534.50	-368.70
15	Champasak	578.74	460.83	117.92
16	Xekong	432.32	216.00	216.32
17	Attapeu	568.70	355.46	213.24
18	Xaisomboun	346.00	355.80	-9.80
Total		7,565.75	7,730.96	-165.20

Source: JICA Expert Team

3) Implementation of GIS Training

GIS training were carried out two times in November 2015 and August 2016, and participants were from TED, PTRI and PTTI to improve skills among related organizations. In the first GIS training, the focus was made on basic GIS and GIS software knowledge summarized in the table below.

Table 2.2.6 Summary of 1st GIS Training

Date	Session	Subject
9th Nov.	Session 1 (AM)	Introduction of GIS and GIS software
	Session 2 (PM)	Understanding of DOR's GIS network with GIS software
10th Nov.	Session 1 (AM)	Development of GIS map/network (preparation of GIS map)
	Session 2 (PM)	Editing of GIS map/network
11th Nov.	AM/PM	Data collection (Field work) and compilation to GIS
12th Nov.	Session 1 (AM)	Data maintenance & management (Discussion on Current issues of GIS road network data maintenance and management)
	Session 2 (PM)	Data maintenance & management (Identify possible solutions of GIS road network data maintenance and management)
13th Nov.	Session 1 (AM)	Utilization of Public Domain data
	Session 2 (AM)	Training evaluation and skill test
Objectives	・ Understand basic functions and transactions of GIS software ・ Understand GIS data editing to update road network data ・ Understand GIS data collection using GPS to update road network data ・ Discuss maintenance and management plan of GIS based road network data	
Participants	Vongsack MALIVANH (PTRI) Bounthipphasert SOUMPHOMPHAKDY (TED/DOR) Bounthavg SOULIVONG (PTTI) Xiongwue NENGTHONG (TED/DOR) Malayphone SADIDMANY (TED/DOR) Chinlana Sirianphone (TED/DOR) Bounphrasebth SOUKVASEUM (TED/DOR)	

Note: ArcGIS desktop software was utilized as requested from TED

Source: JICA Expert Team

In the first training, participants are discussed current issues and possible solutions to tackle this issue of Updating GIS based road network data. This brain storming exercise gave clear image of issues and reason why it is necessary for all participants.

Lecture and Exercise

Discussion on GIS road master data update

Data collection exercise using GPS

Data editing by collected GPS data

After 1st GIS training in 2015, there was additional request on GIS training from TED to improve their skills to update GIS based road master data and overall procedure to update data including field data collection. In response to the request from TED, the Expert Team held 2nd GIS training in August 2016. The following table shows contents of 2nd GIS Training.

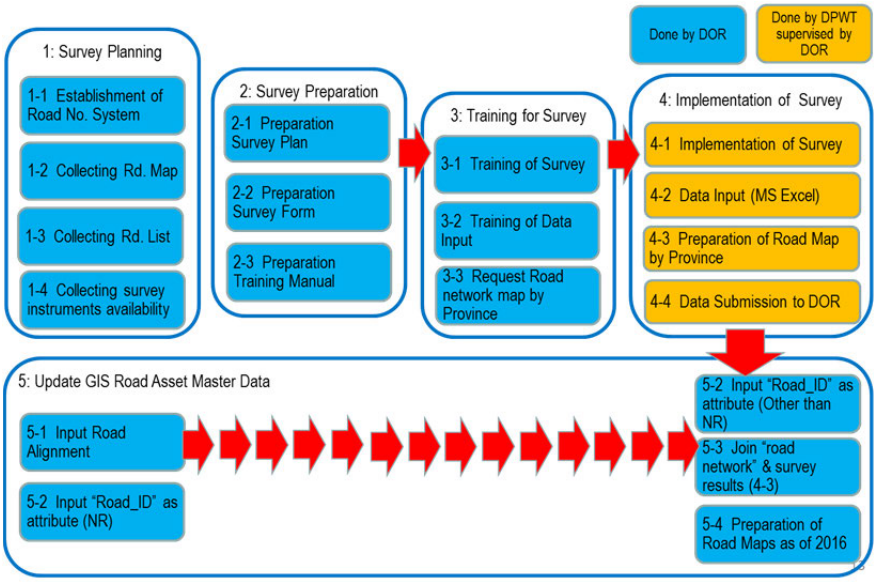
Table 2.2.7 Summary of 2nd GIS Training

Contents	Description
Understandings of road asset master data (1-hour)	Understandings of objective/ contents of road asset master data Understand methodology (work flow) of updating data
Data editing by QGIS referring Google Satellite Imagery (2-hour)	How to edit line How to edit attribute table How to calculate length of line
Refresher course: Utilization of GPS (2-hour)	How to collect GPS data (setting GPS/ collection of data) Import .to gpx file Integrate with current data
Skill test (30 min.)	Skill test of this training
Participants	Laythong Phommnong (Dir. DOR) Vongsack MALIVANH (PTRI) Xiongwue NENGTHONG (TED/DOR) Malayphone SADIDMANY (TED/DOR) Chinlana Sirianphone (TED/DOR) Bounphrasebth SOUKVASEUM (TED/DOR)

Note: QGIS is Quantum Geographic Information System

Source: JICA Expert Team

In the 2nd GIS training, participants learned not only GIS software skills, but also methodology to implement data collection to update GIS data. It is because DOR/TED planned to implement road inventory survey to update GIS based road network data. The following figure shows proposed implementation steps to update GIS based road network data.



Source: JICA Expert Team

Figure 2.2.1 Proposed Survey Procedure

(2) Reorganization of DOR and Setting Road Asset Management Team

1) Road Asset Management Team

Due to the reorganization of DOR in April 2017, the responsibility of the RMS was transferred from PTRI to RAD under DOR. Due to this reorganization, RAD has responsibility of all related tasks of RMS as shown below;

- Planning/ implementation for RMS data collection survey
- RMS data input
- System maintenance and management of RMS
- Analysis of RMS database
- Preparation of Annual Road Asset Management Report
- Formulate a road maintenance plan

To manage RMS database including GIS road master data, DOR set the Road Asset Management Team in October 2017. The Expert Team was requested to provide GIS trainings for the team to manage GIS based road master data. Through discussion between DOR and the Expert Team are agreed as follows;

- Provide training to newly assigned Road Asset Management Team to manage road master data
- Update GIS based road master data for National Road, Provincial Road and District Road with proper attributes (road class, road number)
- Regarding Urban Road, Local Road and Special Road, would be inputted, referring to the secondary data, including road alignments based on Google Earth without any attributes.

2) Availability of Latest Road Data by Province

Prior to GIS training, GIS based road data and road map was reviewed for all Provinces and both data and map of current road network are not available in many Provinces. Based on discussion with DOR, it was agreed to utilize existing data as of 2008. To update

road master data, DOR requested the Expert Team to provide GIS intensive training to manage road master data.

Table 2.2.8 Summary of Road Data/ Map Availability as of Dec. 2017

PCODE	Province name	Map (Any format)	GIS data
		Availability	Availability
1	VIENTIANE MUN.	Yes	No
2	PHONGSALI	Yes	Yes
3	LOUANGNAMTHA	No	No
4	OUDOMXAI	No	No
5	BOKEO	Yes	No
6	LOUANGPHRABANG	No	No
7	HOUAPHAN	No	No
8	XAIGNABOURI	No	No
9	XIANGKHOUANG	No	No
10	VIENTIANE	No	No
11	BORIKHAMXAI	No	No
12	KHAMMOUAN	Yes	Yes
13	SAVANNAKHET	No	No
14	SARAVAN	Yes	No
15	SEKONG	Yes	Yes
16	CHAMPASAK	No answer	Yes
17	ATTAPU	No	No
18	XAISOMBOUN	No	No

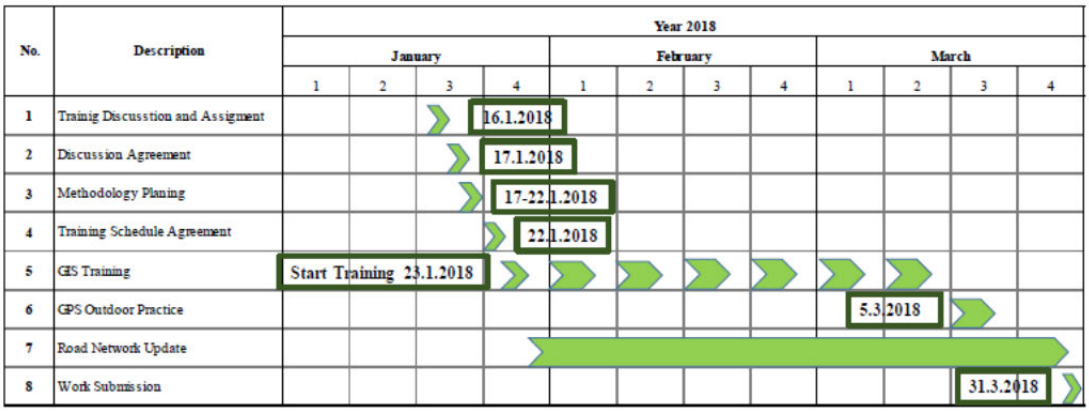
Source: JICA Expert Team

3) Intensive Training for Road Asset Management Team

In total, 17 times intensive trainings were implemented from January to March 2018. The Road Asset Management Team improved to sufficient GIS skills to update GIS based road master data during two and a half months training and field practice using the GPS. Through these trainings, the Road Asset Management Team members obtained following skills;

- Updating road master data with QGIS software
- Data collection by GPS and utilization of GPS data in QGIS software
- Utilization of RMS data in QGIS software

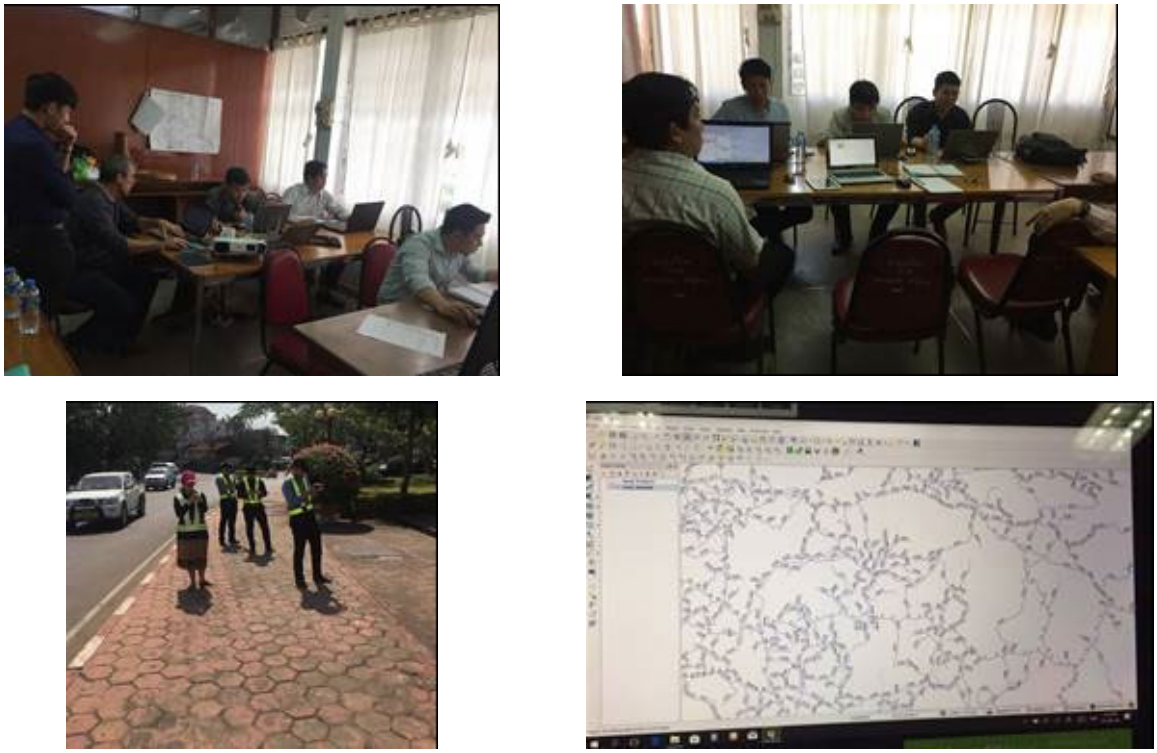
As a result of the intensive training, all members updated GIS based road master data at least one Province.



Source: JICA Expert Team

Figure 2.2.2 Schedule of Intensive Training Course

To support activity of the Team, the Expert Team produced “Road Network Data Update Guideline” as a basic GIS operation manual in Lao langrage.

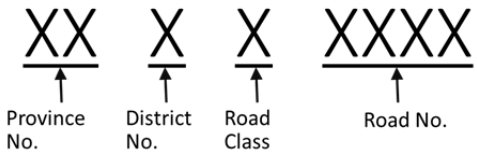


Source: JICA Expert Team

Figure 2.2.3 Intensive Training for Road Asset Management Team

(3) Issues related to GIS based Road Master Data

Through discussions with TED and DOR regarding updating road network data, it was identified that there is a need to improve a road numbering system. The current official road numbering system in Laos was developed by combination of Provincial number, District number, road class and road number as follows;



However, the road numbers in some Provinces are already saturated (Only four-digit number for all roads within their Provinces), and TED/ DOR in charge of road number faces difficulties to establish new road numbering system so that some Provinces have road without road number in recent years. DOR still continue to discuss a new road numbering system as a regulation official based on revised Road Law as of April 2018.

2.2.5 Monitor Progress of the Activities and Evaluate Maintenance Planning Capabilities

In the PRoMMS training for provincial DPWT staffs, an evaluation survey was carried out using the evaluation survey forms prepared by the Expert Team and PTRI. The results of evaluation survey for the training are summarized below,

- More than 60% of participants answered training was “understandable” and “very understandable”
- More than 80% of participants answered “results of the training are appropriate enough to apply to their works”.

In the PRoMMS data collection training for OPWT staffs in pilot provinces, an evaluation was also carried out. The results of evaluation are summarized below,

- 90% of participants were "satisfied" with the training
- More than 70% of participants expected more training for PRoMMS and its operation.
- To understand socio-economic indicators such as population along the road, distance to market and potential were more difficult to understand than other road elements or conditions.
- Almost 30% of participants requested "need to extend days for training".
- Almost half of participants expected training "using PRoMMS" in next training.

In the data collection training at the field, some mistakes such as omitted data and illegible letter and/or figure were found. Since the main activities of OPWT were data collection, OPWT staffs need to be trained for data collection works rather than PRoMMS operation training.

A questionnaire survey for understanding the skill level of PRoMMS users in all provincial DPWTs was carried out at the beginning of the Project in November 2011. In the survey, 27 staffs answered in 17 provinces. Before the end of Phase 1 in August 2014, similar questionnaire survey was carried out to access the capacity gained during the Project. The survey obtained answers from 49 PRoMMS users in 18 provinces.

- Average skill level of PRoMMS users at the beginning of the Project in 2011 was estimated at 3.53 points.
- Average skill level of PRoMMS users at the end of Project Phase 1 in 2014, was estimated at 3.55 points for staffs who participated in the training for the first time and at 3.62 points for experienced staffs who participated in several trainings.

Skill level 3.0 points means “operated with limited external support”, and 4.0 points means “operated without external support”.

2.3 Development of Technical Manuals for Road/Bridge Maintenance, Slope Protection and Operation Guideline for PBC

2.3.1 Review and Revise Existing Technical Manuals, including Condition Survey Manual, Inventory Manual and Slope Protection Manual and Performance Based Contract

(1) Review of Existing Manuals

1) Road Maintenance

The Expert Team reviewed International Road Maintenance Handbook (PIARC, 1994), commonly used in Laos, and identified following issues: (i) The contents of the manual is not comprehensive and does not cover from inspection to repair works. (ii) Criteria for evaluation of defects are not clearly described and (iii) Format sheets such as inspection and working record are absent or not relevant for the use in Laos.

Furthermore, the Expert Team reviewed the Maintenance for Asphalt Concrete Road (JICA, 2004), prepared during the road improvement project of the NR-9, and found following issues: (i) It contains only maintenance method of asphalt pavement road. (ii) There is no description for other facilities such as drainage and traffic control devices. (iii) Pictures and/or drawings to illustrate work procedure are not attached (text only) and (iv) The standard applied is limited to “Japanese Industrial Standards (JIS)” instead of “American Association of State Highway and Transportation Officials (AASHTO)” or other international standards.

2) Bridge Maintenance

The Expert Team reviewed existing International Road Maintenance Handbook (PIARC). Some shortcomings were identified during the review works as follows:

(i) Contents of Bridge Maintenance Works

Bridge Maintenance works described in the manual are not widely covered and some types of the structures were not appropriate for Laos. Only general view of maintenance works was shown without any category of the structural defects. The criteria and causes of each types of defect were not clearly defined, therefore it was found difficult for the site engineer to identify and evaluate the damage of the bridge.

(ii) Comprehensive works procedure

Main process of bridge maintenance works, such as (a) inspection, (b) evaluation and (c) the execution works, were not described in the manual. Especially, the inspection work is the most important in order to identify the condition of the bridge accurately and provides an appropriate repair methodology through the evaluation of the damage of the bridge.

(iii) Shortage of expertise

Due to the lack of human resource such as structural engineers in both provincial and district levels, bridge inspection had not been done through routine maintenance works. Detailed inspection and appropriate evaluation of the bridge were required periodically in order to maintain the soundness and safety of the bridge.

3) Slope Maintenance

The Expert Team reviewed existing Slope Maintenance Manual, prepared under Department for International Development (DFID) funded South East Asia Community Access Program (SEACAP). The manual helps to understand slope stability and treatment measures with plenty of visual aids. The manuals also detail inspection/maintenance works and sheets, helping inspectors to work at site. However, as a result of the interview survey at DPWT Vientiane, it was found that the manual is not fully utilized because of shortfall of budget allocation for preventive slope maintenance.

4) Performance Based Contract

The Expert Team reviewed existing PBC initially prepared by the WB funded project and modified by MPWT. According to results of the interview surveys on DPWT Savannakhet and Vientiane Provinces, following issues were recognized: 1) Although existing PBC required the performance for all road infrastructure including road, bridge and road facilities, the contract should be applied only for pavement maintenance for taking account of the available budget, 2) Since the duties and responsibilities were not defined clearly between implementation organization and local contractors, operation manual was found necessary, and 3) technical trainings including practical lessons for implementation organization and local contractors were required, since training sessions were not enough for them to understand well when new PBC was in practice in May 2012.

(2) Interview to the Manual Users and Site Visit

1) Road Maintenance

In May 2012, the Expert Team interviewed to the local contractors in order to understand the current usage of the technical manuals and issues for encouraging the local contractors to use the technical manual. These are some findings as follows: i) only 3 out of 10 major/middle contractors have technical manuals for road maintenance, ii) The manuals include International Road Maintenance Manual (PIARC, 1994) and Road Maintenance Process (SIDA, 2003) and AC Pavement Maintenance Manual (JICA, 2004), iii) the manuals are not used at maintenance site since (a) engineers at site fully understand contents of manuals and (b) follow technical specifications attached to the contract, and iv) technical trainings for staffs of local contractors however are found necessary for such as AC pavement maintenance, material testing and quality control.

2) Bridge Maintenance

In June 2012, the Expert Team performed bridge inventory and bridge condition survey together with DPWT Vientiane on National Road No.13 (NR-13) North in Vientiane Province in order to understand the level of local knowledge and skills for bridge maintenance works.

Prior to site survey for bridge inventory/condition survey, discussion between the Expert and DPWT Vientiane was conducted. DWPT Vientiane requested to perform the surveys regularly in order to understand and evaluate the condition of the bridge, which had not been done since 2008.

In this survey, draft inventory sheet and bridge condition survey sheet were prepared, 46 bridges inventory was updated and bridge condition survey by visual inspection was carried out in 10 of them. The inspections were done by DWPT staff, under the technical support by the Expert.

Source: JICA Expert Team

Figure 2.3.1 Bridge Inventory Survey

During the bridge condition survey by visual inspection using prepared inspection sheet, inspection methodology, critical point of inspection and evaluation on the site were explained and demonstrated to the staff of DPWT Vientiane. Mainly, condition of main girder, piers, bearing, expansion joint, abutment, guardrail were inspected and recorded.

Guardrail

Main Girder

Abutment

Expansion Joint

Bridge surface

Drainage System

Source: JICA Expert Team

Figure 2.3.2 Situation of Bridge condition Survey

As a result of the survey, there were 46 bridges along Route No.13 North in Vientiane Province, while only 45 bridges were found in the previous inventory data (2008). Typical structures of the bridges were PC-T girder with RC slap, while some of them were Arch and Box Girder. Bridge structure itself, such as main girders, piers, still remained in a good condition. However, expansion joint, bridge surface, guardrail, parapet on the bridge had a significant damage, which needed to be repaired/replaced immediately in order to maintain safety for bridge users.

Through the survey, the following issues were found and should be reflected in developing the technical manual.

- Lack of experience in inspection for bridge maintenance work and bridge condition survey
- Lack of understanding in purpose and methodology of inspection
- Bridge maintenance manual was not properly used
- Lack of knowledge in the evaluation of damage

Referring to the result of the survey, the technical manual for bridge maintenance work was developed, considering the following bullet points.

- Comprehensiveness in bridge maintenance work (Inspection – Evaluation – Repair – Work Record);
- Methodology of inspection (routine inspection, periodic inspection and emergency inspection);
- Standard format of each inspection sheet;

A criterion for defect evaluation by each inspection item (e.g. super-structure, sub-structure, bridge facilities) was found necessary as well.

3) Slope Maintenance

In April 2012, the Expert Team together with counterparts went for the site investigation along NR-13 North between Vang Vieng and Luang Prabang and found the following technical and engineering faults for slope protection: (i) Slid soil was not properly removed. (ii) Due to lack of slope protection (e.g.; vegetation) or slope drainage, rehabilitated slopes were still prone to slide during/after the heavy rain. (iii) Slid soil was disposed to vale side without enough surface compaction, and which may cause mudslide at downstream. (iv) The survey area was widely covered with soft/weathered rock and soils were on the soft rock. Such geological condition should be designed to 1 (vertical): 0.5-1.2 (horizontal) on slope ratio.

Also, in the course of the site investigation, a road geometric design related issue was raised for NR-13 North. Although, the said road caters major international and domestic freight and passenger transport and is one of the most important trunk roads in Laos, the road does not meet the design standard and there are many sections to be upgraded in view of traffic safety. Considering the undergoing construction projects for the new link between Kasi and Xiang Ngeun, the Expert recommended to upgrade the about 73 km-long section between Ban Nong Khay and Vang Vieng (KM 82-155).

4) Performance Based Contract (PBC)

In February and March 2013, the Expert Team interviewed to the DPWT Vientiane and Savannakhet. As a result of the interview survey on the operation of the PBC, some operational misunderstandings and faults were found as follows: (i) Implementing agency conducted the inspection by himself instead of the contractor, (ii) DPWT staff did not fully understand the evaluation and payment method especially calculation of deduction payment to the contractor, (iii) there are no monitoring sheet to keep the required service level (iv) there are some discrepancies between required service level and the contract.

2.3.2 Development of Technical Manuals, including Inspection, Evaluation, Repair and Operation Guideline

(1) General

The draft technical manuals for road and bridge maintenance and slope protection were prepared for addressing the issues identified during the above-mentioned review works. The draft manuals are composed of inspection, evaluation and repair and prepared by highlighting the following points: i) usage of technical manuals needs to be integrated into decision making process: e.g., standard forms and reporting system for monitoring and

evaluation of the work, technical specification, ii) maintenance cycle, inspection/ evaluation/ implementation, needs to be designed and absorbed with minor institutional re-organization, iii) sustainable capacity building needs to be enhanced, by developing self-reliant training capability, iv) the contents of the manual should be comprehensive, covering inspection, evaluation and repair works, v) inspection and evaluation items are clearly described and carefully developed, considering existing system, such as RMS, BMS and PBC, vi) work procedure is illustrated by visual aids, such as pictures and drawings, to assist sufficient understanding of the users.

Contents of technical manuals are as shown in the following figure.

Source: JICA Expert Team

Figure 2.3.3 Provisional Contents of Technical Manual

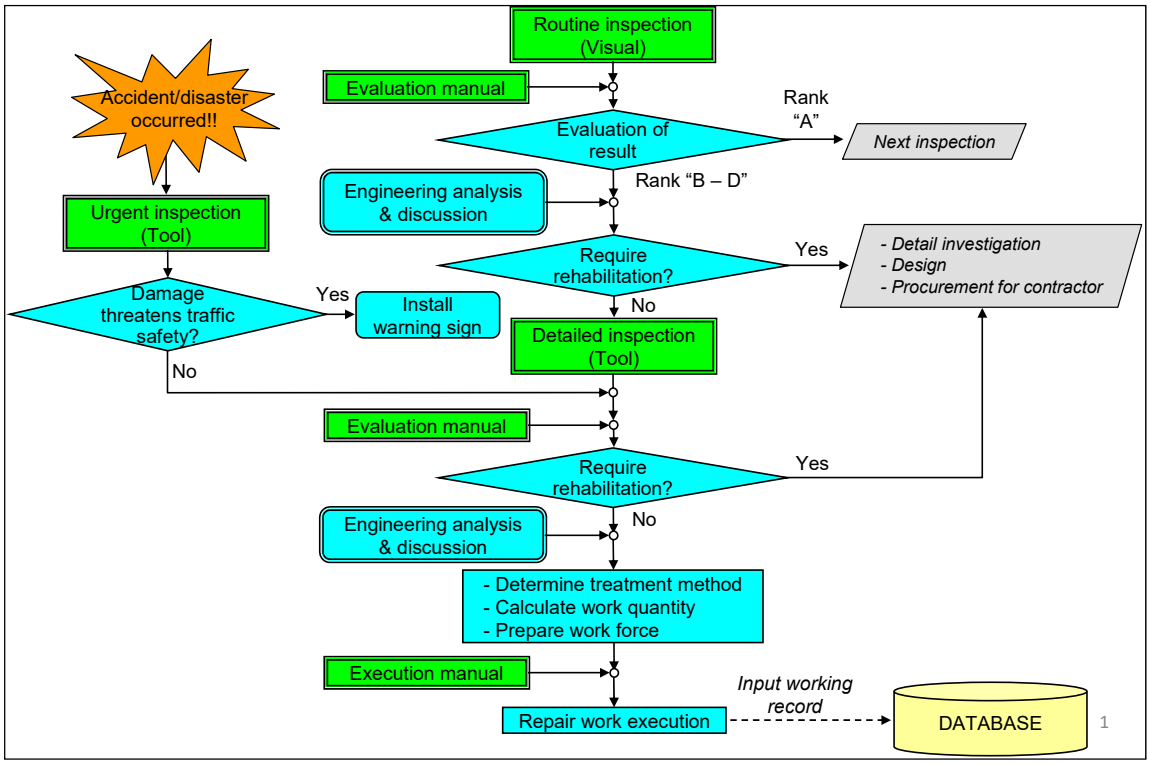
(2) Road Maintenance

1) Purpose of the Development of the Manual

Currently, paved roads are maintained by the local contractor(s) under the PBC. However, as seen in the previous sections, the road maintenance system and methodology are still lacking, especially that for the asphalt concrete roads. Hence the Experts developed the draft manual to apply for maintenance work of asphalt concrete roads for both implementing agencies and local contractors.

2) Work Procedure of the Road Maintenance Management

Road maintenance work is composed of 3 major activities namely (i) inspection, (ii) evaluation and (iii) repair work. These activities are closely interrelated. The implementing agency should appropriately conduct the work by applying the manuals. A comprehensive work flow of road maintenance activities is shown in the following figure.



Source: JICA Expert Team

Figure 2.3.4 Comprehensive Work Flow of Road Maintenance Activities

3) Finalization and Submission of the Manuals (Version-01)

(i) Establishment of Sub-working Group (SWG)

The Expert Team and the counterparts from DOR, DPWT, PTTI and PTRI established the Sub-working Group (SWG) to jointly work for the finalization of the technical manuals. The members were assigned for finalization of each manual. The scope of work of the SWG is described below.

- Review the draft manual (prepared in English) and identify technical and operational issues
- Revise the draft manual and prepare Manual Version-01 (in English)
- Translate to Laotian
- Check and review the translated manual and prepare Manual Version-01 (in Lao)

Joint meeting of the SWG were held 4 times on the following dates.

- 1st : 09/Apr/2013
- 2nd : 20/Aug/2013
- 3rd : 06/Nov/2013
- 4th : 20/Dec/2013

The SWG completed the finalization work of the manuals by February, 2014. Subsequently, the Manual Version-01 was submitted to DOR for the final check in June 2014. After checked and approved by DOR, the finalized Manual Version-01 was submitted in September 2014. In Sam Sang Meeting organized for three days in September 2014, which called up for the representative of each department in MPWT,

DPWTs and OPWTs, the Manual Version-01 was explained and the copies were distributed for attendants from all DPWTs. The member list of the SWG is as shown in Table 2.3.1.

Table 2.3.1 Review Team Member of Technical Manual

Road		Bridge		Slope	
Name	Organization	Name	Organization	Name	Organization
1. Leader Mr. Siriphone	PTTC	1. Leader Mr. Sisomphone	PTTC	1. Leader Mr. Vongsak	PTI
2. Deputy Mr. Soulivanh	RAD	2. Deputy Mr. Phonephana	TED	2. Deputy Mr. Khampasay	LRD
3. Mr. Souvanh	DPWT ZVK	3. Mr. Khammy	DPWT ZVK	3. Mr. Vongdeuan	LRD
4. Mr. Khamlune	PTI	4. Mr. Somsanouk	DPWT Vientiane	4. Mr. Korakan	DPWT Vientiane
5. Mr. Sermmany	TED				
6. Mr. Phitsaphonh	RAD				

Source: JICA Expert Team

(ii) Prospective revision of the Manual

The revision works of the Manual Version-01 will be done in collaboration with ADB Project, considering the following bullet points.

- Unification of the codes of repair works with MAC codes.
- Modification of technical manuals to be integrated into e.g., standard forms and reporting system for monitoring and evaluation of the work, technical specification

(3) Bridge Maintenance

The first draft of Bridge Maintenance Manual was prepared based on review of the existing manual, the interview results of the manual users, and site visit surveys. The manual is divided into three parts including “inspection”, “evaluation” and “execution works”. The descriptions of scope of maintenance work are clearly defined. Besides, inspection sheet, necessary equipment and work procedure, including the format of report of each activity are attached to the manual.

As discussed above, the final versions of Manuals Version-01 were submitted to DOR in September 2014.

Source: JICA Expert Team

Figure 2.3.5 Workshop of SWG

(4) Slope Maintenance

The slope maintenance manual was drafted in January 2013. A dissemination workshop for the manual was held on 29 January 2013 in order for counterparts to understand and to exchange ideas on the technical manual. In the workshop, the Expert Team explained the contents of slope maintenance manual to counterparts, from RAD, LRD, Technique and Environment Division (TED), PTRI and PTTI and the counterparts raised some comments. Based on the comments raised in the workshop, the Expert Team revised the draft manual.

Between 1st and 5th April, 2013, the intensive training on slope maintenance was conducted in Vang Vieng in Vientiane Province. 22 trainees from relevant counterpart agencies including DOR, DPWT Vientiane and Savannakhet and OPWT Vientiane Province and local consultants participated in the training in order to gain better understanding of slope failure along NR-13 North and appropriate countermeasures for slope protection. The trainees learned mechanisms of slope failure as well as proper inspection, evaluation and rehabilitation methods.

Opening Remarks by DOR

Lectures by PTTI Staff

Practices on Slope Inspection by the Expert

Explanation on Key Points of Inspection by the Expert

Source: JICA Expert Team

Figure 2.3.6 Photos: Intensive Training on Slope

(5) Performance Based Contract

DBST paved roads were maintained by the local contractors under the PBC in Laos. In order to solve the current maintenance issues which were recognized in a series of review works, PBC was revised by the Expert Team in terms of narrowing down the maintenance contents, defining of the responsibilities of contractors and preparation of necessary formats in practical operation. Draft revised PBC was presented by the Expert Team in a workshop on July 25, 2013. In the workshop, the stakeholders and counterparts from DOR, RAD, TED and LRD attended and exchanged their opinions. Based on these comments raised in the workshop, the Experts revised the draft revised PBC, and then 2nd, 3rd and 4th incentive trainings were conducted in different provinces between February and July 2014.

Pilot Project of Performance Based Contract was conducted in four different roads/provinces for one-year period from December 2014 as a trial, using the RMF. As result of negotiation of bidding, Pilot Project in Phongsali was monitored for its performance of PBC maintenance works. Kickoff meeting was held on 31th July 2015 after completion of initial rehabilitation and before commencement of PBC maintenance. In the kickoff meeting, Summary of PBC and daily activities were explained to contractor and staff of DOR, DPWT and OPWT.

Source: JICA Expert Team

Figure 2.3.7 Photos: Kickoff Meeting in Phongsali

2.3.3 Monitor Utilization of Technical Manuals and Evaluate their Usage and Relevance for its Revision and Finalization

(1) Road Maintenance

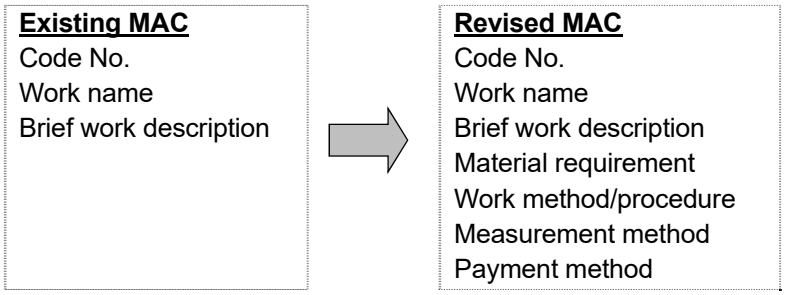
As mentioned above, the work scope of other road rehabilitation and maintenance project financed by the ADB (i.e. Lao Road Sector Governance and Maintenance Project) stipulates that the manual developed by the JICA Project will be revised and finalized for official adoption in the Lao Government. Currently, the revision work has been in progress under the mutual cooperation in line with the following procedures.

(i) Revision of the MAC (formation to standard technical specifications)

The Maintenance Activity Code (MAC) was initially developed for that the local contractors would have common understanding of each code and propose corresponding unit rate in

the BOQ adequately when they participated in the bidding of road maintenance projects undertaken by the MPWT. MAC was established in 1999 and the latest revision work was done in 2002. However, the existing MAC contains only code name and its brief work explanation. Detailed work contents (e.g. material specification, work procedure) are not stipulated herein and it is inadequate to fulfill the proper work procedure. Therefore, the Project reviewed existing MAC for that the revised MAC would be a part of bidding/contract documents as standard technical specifications of the maintenance work.

Furthermore, the Project made correction and/or additional description in case that the contents of existing MAC were technically improper and/or insufficient to rectify possible damages.



The Project implemented the above revision works and submitted the revised MAC (draft) to the MPWT. The ADB project will take over further revision works, following below schedule up to the finalization.

	Work item	Tentative Date	Responsible Project
1.	Workshop for revised MAC	26 April 2018	JICA/ADB
2.	Submit revised MAC in accordance with feedback of the Workshop	May 2018	ADB
3.	Review of revised MAC by MPWT	By June 2018	
4.	Submit draft final MAC in accordance with the above review	July 2018	

(ii) Revision of the technical manual

The Project also implemented revision work of the technical manual in parallel with the MAC revision work. Major work contents are as follows;

- The manual initially developed by the Project was specialized to be applied for paved roads (i.e. bituminous and asphalt concrete). On the other hand, the MAC contains the work of unpaved roads. Therefore, the work contents for unpaved roads were additionally described in the revised manual.
- The work component would be rearranged in accordance with the revised MAC.
- The description of the manual would be further reviewed and modified in case if any appropriate description is necessary.

(iii) Finalization of Technical Manual

The manual will be revised in compliance with the revised MAC (to be technical standard specifications). Subsequently, the revised manual will be trialed through the OJT under the ADB project and/or other projects. Consequently, the manual will be finalized in accordance with feedback from utilization of these projects under the ADB project.

(2) Bridge Maintenance

As part of monitoring exercise of the manual, DPWT Savannakhet, using the bridge maintenance manual, repaired bridges along NR-9 with supports from the Experts. The bridge repair works was done as urgent bridge repair work project, financed by the RMF.

Through the repairing works of bridges along NR-9, the capability of provincial DPWT staff(s) and local contractor(s) was evaluated as follows:

[DPWT]

- DPWT staff was able to evaluate the damage of bridges by the manual.
- DPWT staff was able to determine quantities of damage properly by using the manual.
- DPWT staff was able to select execution method and material properly.
- DPWT staff was able to instruct the contractor, using the manual.
- DPWT staff was not able to do construction management and reporting works, using the manual.

[Contractor]

- The Contractor who participated in the intensive training and workshop under the Project, understood well about the procedure of repairing works and selection of appropriated material.
- However, Contractors still lacked knowledge on the safety management during repairing works, such as traffic control of heavy trucks and safety control during repairing works. The proper instruction by DPWT was also identified necessary.

Repair of Main Girder (Before)

Repairing of Main Girder (After)

Repairing of Slap

Repairing of Expansion Joint

Source: JICA Expert Team

Figure 2.3.8 Repair Works for Bridges along NR-9

(3) Slope Maintenance

The utilization of the slope maintenance manual was monitored after the intensive training in April 2013. Through the intensive training course, the level of slope maintenance skill was increased by the lecture and fieldworks, according to the training evaluation report. The draft manual is considered to work appropriately for the maintenance activities by both DPWT and local contractors. For further improvements, comments through the discussion in the intensive training and SWG were taken into account for revision works of the slope maintenance manual.

2.4 Improvement of Capacity of Physical Road/Bridge Maintenance Work

2.4.1 Review Current Situation and Obtain Baseline Capabilities on Physical Maintenance Works and Formulate Training Plan and Monitoring Plan

(1) Road Maintenance

1) Current Situation of Road Maintenance Management in Laos

At the beginning of the Project, local contractors were undertaking road maintenance work of paved roads under the Performance Based Contract (PBC). DPWTs are responsible for monitoring the contractor's works such as confirmation of the service level designated in the contract document. However, the PBC was found not properly implemented due to several reasons[6]. Also, DPWT itself doesn't own the sufficient resources for monitoring the maintenance work such as equipment and personnel. Furthermore, local capacity for maintenance of asphalt concrete road in both DPWTs and local contractor(s) was found still absent.

2) Training Plan and Monitoring Plan for Capacity Development

The Project prepared the training programs, composed of intensive trainings and on-the-job trainings (OJTs) for the capacity development of DPWT for appropriate implementation of road maintenance management. Further, local contractors were invited to the intensive training since they are implementation bodies for road maintenance work under current maintenance system. Therefore, capacity development of the contractors is also found crucial. Detailed contents of the trainings are described in the following section.

2.4.2 Conduct on-the-job training (OJT) in Pilot Provinces

(1) Preparation of OJT Program

Following the discussions with the DOR and other concerned departments of the MPWT, the Expert Team has prepared the technical transfer program under the Project. Four components of technical transfer programs were prepared to enhance the road maintenance capacity. The on-the-job training (OJT) for the maintenance in the DPWT focuses the following four components;

- Component-1: Supervision ability and road patrol
- Component-2: Routine maintenance of asphalt concrete pavement
- Component-3: Bridge maintenance
- Component-4: Road disaster management (Slope protection)

The technical transfer program was designed under the assumption that a maintenance unit or a task force for road maintenance would be established in the pilot provinces. Each component of OJT was conducted by the assistance of the Expert Team in collaboration

[6] 1) Although existing PBC required the performance for all road infrastructure including road, bridge and road facilities, the contract should be applied only for pavement maintenance for taking account of the available budget, 2) Since the duties and responsibilities were not defined clearly between implementation organization and local contractors, operation manual was found necessary, and 3) technical trainings including practical lessons for implementation organization and local contractors were required, since training sessions were not enough for them to understand well when new PBC was in practice in May 2012

with PTTI and DOR. The Expert Team also conducted monitoring and evaluation of these OJT programs to assure the quality and performance of the OJT.

(2) Budgeting of OJT Program

In May 2012, the Expert Team presented the annual operation and maintenance cost, which amounted to around USD 140,000 per annum for implementation of OJT and which was proposed to the draft budgetary plan of the DOR. The amount of USD 25,000 was set aside to be allocated for the implementation of OJT in 2012-13, and the expenditure of RMF once included the budget for OJT, however it abandoned due to that RMF was restrict to be used in maintenance activities only. Accordingly, the DOR and Expert Team seek for the budget for implementation of the Pilot Project, which was finally approved by the MPWT and allocated for implementation of the Pilot Project as described in the following section.

(3) Procurement of Maintenance Vehicles and Equipment

As part of the Project, JICA Laos Office procured vehicles and equipment necessary for the implementation of routine maintenance in two pilot provinces. The list of vehicles and equipment procured is shown in Table 2.4.1. The vehicles and equipment were handed over from JICA Laos Office to Savannakhet Province in the presence of Vice Governor of Savannakhet and Chief Representative of JICA Laos Office on 19th July 2012. For the operation and maintenance of the vehicles and equipment, MOU was signed among four parties; DOR, DPWT Savannakhet, DPWT Vientiane and JICA Laos Office, on 28th September 2012.

Table 2.4.1 List of Maintenance Vehicles and Equipment Procured under the Project

No.	Items	Savannakhet	Vientiane	Total
1	Dump Truck	1	1	2 unit
2	Truck with Crane	1	1	2 unit
3	Wheel Backhoe Loader	1	1	2 unit
4	Double Cab Truck	2	2	4 unit
5**	Station Wagon	1(1)	1(1)	2(2) unit
6*	Asphalt Cutter	2	-	2 unit
7*	Vibration Plate Compactor	2	-	2 unit
8*	Hand Breaker	2	-	2 unit
9*	Air Compressor	1	-	1 unit
10*	Asphalt Sprayer	1	-	1 unit
11*	Hand-guided Roller	1	-	1 unit
12*	Low-pressure Filler Injection Pump	3	3	6 unit
13*	Core Cutter	1	1	2 unit
14*	Electric Generator	1	1	2 unit

Remarks:

"*" in the list are subject to the discussion with the counterparts for the necessary equipment upon finalizing the scheduled activities in technical transfer program (OJT).

"**" of the number in parenthesis are to be used by JICA Expert Team for the activities of Project including site survey, technical transfer program, Pilot Project, and other purpose required for the Project.

Source: JICA Expert Team

(4) Intensive Training

Intensive trainings were carried out to develop common understanding of the management of road infrastructure and skills and knowledge on physical maintenance works. The intensive training session focuses on maintenance of asphalt surface, DBST surface, bridges and slope/drainage on national roads in the pilot provinces. Trainees were selected from technical staffs in the DPWTs, OPWTs and local contractors in the pilot provinces. Detail of the training contents is described in the following section.

1) Road Maintenance

The Project conducted the intensive training from road maintenance from 21 to 25 January 2013 in Savannakhet Province. The training contents are summarized as follows. In order to evaluate the capacity of trainees, skill tests as well as training evaluation survey were carried out before and after the intensive training.

(i) General

Purpose of Training

The purpose of the training is to improve knowledge for application of the manual to maintenance works for the potential users including DPWT, OPWT, DOR and local contractors.

Schedule and Venue

- Period: 21/Jan (Mon) – 25/Jan (Fri), 2013
- Venue: Conference Room, DPWT Savannakhet (classroom) and NR-9 (fieldwork)

Trainees

Total 29 persons: MPWT (6 persons), DPWT-Vientiane (3), DPWT-Savannakhet (6), OPWT-Savannakhet (8), and Contractors (6)

Timetable

Table 2.4.2 Time Table of Intensive Training for Road Maintenance

Class	From	To	21-Jan	22-Jan
			Mon	Tue
			I. Routine maintenance	
			Classwork	Fieldwork
1	8:30	10:00	**OPENING REMARKS** **0. GENERAL INFORMATION** (1) Training schedule **1. INTRODUCTION** (0) What is CaRoL? (1) Purpose of development of manual (2) Covergage of manual (3) Work procedure **2. INSPECTION** 2.1 Type of inspection 2.2 Type of defect	(Class) - Guidance - Check tool & vehicle - Move to site (Site) 2.3 Routine inspection - Trial inspection (type-1) (5Km: Km 35 - 40) - Trial inspection (type-2) (road side: Km 35 - 40) 2.4 Detailed & urgent inspection - Trial inspection-1 (500m: Km 35 - 40)
Break	10:00	10:20		
2	10:20	11:50	2.3 Routine inspection (1) Work frequency & input (2) Inspection item & work type (3) Work procedures 2.4 Detailed & urgent inspection (1) Work frequency & input (2) Work procedures	
Lunch	11:50	13:00	in Savannakhet town	on site
3	13:00	14:30	**3. EVALUATION** 3.1 Method & procedure of routine inspection 3.2 Method & procedure of detailed & urgent inspection **4. REPAIR WORK** 4.1 Planning of implementation program (1) Repair work (2) Safety measure	4.2 Repair work execution (Km35 - 40) - Crack seal (Km35 - 45), A=10m2 - Patching, A=1m2@3locations - Spot replacement, A=10m2 - Move to office
Break	14:30	14:50		
4	14:50	16:20	4.2 Repair work execution 4.3 Recording & reporting	

Class	From	To	23-Jan	24-Jan	25-Jan
			Wed	Thu	Fri
			II. Large scale rehabilitation		
			Classwork	Fieldwork (NR9 project)	Classwork
1	8:30	10:00	**2.1 PLANNING & DESIGN** 2.1.1 Introduction 2.1.2 Survey work	(Class) - Guidance - Check tool & vehicle - Move to site (Site) - Crushing plant - Asphalt plant - Measurement control - Move to office	*** PRESENTATION OF REPORT**
Break	10:00	10:20			
2	10:20	11:50	2.1.3 Planning & design 2.1.4 Construction planning 2.1.5 Cost estimate		*** SKILL TEST** *** HANDOVER OF CERTIFICATE** *** CLOSING REMARKS**
Lunch	11:50	13:00	in Savannakhet town	in Savannakhet town	
3	13:00	14:30	**2.2 CONSTRUCTION SUPERVISION** 2.2.1 Introduction 2.2.2 Component of supervision work 2.2.3 Description of supervision work	*** DRAFTING WORK OF REPORT** - Rotine inspection - Detailed inspection - Evaluation	
Break	14:30	14:50			
4	14:50	16:20	**(Continued)**	**(Continued)**	

Source: JICA Expert Team

(ii) Photos of Training

Opening remarks

Classwork (routine maintenance)

Routine inspection (culvert)

Detailed inspection (pavement)

Repair work (spot replacement)

Repair work (spot replacement)

Repair work (crack seal)

Classwork (rehabilitation)

Asphalt plant

Laboratory

Quarry

Paving work

Presentation of report

Skill test

Handover of certificate

End of training

Source: JICA Expert Team

Figure 2.4.1 Intensive Training for Road Maintenance

2) Bridge Maintenance

1st Intensive Training for Bridge Maintenance

In order to monitor utilization of bridge maintenance manual and evaluate their usage, the intensive training was conducted from 17th to 20th December 2012.

The intensive training was divided into lecture (classroom) and fieldwork. In the lecture, inspection, evaluation and execution work (repair work) including the methodology of each work and work plan were explained. On-site demonstration of routine inspection, periodic inspection, evaluation and execution work were conducted by using the technical manual. Bridge maintenance works in the training concentrated on crack sealing, repairing of damaged main girder of the bridge, repainting of guard rail, steel bearing, cleaning and minor repair of expansion joint, water drainage facilities and cleaning surround of the bridges.

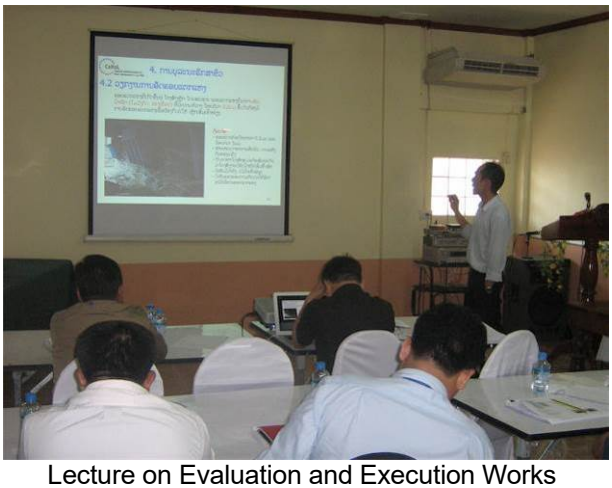
In order to evaluate the capacity of trainees, skill tests as well as training evaluation survey were carried out before and after the intensive training.

Table 2.4.3 Intensive Program for Bridge Maintenance Work

Class	Time		12/17/2012 (Monday)	12/18/2012 (Tuesday)	12/19/2012 (Wednesday)	12/20/2012 (Thursday)
	From	To	Classwork	Classwork / Field Work	Field Work	Classwork
1	8:30	10:00	**1. Comprehansive** - Guidance - Overall Training Schedule **2. Lecture on Bridge Inspection Work** - Inpsection work flow - Point of view in inspection - Frequency of bridge maintenance	**1. Preparation** - Guidance - Confirm work procedure & each task - Check Tool & Vehicle **2. Inspection** - Start inspection of Huay Lai Bridge - Works can be done during inspection - Record - Move to next site - Start inspection of Huay Kasae Bridge - Work can be done during inspection - Record - Move to next site - Start inspection of Long Kong bridge - Work can be done during inspection - Record **Remark**: SIKA joint the inspection	**1. Preparation** - Confirm Work Procedure & each task - Check equipments & Vehicle **2. Execution Works** - Guidance - Start Execution Works based on the plan (Crack sealing, repair lost section, repainting guard rail, bearing, clean expansion joint, drainage facilities, surround the bridge, etc) **Remark**: SIKA demonstrate Execution Work at the site	**4. Overall Evaluation** - Guidance - Summarize of the report - Discussion **5. Skill Test** - Guidance - Skill Test
	10:00	10:10	**Break**			**Break**
2	10:10	11:40	**2. Lecture on Bridge Inspection Work** - Necessary resource - Inspection Methodology - Recording on site - Works can be done during inspection - Reporting			**6. Sammarize the Training** - Guidance - Discuss on skill test result - Sammarize through the Training **7. Close the Training** - Handover Training Certificate - Closing remark
	11:40	13:00	**Lunch at Office (Savannaketh)**	**Lunch on site**	**Lunch at Office (Savannaketh)**	**Lunch at Office (Savannaketh)**
3	13:00	14:30	**3. Evaluaton** - Select part for detail inspection - Criteria of the determination - Selection of the Treatment methodology - Ranking of priority - Reporting	**3. Return to Office** - Check Equipments and Vehicle - Summarize the record - Draft Report **4. Evaluation** - Guidance - Evaluation of the result of inspection - Determind the Execution method - Draft Work Plan **Remark**: SIKA Preparing for Execution Work at the site	**3. Execution Works (Continue)** - Execution Works based on the plan (Crack sealing, repair lost section, repainting guard rail, bearing, clean expansion joint, drainage facilities, surround the bridge, etc) - Record Remark: SIKA demonstrate Execution Work at the site **4. Return to Office** - Check Equipment and Vehicle - Summarize the record - Draft Report	
	14:30	14:40	**Break**			
4	14:40	16:30	**4. Typical repair works** - Crack sealing, repair of lost section* - Repainting of guard rail, bearing - Cleaning and mino repair of expansion - Cleaning of drainge facility, etc... - Necessary resource - Work procedure - Recording on the site - Reporting **Remark**: * Prepairied by SIKA from **15:30** to **16:30**			

Source: JICA Expert Team

Lecture on Inspection Works



Lecture on Evaluation and Execution Works

Demonstration of Bridge Surface Inspection

Demonstration of Bridge Structure Inspection

Presentation by Trainee

Demonstration of Crack sealing

Source: JICA Expert Team

Figure 2.4.2 Photos: Intensive Training of Bridge Maintenance Manual

2nd Intensive Training for Bridge Maintenance

In line with the budget allocation of urgent repair works of selected bridges along NR-13 South and NR-9, the Expert Team organized the 2nd Intensive training (workshop) between 27th and 30th May 2013. The intensive training concentrated on actual practice works such as estimation of work quantities, evaluation of the damage and selection of execution method by DPWT and the contractor to use the manual properly before

repairing works. Pre- and post-skill tests were also carried out in order to evaluation the capacity of trainees.

Table 2.4.4 Time Table of 2nd Intensive Training for Bridge Maintenance

Time		05/27/2013 (Monday)	05/28/2013 (Tuesday)	05/29/2013 (Wednesday)	05/30/2013 (Thursday)
From	To	Classwork / Field Work	Field Work	Classwork / Field Work	Classwork
8:30	10:30	1. Comprehansive (CaRoL, DPWT) - Openning Remark - Overall Training Schedule 2. Guideline of Training (CaRoL, Sika) - Bridge Inspection - Repairing of Bridge Facilities (Crack Sealling, Expansion Joint, Bearing, etc.)	1. Preparation (CaRoL) - Guidance - Confirm work procedure & each task - Check Tool & Vehicle 2. Inspection Work Move to the Site + Site 1 (CaRoL, Trainee) - Carry out on Inspection (BoQ) on Site + Site 2 (CaRoL, Sika, DPWT) - Carry out the Inspection of Fired Accident Damaged bridge and Steel Girder Bridge Remark: Site 1, Huay Ta Bong Phet Bridge Site 2, Dong Ling Bridge	1. Comprehansive (CaRoL, Sika) - Conclusion of Inspection Result - Selection of the Treatment Method 2. Introduce New Technique of Repairwork - Guidance - Repairing of Expansion Joint - Reparing of Bearing Move to the Site 3. Site Visit (CaRoL, Sika) - Observation of several type of Expansion Joint and Bearing. Remark: Site on Huay Long Kong Bridge, (50 km) Se Bang Hieng Bridge (100 km)	1. Overall Evaluation (CaRoL, Sika) - Presentation of the Repairing method of Expansion Joint/Bearing - Discussion 2. Answer the Questionnaire (CaRoL)
10:30	10:40	Break			Break
10:40	11:30	3. Free Discussion (CaRoL, Sika) - Inspection Work - Collection of BoQ - Excution Work Plan - Answer the Questionnaire			6. Sammarize the Training (CaRoL) 7. Close the Training (DPWT)
11:30	13:30	Lunch and Move to the Site	Lunch	Lunch	
13:30	16:30	3. Training on Inspection and BoQ Collection - Detailed Inspectioin - Selection of the Treatment Method - BoQ Collection - Summarize - Reporting Remark: Site on Huay Ta Bong Phet Bridge (67 km)	3. Return to Site 1 - Checking the Inspection Result, which done by Trainees. - Adjust the BoQ by the Expert Remark: Site 1, Huay Ta Bong Phet Bridge (67 km)	4. Site Visit (Continue) - Obersvation of Several type of Expansion Joint and Bearing. Remark: Site on Huay Long Kong Bridge (50 km), Se Bang Hieng Bridge (100km)	

Source: JICA Expert Team

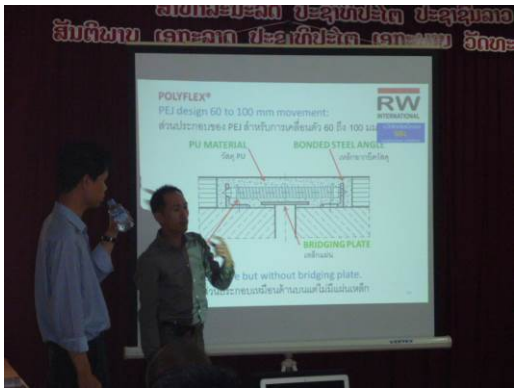
Inspection, Evaluation and Selection of Execution Method

Practice on Inspection Work (Determined Works Quantities)

Method of Determine the quantities of Damage

Evaluation the Results of Trainee

Inspection of Expansion Joint



Evaluation of Damage and Proposal of Execution Method

Source: JICA Expert Team

Figure 2.4.3 2nd Intensive Training for Bridge Maintenance

3) Performance Based Contract

A series of intensive trainings were conducted to gain knowledge on operational method for revised PBC, involving DOR, DPWTs, OPWTs and local contractors. The training contents are summarized as follows.

i) General

Purpose of Training

The purpose of the training is to improve knowledge on how to apply the revised PBC to maintenance works for the potential users including DOR, DPWT, OPWT and local contractors.

Location, Schedule and Trainee

Location	Schedule	Trainee
Vientiane(RAD)	12th Feb – 14th Feb 2014	MPWT: 22 people
Savannakhet	4th April – 7th April 2014	DPWT: 6 people OPWT: 33 people Contractor: 33 people
Luang Prabang	13th May – 16th May 2014	PTTI: 1 person DPWT: 9 people OPWT: 30 people Contractor: 42 people
Pakse	1st July – 4th July 2014	PTTI: 1 person DPWT: 9 people OPWT: 21 people Contractor: 21 people

Timetable

Date	*Time*	*Contents*
1st day	08:30 – 09:00	- **Opening Remarks**
		- **Explanation of training schedule** by the Expert Team
		- **Explanation of classroom/fieldwork** by RMP
	09:00 – 09:30	- Classroom : **Skill test**
	09:30– 10:00	- Classroom : **Introduction of PBC**
	10:00 – 10:20	- Tea break
	10:20 – 11:20	- Classroom : **Planning of PBC**
	11:20 – 11:50	- Classroom : **Discussion**
	11:50 – 13:00	- Lunch break
	13:00 – 14:30	- Classroom : **Operation of PBC**
	14:30 – 14:50	- Tea break
	14:50 – 15:20	- Classroom : **Procurement of PBC**
	15:20 – 16:20	- Classroom : **Discussion**
2nd day	08:30 – 10:00	- Classroom: **Introduction of VIMS (incl. demo)**
	10:00 – 12:00	- Fieldwork **Monitoring Exercise**
	12:00 – 13:00	- Lunch break
	13:00 – 14:30	- Classroom: **Payment Calculations and Introduction of group work**
	14:30 – 16:30	- Classroom: **Group work, Monitoring Exercise & Payment Calculations**
3rd day	08:30 – 12:00	- Classroom: **Group work, Monitoring Exercise & Payment Calculation Thursday**
	12:00 – 13:00	- Lunch break
	13:00 – 16:30	- Classroom: **Presentation of group works**
4th day	08:30 – 9:30	- Classroom: **Evaluation of presentation**
	9:30 – 10:00	- Classroom : **Skill test**
	10:00 – 10:15	- Tea break)
	10:15 – 10:45	- **Handover of certificate**
	10:45 – 11:00	- **Closing Remarks**

Source: JICA Expert Team

ii) Photos of Training

Opening remarks

Classwork

Fieldwork(1)

Fieldwork(2)

Group work

Presentation of group work

Handover of certificate

End of training

Source: JICA Expert Team

Figure 2.4.4 Intensive Training for PBC

(5) Current Situation of the OJT Program

The Project initially planned the OJT program by applying the manuals to strengthen the capability of routine road maintenance work of DPWT/OPWT under the force account system. However, the routine maintenance work has been suspended since all the budget of the RMF was channeled to rehabilitation works of the national roads. Currently, two local contractors have been implementing large-scale road (pavement) rehabilitation works including spot replacement work and overlay work in the whole section (excluding 58-km Japan's Grant Aid section) on NR-9. The routine maintenance work is to be resumed once after completion of the rehabilitation works.

2.4.3 Evaluate OJT on Routine Maintenance Work and Improve Training Modules and Training Programs

A series of intensive trainings and OJT programs have been carried out as described in Section 2.3 and 2.4. During the course of these intensive trainings and OJT programs, skill tests and training evaluations were also carried out to monitor the performance of the trainings, including the level of capacity of the trainees (see training evaluation reports in the attachment of the Final Report). Also, the Technical Manual ver.1 was submitted to DOR in 2014. In Sam Sang Workshop held in September 2014, distribution and utilization of the manual were emphasized to all DPWTs by the representative of DOR.

Also, revision of the Maintenance Activity Code (MAC) is initially proposed by the Project and undergoing under the ADB's Lao Road Sector Governance and Maintenance Project.

Therefore, finalization of the technical manual would be carried out in line with revising MAC under the support by ADB project.

2.4.4 Develop an Optimum Institutional Framework (e.g. informal task force, formal road maintenance unit) with Charter of Operations to Conduct Routine Maintenance Work

The technical transfer program under the Project was designed in consideration of the necessary capacity in DPWT to operate the routine maintenance, taking into accounts for the technical requirements for road maintenance in Laos.

(1) Organizational Set-up

Currently, DPWT contracts out all the maintenance works on the pavement to local contractors. The Project proposed to establish the maintenance unit in the DPWT, effectively allocating the tasks between local contractors and the DPWT. Overall responsibilities of DPWT/consultant/local contractor/community are described below:

- DPWT maintains DBST surfaced roads by the Performance Based Contract, contracting out the routine maintenance work to local contractors.
- DPWT sets up special maintenance unit and maintain asphalt concrete roads by force account. DPWT owns maintenance equipment and outsources manpower, including engineers and mechanics to state enterprise(s) and local contractor(s).
- For periodic maintenance and rehabilitation, DPWT contracts out the management duties to private consultants which oversee all the maintenance works by the contractors.
- DPWT compensates local community to conduct roadside routine maintenance works, including grass cutting and cleaning of roads and ditches.

(2) Duties fulfilled by the Maintenance Unit

The duties proposed to be fulfilled by the maintenance unit are detailed below.

- Inventory: records the inventory and outstanding characteristics of each section of the road.
- Inspection: examines the road section and measures and records its condition.
- Determination of maintenance requirements: analyzes effects and their causes and specifies maintenance activities needed to repair and prevent further deterioration.
- Resource and cost estimation: costs the maintenance activities in order to define the budget.
- Identification of priorities: decides the work that has to take precedence if resources are limited.
- Work scheduling and implementation: controls the work implementation.
- Monitoring: checks the quality, its progress and performance of the work.

(3) Manpower of the Maintenance Unit

The following manpower is necessary to operate the maintenance unit and conduct the physical maintenance works:

- Maintenance Supervisor (1) - to check and ensure correct conduct of the maintenance works, regular inspection, checking, and reporting on road condition for planning of new maintenance activities.

- Contract Manager (1) - to prepare cost estimates, contract documents and process award of contracts for special, recurrent and periodic maintenance activities.
- Finance Officer (1) - to process all payments, keep proper accounts, process budgetary allocation and exercise financial control on behalf of the Provincial Government.
- Administrative staff (2) - necessary administrative and support staff is allotted to the unit for its efficient functioning.
- Inspection and repair team organized by DPWT with outsourced manpower (See Table 2.4.5)

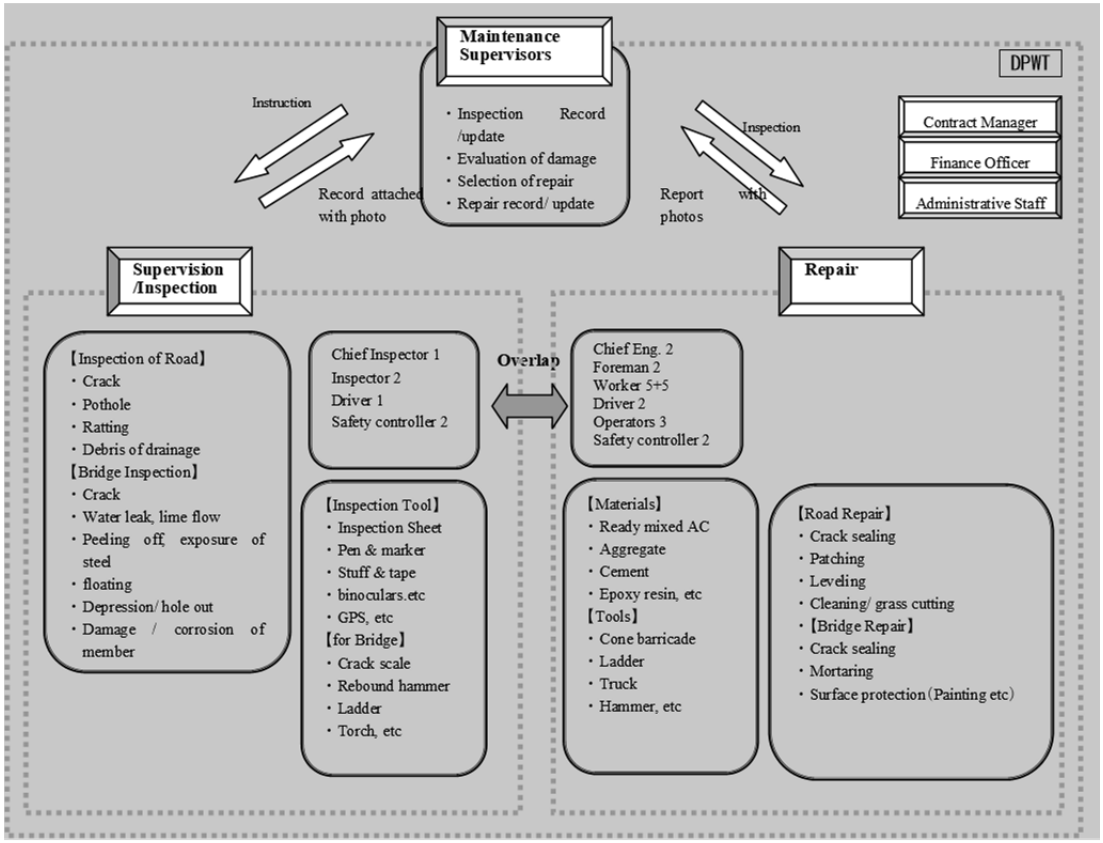
Table 2.4.5 Scheduled Manpower Inputs for OJT (Per Pilot Province)

Position	Source	1) Patrol /PBC	2) Asphalt	3)Bridge	4)Disaster	Per province
		Common	SVN only	Common	VTN only	
Chief Engineer	DPWT	1	1	1	(1)	3
Technical Staff	DPWT	2	2	2	(2)	6
Foreman of repair work	Contract	-	1	1	1	2
Workers of repair work	Contract	-	5	5	5	10
Operator-1 (Dump truck)	Contract	-	1	-	1	1
Operator-2 (Truck with crane)	Contract	-	1	-	1	1
Operator-3 (Backhoe Loader)	Contract	-	1	-	1	1
Operator-4 (Bridge)	Contract	-	-	1	-	-
Safety controller	Contract	-	2	2	2	2
Driver	Contract	-	2	1	2	1

Note: (Numbers) in parentheses of 4) are to be shared with the activities of 1).

Source: JICA Expert Team

A sample structure of the task force for the routine maintenance is described in the following figure.



Source: JICA Expert Team

Figure 2.4.5 Structure of Task Force in Pilot Province

2.4.5 Conduct a Pilot Project on Repair Work and Improve Capacities on Supervision and Quality Control for Rehabilitation of Asphalt Concrete Pavement in Savannakhet Province

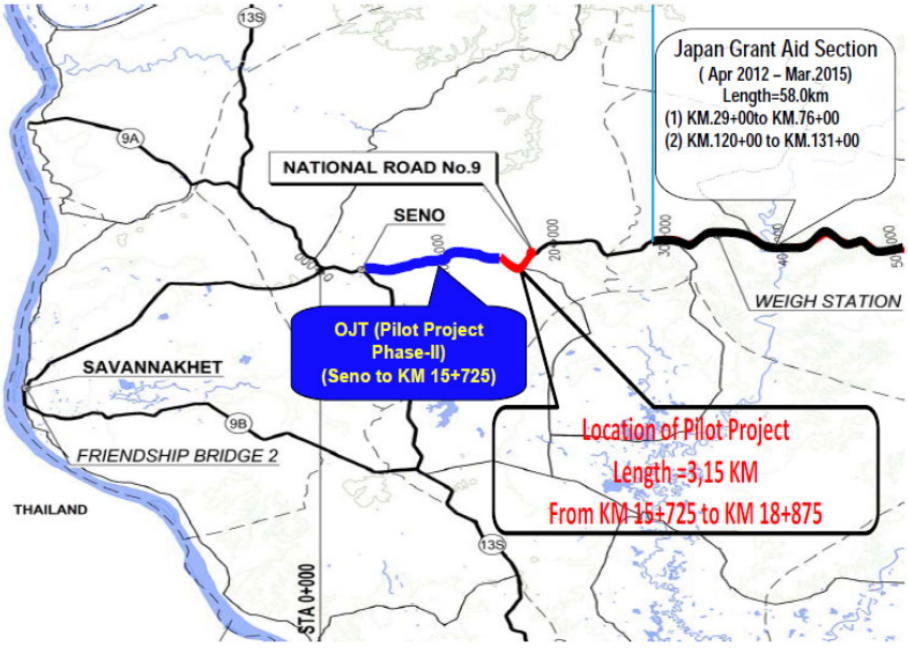
The activities of Pilot Project up to date are summarized in the Table 2.4.6. Furthermore, a location map of the Project is illustrated in the Figure 2.4.6.

Table 2.4.6 Summary of Activities for Pilot Projects on NR-9

Pilot Project	Phase-1	Phase-2	Phase-3
Fiscal year	2011/12	2012/13	2013/14
Execution period	Jan 2012 to Jun 2012	Jan 2013 to Jun 2013	Apr 2014 up to date
Length of Project	3.1km	15.7km	180km (including 74km Japan OD Section)
Objective	・ OJT program for large scaled rehabilitation of pavement for local contractor and road administration	・ OJT program for small scaled rehabilitation of AC pavement for local contractor and road administration	・ OJT program for large scaled rehabilitation of AC pavement for local contractor and road administration
Work contents	・ Patching, replacement of subsoil materials ・ Section overlay	・ Repair (patching, partial replacement and replacement of sub base and subgrade)	・ Repair (patching, partial replacement and replacement of sub base and subgrade) ・ Section overlay
Participants	・ Supervision: DPWT Savannakhet supported by Expert Team ・ Contractor: Rd No.8	・ Supervision: DPWT Savannakhet supported by Expert Team ・ Contractor: Tongkhung	・ Supervision: DPWT Savannakhet supported by Expert Team ・ Contractor :Rd No.8/ Khounxay

Pilot Project	Phase-1	Phase-2	Phase-3
Role of Japan side	• Plan and design • Cost estimate • Procurement, including bidding assistance	• Supply of AC materials	• Concept plan and design • Preliminary cost estimate
Workshop participants	• DOR • DPWT Savannakhet / Vientiane • Local contractors (4)	• DOR • DPWT Savannakhet / Vientiane • Local contractors (6)	• DOR • DPWT Savannakhet / Vientiane • Local contractors (6)
Monitoring evaluation/ Outstanding	[DPWT Savannakhet] • Improve quality control of AC pavement • Improve understanding of supervision process and work approach [Contractor] • Improve the capacity of work planning, procurement, quality control in compliance with specification, and safety control	[DPWT Savannakhet] • Improve capacity of work arrangements and order of repair works, progress and quality control, site instruction to contractor, and administration. [Contractor] • Improve capacity of work planning, procurements, quality control satisfying spec and safety control.	[DPWT Savannakhet] • Improve quality control of AC pavement • Improve understanding of supervision process and work approach [Contractor] • Improve the capacity of work planning, procurement, quality control in compliance with specification, and safety control

Source: JICA Expert Team



Source: JICA Expert Team

Figure 2.4.6 Location Map of the Pilot Projects by Phase

(1) Phase-1 (2011 – 2012)

In October 2011, the 3.1 km length road section between Stn.15+800 and Stn.18+900 along the NR-9 was selected as Pilot Project section. The components of the Pilot Project include 3.1 km overlay (t=9.0cm) works by the asphalt on the top of treated base course by crack sealing and bituminous base course and partial replacement with granular materials for the base course.

The detailed design was prepared by the Expert Team in November 2011. The tender opening of prequalified contractors was held in December 2011 and Road No.8 Construction State Enterprise was awarded for the implementation of the Pilot Project. The total amount of contract is USD 1,449,587. The construction period agreed was 180 days in total from the commencement of works on 19th January 2012 and the Pilot Project was successfully completed on 28th June 2012. The progress chart of the Pilot Project is shown in Figure 2.4.7.

Pilot Project for Rehabilitation of National Road No. 9 in Lao PDR

1).1 Progress Summary

CONSTRUCTION SCHEDULE FOR PILOT PROJECT FOR REHABILITATION OF NATIONAL ROAD No.9 (15+720 - 18+875)

Item No.	Item	Quantity	Weight%	2012 Jan	Feb	Mar	Apr	May	June	July
1	**Temporary Work**		**10.274%**							
1.1	Mobilization & Demobilization of Plant & Equipment	1.0	1.545%	0.773%	0.464%			0.309%		
1.2	Site Preparation	1.0	0.152%	0.076%	0.076%					
1.3	Assamble / Dismantle of Plant	1.0	2.001%	0.400%	1.401%			0.200%		
1.4	Site Operation & Maintenance	1.0	3.229%	1.615%	1.615%					
1.5	Traffic Safety Control	1.0	0.197%	0.099%	0.099%					
1.6	Office / Accommodation	1.0	2.704%	0.811%	1.893%					
1.7	Project Sign Board	1.0	0.110%	0.022%	0.088%					
1.8	All risk insurance and third party insurance	1.0	0.336%	0.067%	0.269%					
2	**Road Rehabilitation Works**		**89.006%**							
2.1	Crack Sealing	2,920.1	0.653%			0.196%	0.457%			
2.6	Gravel Filling for Shoulder	210.6	0.479%				0.479%			
2.2	Removal of Existing Pavement	1,141.1	0.283%			0.099%	0.184%			
2.3	Base Course Preparation	11,411.6	0.433%			0.173%	0.260%			
2.4	Base Course Preparation (Leveling)	601.0	1.530%			0.612%	0.918%			
2.7	Prime coat	11,411.6	1.386%			0.554%	0.832%			
2.8	Tack coat	69,812.6	2.938%			1.175%	1.763%			
2.5	Asphalt stabilized base course (h=100mm)	1,141.1	22.607%			15.825%	6.782%			
2.9	Asphalt wearing course (h=90mm)	2,815.0	58.697%			38.153%	20.544%			
3	**Ancillary Works**		**0.693%**							
3.1	Road Marking (White Colour)	782.0	0.693%					0.693%		
Total			100.0%							
Program of Each Month				3.862%	7.537%	57.804%	29.568%	1.202%	9.270%	2.000%
Accumulated program				3.862%	11.399%	69.203%	98.771%	100.0%		
Program of Each Month revised				3.60%	10.00%	55.00%	75.00%	90.00%	98.00%	100.00%
Actual progress				3.27%	5.54%	23.14%	23.84%	32.94%	11.27%	
Summary progress				3.270%	8.810%	31.950%	55.790%	88.730%	100.0%	
Difference				-0.592%	-2.589%	-37.253%	-42.981%	-11.270%	2.0%	

Source: JICA Expert Team

Figure 2.4.7 Progress Chart of the Pilot Project Phase-1

Before rehabilitation

After rehabilitation

Source: JICA Expert Team

Figure 2.4.8 Comparative of Road Condition

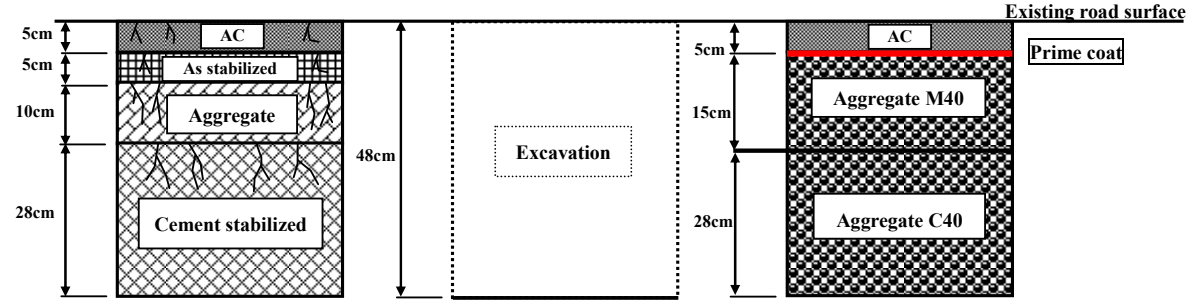
On 20th July 2012, in order to share the knowledge and skills which the Contractor learnt through the activities in Pilot Project (Phase-1), the workshop was organized at the conference room of DPWT Savannakhet. The staffs from DPWTs, OPWTs and the engineers from local contractors involved in the rehabilitation of NR-9 attended the said workshop. During the workshop, the project manager from DPWT Savannakhet made a presentation on the contents of the Project and related activities on NR-9 including technical transfer program of road maintenance for AC pavement road, quality control, etc. Afterward, the panel discussion was continued discussing the case study of the Pilot Project. The workshop was successfully conducted especially for local staff of the contractors to enhance construction supervision abilities and know-how of maintenance skills for asphalt concrete pavement.

Source: JICA Expert Team

Figure 2.4.9 Workshop for Pilot Project

(2) Phase-2 (2012 – 2013)

Considering financial options, the Expert Team designed the scope of the OJT and Pilot Project Phase-2 and proposed to conduct OJT, using planned rehabilitation works on NR-9 by the DPWT Savannakhet. Thongkoun Houngheung Company was engaged in the periodic maintenance works with the contract amount of 150,000 USD at the section between Seno and Nonevilay (the starting point of Pilot Project Phase-1). The OJT on the routine maintenance of asphalt concrete pavement works was carried, followed by addendum of the contract. To do so, the materials, equipment and machinery were provided by the Project and JICA Laos Office. The OJT and Pilot Project contributed to capacity development on the routine maintenance of the asphalt concrete pavement for both DPWT Savannakhet (such as supervision works and quality control) and local contractors. A work process is shown in Figure 2.4.10 and the location and quantity of each work are shown in Table 2.4.7. Moreover, the work progress chart and photos of road condition (before and after Pilot Project) are illustrated in Figure 2.4.11 and 2.4.12 respectively.



Existing pavement (damaged) ⇒ Remove ⇒ Filled with new material

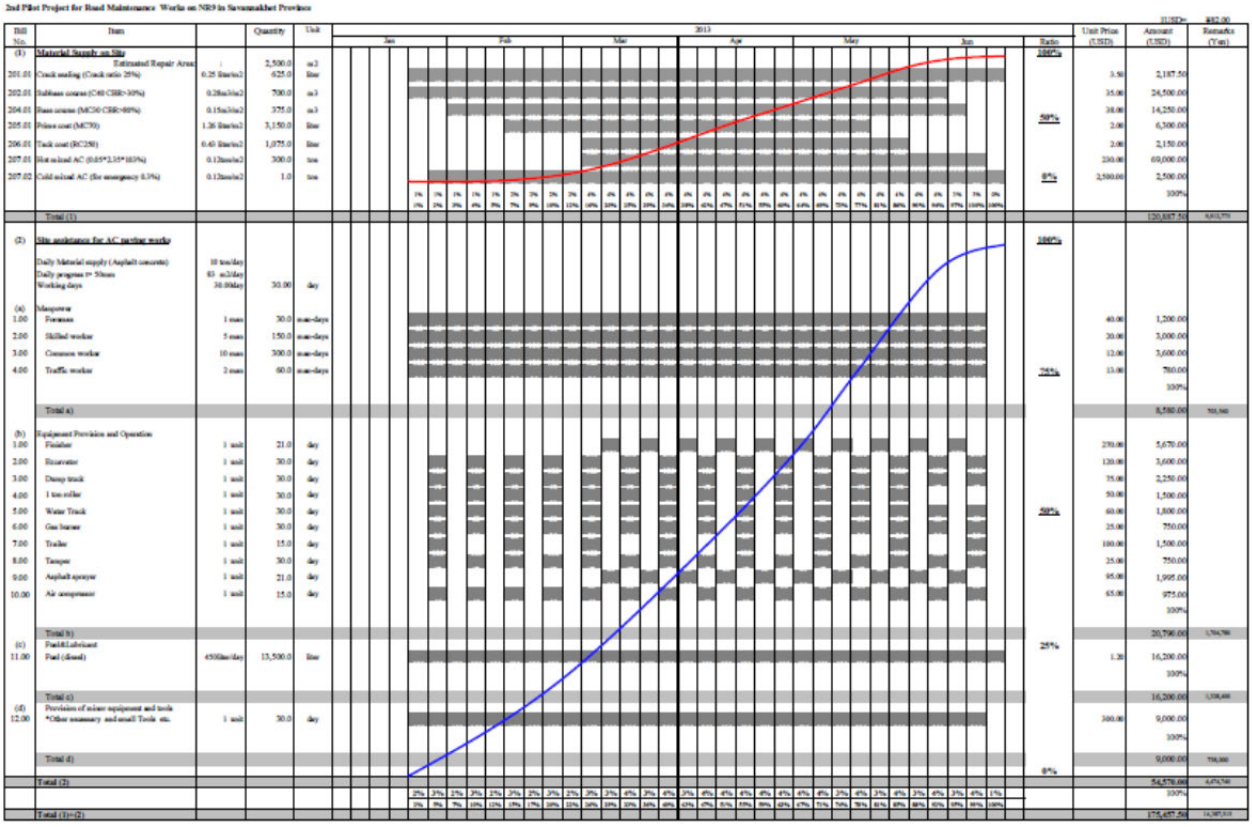
Source: JICA Expert Team

Figure 2.4.10 Work Process of the Pilot Project Phase-2

Table 2.4.7 Location and Quantity of the Work

No.	Start				End			Area (m2)
1	39	+	940	to	39	+	970	135.00
2	40	+	580	to	40	+	588	32.00
3	40	+	600	to	40	+	624	225.60
4	40	+	650	to	40	+	675	235.00
6	41	+	160	to	41	+	188	131.60
5	41	+	155	to	41	+	189	159.80
7	41	+	930	to	41	+	947	76.50
8	41	+	950	to	41	+	960	47.00
9	42	+	400	to	42	+	414	65.80
10	42	+	700	to	42	+	708	37.60
11	43	+	600	to	43	+	622	103.40
12	43	+	650	to	43	+	662	56.40
13	43	+	670	to	43	+	688	72.00
14	43	+	700	to	43	+	760	282.00
15	44	+	990	to	45	+	14	225.60
16	45	+	80	to	45	+	116	432.00
17	45	+	116	to	45	+	147	182.59
							Total	**2,499.89**

Source: JICA Expert Team



Source: JICA Expert Team

Figure 2.4.11 Progress Chart and Quantities of the Pilot Project Phase-2

Before repair After repair

Source: JICA Expert Team

Figure 2.4.12 Comparative Photos of Road Condition

Implementation schedule (Phase-2) is summarized as follows.

- Selection of repair method and section: October 2012
- Preparation of procurement documents : Late October 2012
- Discussion with DPWT on revised contract with local contractor: November 2012
- Negotiation with local contractor: December 2012
- Procurement of material supplier : January 2013

- Contract between material supplier and JICA: January 2013
- Commencement of works: end of January 2013
- Workshop: April 2013
- Completion of works: end of June 2013

For the capacity building purpose of DPWT Savannakhet, OPWTs, and local contractors involved in the maintenance of NR-9, the workshop was organized on 7th April 2013 under the Project. Photos of the workshop are as shown in Figure 2.4.13. The details of evaluation of workshop are separately reported and attached as the evaluation report.

Classroom training in field

Classroom training in field

Asphalt paving works by finisher

Compaction by tire roller

Source: JICA Expert Team

Figure 2.4.13 Workshop in Savannakhet

As the overall assessment of workshop including the skill test results of participants, more than 90% of the participants were satisfied with the contents of workshop and also most of participants were able to understand the contents of routine maintenance works of AC pavement. Accordingly, most participants involved in the maintenance works of NR9 were found familiar with the maintenance works for AC pavement through actual site works on NR-9. In the workshop, the various filed trainings were conducted including operation method of machinery for paving works, compaction works by tire roller and hand compactor, raking asphalt and crack sealing were also conducted. The opinions were collected from most participants and who expect for continuous training that contributes usefully to the actual works on site. Part of the result of questionnaire survey is shown in Figure 2.4.14.

.

Source: JICA Expert Team

Figure 2.4.14 Results of Questionnaire

(3) Phase-3 (2013 – 2014)

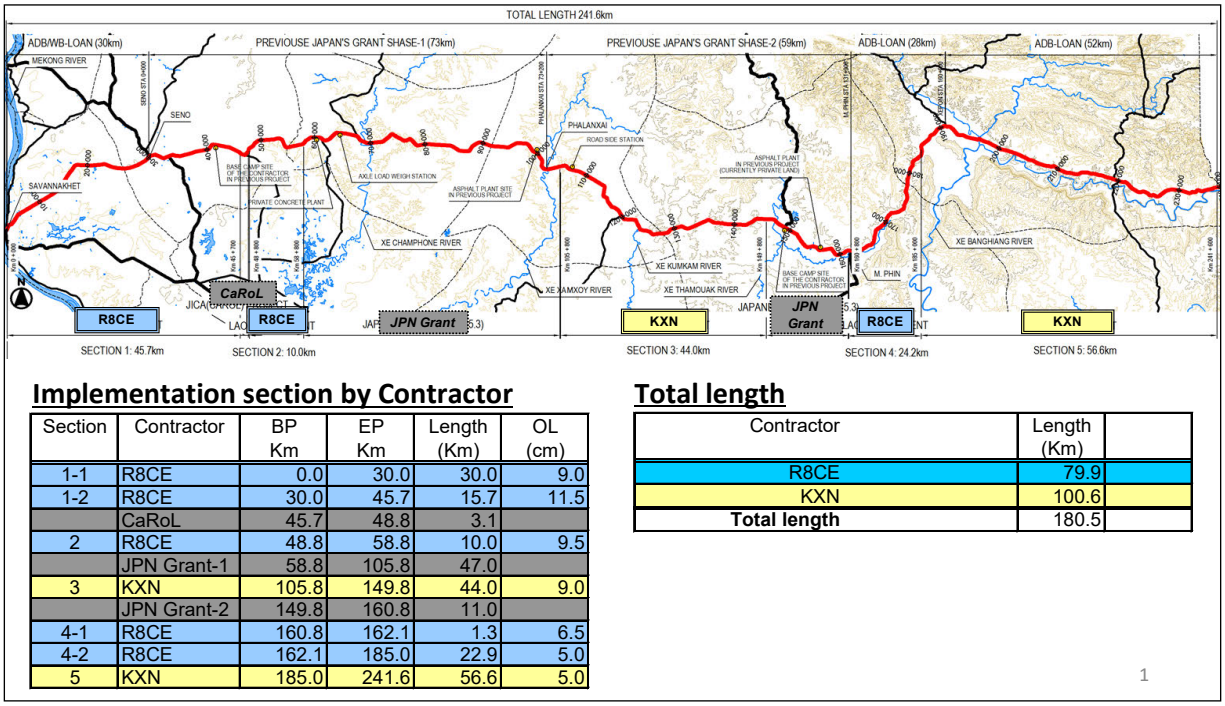
Lao counterparts requested the Expert Team to support for preparation of the concept design and supervision for the 180 km road rehabilitation of NR-9 (excluding 58 km Japan Grant Aid section). Lao counterparts signed Design & Build contract with two local contractors (Road No.8 and Khounxay) for rehabilitation of AC pavement in January 2014. The Expert Team supported for the review of contractors' detailed design and assistance of supervision activities to DOR and DPWT Savannakhet. The project location map and project road sections by the contractors are illustrated in Figure 2.4.15. Furthermore, the provisional work implementation schedule (whole project and Phase-3) is shown in Table 2.4.8.

The cost for the rehabilitation work of the NR-9 is borne by the DOR through the RMF. As a result of coordination among concerned agencies (MPWT, MPI, Prime Minister's Office (PMO), and Ministry of Finance (MOF)), it was decided that approximately 40 million USD, about 60% of total 70 Million USD for the overall rehabilitation works of the entire road section along the NR-9, would be allocated through the RMF. The RMF in principle should be used for maintenance of road so that the budget could not include the cost necessary to improve the road section in the project components. To date, the DOR continues coordinating with the government agencies to secure full amount of the budget necessary for the rehabilitation of NR-9. The following summarizes the outline of the concept design and activities for the assistance of supervision supported by the Expert Team.

1) Preparation of Concept Design

The Expert Team prepared and submitted the concept design for the procurement of Design & Build contract in July 2013. The concept design was prepared based on the detailed investigation (pavement conditions survey, material survey, traffic survey and axle load survey, etc) conducted by DPWT Savannakhet and DOR based on the methodology and instruction suggested by the Expert Team. The length of rehabilitation works for NR-9 (excluding 58 km Japan Grant Aid section and 3.1km Pilot Project (Phase-1)) reaches 180.5 km in total.

The road section was divided into seven subsections and the pavement structure was designed corresponding to the existing pavement strength calculated based on the investigation results (see Table 2.4.9). Two types of optional design period; 5 years and 8 years, were suggested subject to the available local budget.



Implementation section by Contractor

Section	Contractor	BP Km	EP Km	Length (Km)	OL (cm)
1-1	R8CE	0.0	30.0	30.0	9.0
1-2	R8CE	30.0	45.7	15.7	11.5
	CaRoL	45.7	48.8	3.1	
2	R8CE	48.8	58.8	10.0	9.5
	JPN Grant-1	58.8	105.8	47.0	
3	KXN	105.8	149.8	44.0	9.0
	JPN Grant-2	149.8	160.8	11.0	
4-1	R8CE	160.8	162.1	1.3	6.5
4-2	R8CE	162.1	185.0	22.9	5.0
5	KXN	185.0	241.6	56.6	5.0

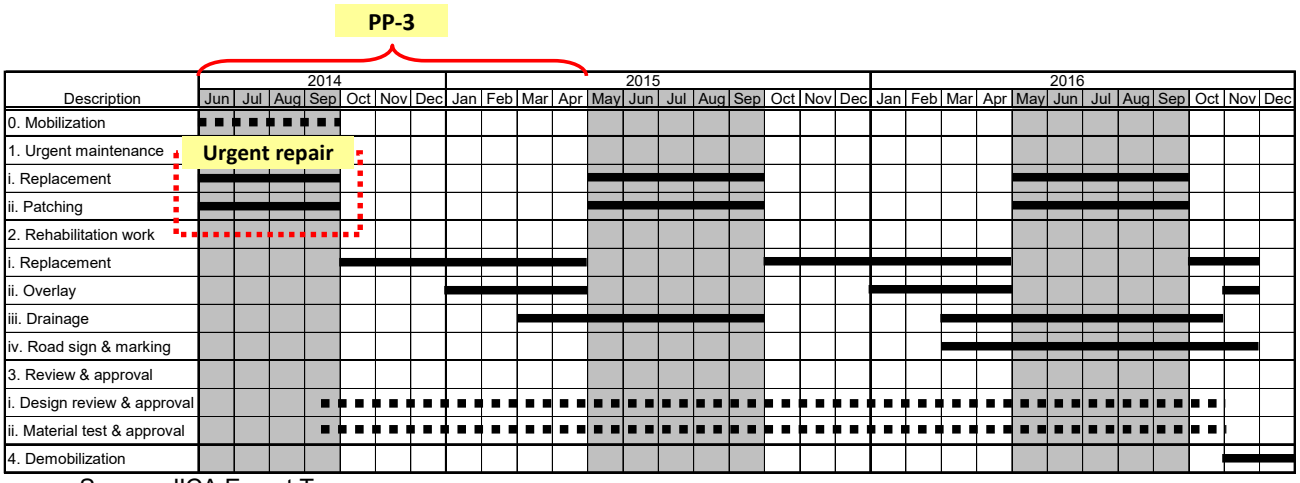
Total length

Contractor	Length (Km)
R8CE	79.9
KXN	100.6
Total length	180.5

Source: JICA Expert Team

Figure 2.4.15 Location Map of Road Rehabilitation Project on NR-9

Table 2.4.8 Implementation Schedule Rehabilitation Project and Project Phase-3 (PP-3)



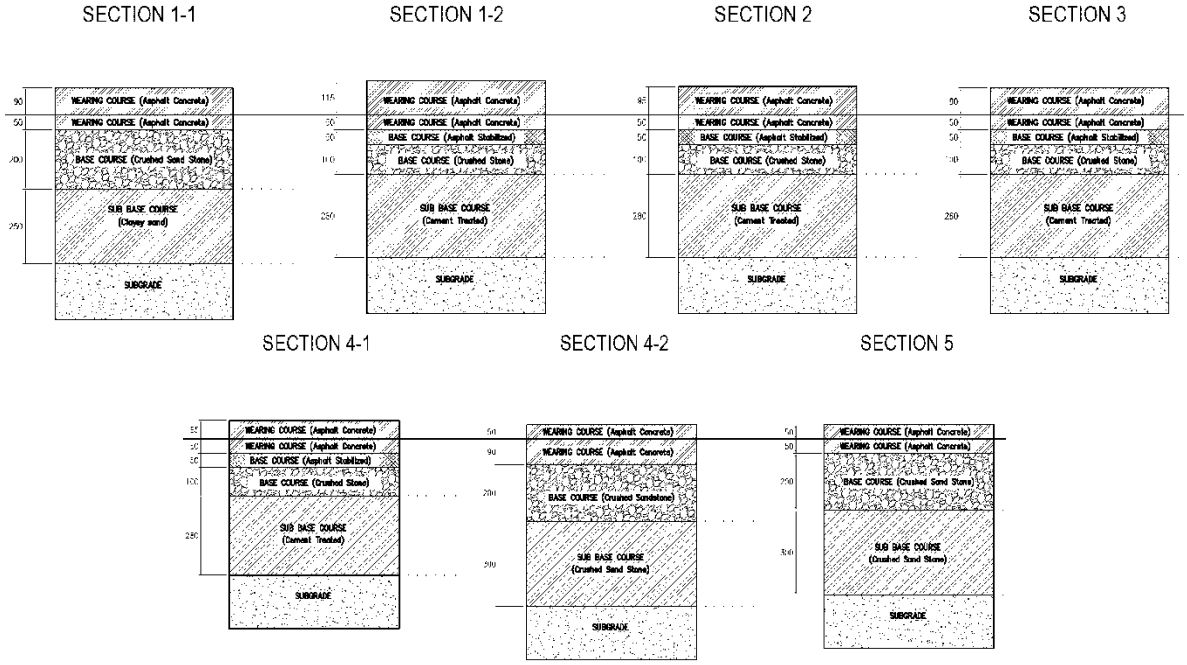
Source: JICA Expert Team

Table 2.4.9 Section of Rehabilitation of NR-9 (Draft)

Section		Start (Km)	End (km)	Length (km)
1	1-1	0.0	30.0	30.0
	1-2	30.0	45.7	15.7
2		48.8	58.8	10.0
3		105.8	149.8	44.0
4	4-1	160.8	162.1	1.3
	4-2	162.1	185.0	22.9
5		185.0	241.6	56.6
		Total		**180.5**

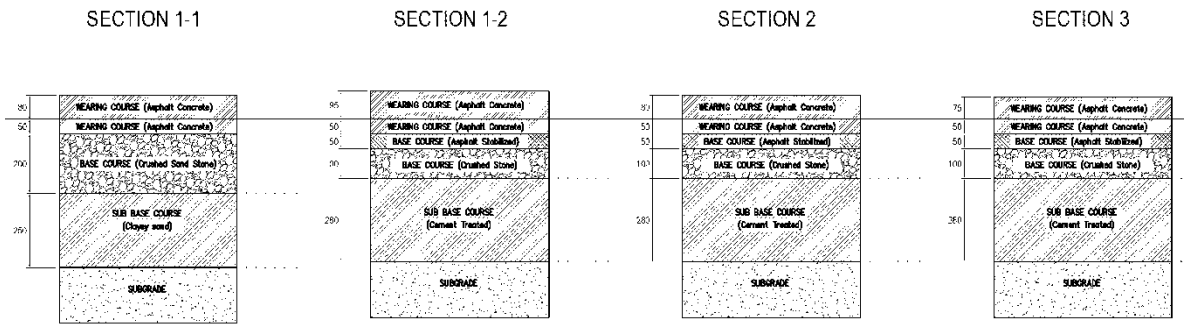
Source: JICA Expert Team

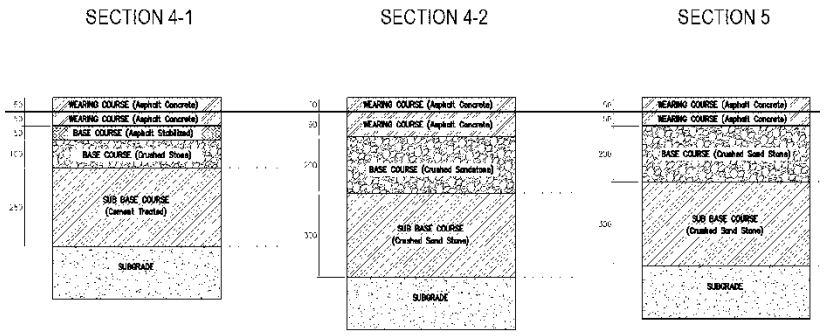
The design of pavement structure (overlay) by sections is illustrated in Figure 2.4.16 and 2.4.17. Furthermore, the summary of cost break down is shown in Table 2.4.10.



Source: JICA Expert Team

Figure 2.4.16 Standard Pavement Structure (8 years)





Source: JICA Expert Team

Figure 2.4.17 Standard Pavement Structure (5 years)

Table 2.4.10 Summary of Rehabilitation Cost for NR-9

Design Period	Cost	Section 1-1 Km0.0 – 30.0 30.0km	Section 1-2 Km30.0 – 45.7 15.7km	CaRoL PP1 Section	Section 2 Km48.8 – 58.8 10.0km	Grant Section-1
5 years	Overlay thickness	t=8.0cm	t=9.5cm		t=8.0cm	
	Pavement	$ 9.3 million	$ 4.9 million		$ 3.0 million	
	Drainage	$ 1.6 million	$ 0.8 million		$ 0.5 million	
	Total	**$ 11.0 million**	**$ 5.8 million**		**$ 3.5 million**	
8 years	Overlay thickness	t=9.0cm	t=11.5cm		t=9.5cm	
	Total amount	$ 10.2 million	$ 5.9 million		$ 3.5 million	
	Drainage	$ 1.6 million	$ 0.8 million		$ 0.5 million	
	Total	**$ 11.9 million**	**$ 6.7 million**		**$ 4.0 million**	
Cost per km	5 years	$ 0.37 million/km	$ 0.37 million/km		$ 0.35 million/km	
	8 years	$ 0.40 million/km	$ 0.43 million/km		$ 0.40 million/km	

Section 3 Km105.8 – 149.8 44.0km	Grant Section-2	Section 4-1 Km160.8 – 162.1 1.3km	Section 4-2 Km162.1 – 185.0 22.9km	Section 5 Km185.0 – 241.6 56.6km	**Total 180.5km**
t=7.5cm		t=5.0cm	t=5.0cm	t=5.0cm	
$ 12.5 million		$ 0.27 million	$ 5.3 million	$ 9.6 million	$ 44.9 million
$ 2.4 million		$ 0.07 million	$ 1.2 million	$ 3.0 million	$ 9.6 million
$ 14.9 million		**$ 0.34 million**	**$ 6.5 million**	**$ 12.6 million**	**$ 54.5 million**
t=9.0cm		t=6.5cm	t=5.0cm	t=5.0cm	
$ 14.5 million		$ 0.3 million	$ 5.3 million	$ 9.6 million	$ 49.3 million
$ 2.4 million		$ 0.1 million	$ 1.2 million	$ 3.0 million	$ 9.6 million
$ 16.8 million		**$ 0.4 million**	**$ 6.5 million**	**$ 12.6 million**	**$ 58.9 million**
$ 0.34 million/km		$ 0.26 million/km	$ 0.28 million/km	$ 0.22 million/km	$ 0.30 million/km
$ 0.38 million/km		$ 0.31 million/km	$ 0.28 million/km	$ 0.22 million/km	$ 0.33 million/km

Source: JICA Expert Team

The concept design of rehabilitation on NR-9 was submitted to DOR, accordingly.

2) Supervision for Rehabilitation of NR-9

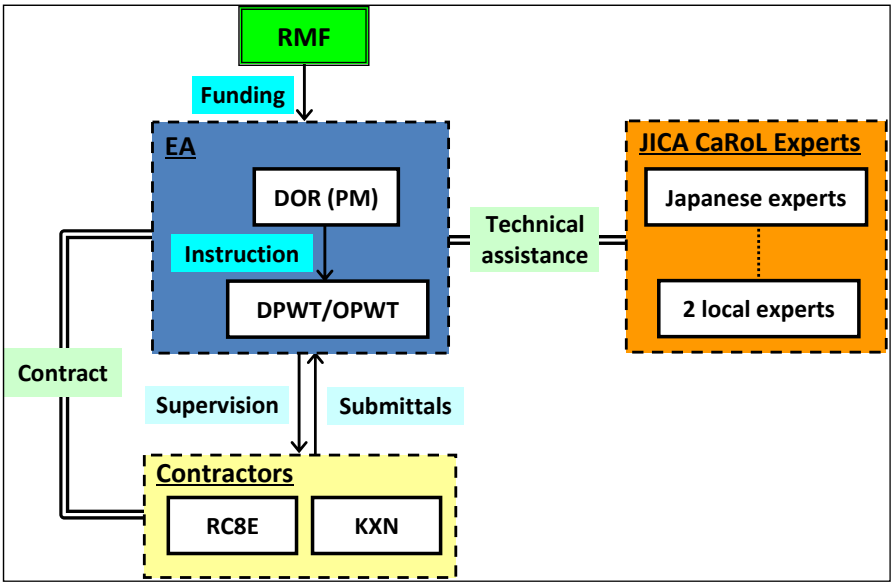
The contract of rehabilitation works for NR-9 was signed with two local contractors. The Expert Team was requested to conduct design review of contractors' detailed design and assist the supervision works. The design review was conducted for design prepared by the contractors prior to the execution of rehabilitation works. The Expert Team supported for the supervision as shown in Table 2.4.11 to improve the capacity of road administration

especially for the quality control works. During these procedures, the capacity building program through OJT and workshop was periodically conducted to enhance the knowledge and skill for DOR, DPWT Savannakhet, OPWT and local contractors. The program was reviewed at the workshop in each phase of rehabilitation works. The structure of work implementation and support is illustrated in Figure 2.4.18.

Table 2.4.11 Activities of Pilot Project (Phase-3)

Program	**Supervision of Rehabilitation of NR-9 (Technical Support) for Pilot Project Phase –3 2013/14**
Location	NR-9 excluding Japan Grant Aid Section (L=74km) covers the work section implanted in 2013/14 (Estimate 4 Million USD funded by RMF)
Activities	Based on the concept design prepared by the Expert Team in 2013, the assistance of supervision activities for the rehabilitation works of NR-9.
Technical support	Technical supports was conducted by the Expert Team in 2013/14 as follows; 。 ・ **Design review(pavement／drainage／structure/ construction plan, cost control)** ・ Assist preparation of construction plan(Work sequence of pavement by type) ・ **Supervision (quality, progress, measurement & payment)**) ・ **OJT and workshop (technical instruction)**
Input from Expert Team	・ International expert: 4～5MM ・ National experts: 10～20MM

Source: JICA Expert Team



Source: JICA Expert Team

Figure 2.4.18 Structure of Work Implementation and Support (Phase-3)

3) Urgent Repair Work

Lao counterpart was going to start the rehabilitation of NR-9 from October 2014, however, the damage of road surface was accelerated in some sections. The road surface was damaged by losing the strength of pavement structure after rainy season and which caused large pothole, crocodile crack and deformation. Some road sections were in a fatal condition hindering smooth transportation on NR-9. Under this situation, the Expert Team suggested DOR to conduct urgent repair works to maintain traffic safety for road users on

NR-9.

Crocodile crack and rutting development

Deformation of surface

Source: JICA Expert Team

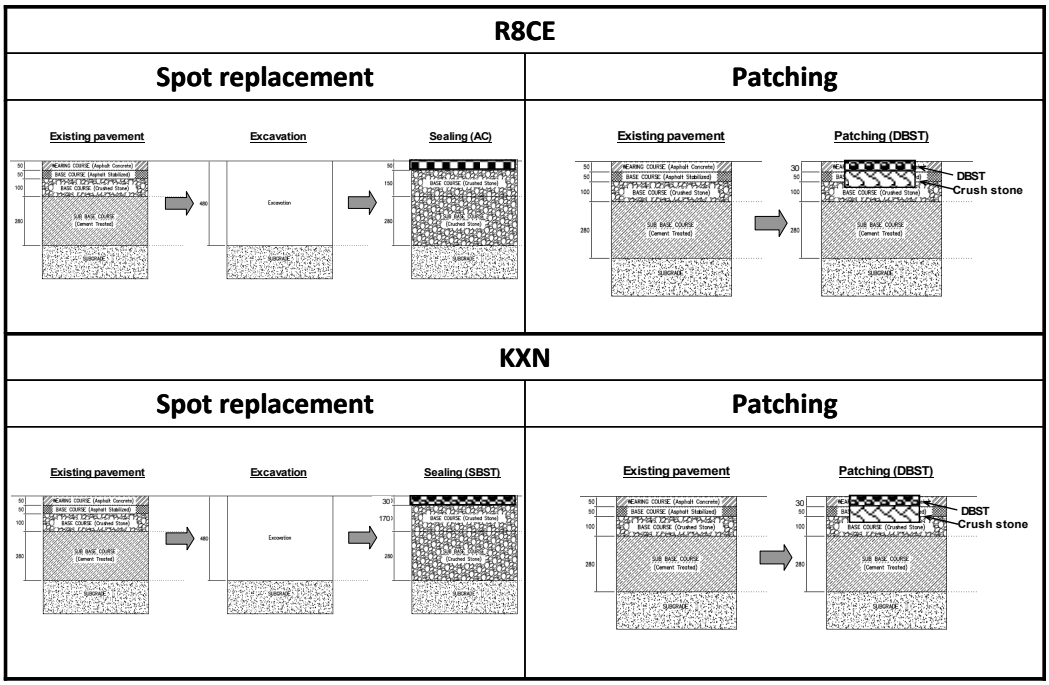
Figure 2.4.19 Observation of Road Conditions on NR-9 (April 2014)

Urgent rehabilitation works were conducted as part of the contract with two local contractors. The coordination meeting was held in April 2014 among DPWT Savannakhet, two local contractors and Expert Team. The urgent rehabilitation works was commenced since April 2014 and the works was continued during rainy season.

Work items in the urgent repair work include spot replacement of pavement and pothole patching work. A concept design of urgent rehabilitation work is illustrated in Figure 2.4.21. Furthermore, work quantity (by contractors) is shown in Table 2.4.12.

Source: JICA Expert Team

Figure 2.4.20 Discussion on Urgent Repair Works with DPWT and Local Contractor



Source: JICA Expert Team

Figure 2.4.21 Urgent Rehabilitation Works by the Contractor

Table 2.4.12 Work Quantity in the Contract

Contractor	Work Type	Area (m2)	Volume (m3)	Nos
R8CE	Replacement	11,749	5,639	35
	Patching			58
KXN	Replacement	16,303	7,825	39
	Patching			148

Source: JICA Expert Team

Existing road surface

Removal of existing pavement

Removal of deteriorated material

Filling new material

Source: JICA Expert Team

Figure 2.4.22 Photos: Work Activities in Phase-3

4) Rehabilitation Work

Road No.8 (Contract 1)

1. Summary of Contract

- Client: Department of Road (DOR), Ministry of Public Works and Transport
- Consultant: Lao Transport Engineering Consult (LTEC) and State Enterprise for Survey Design and Material Testing (SDMT)
- Contractor: Road No.8 Construction Enterprise (Road No.8)

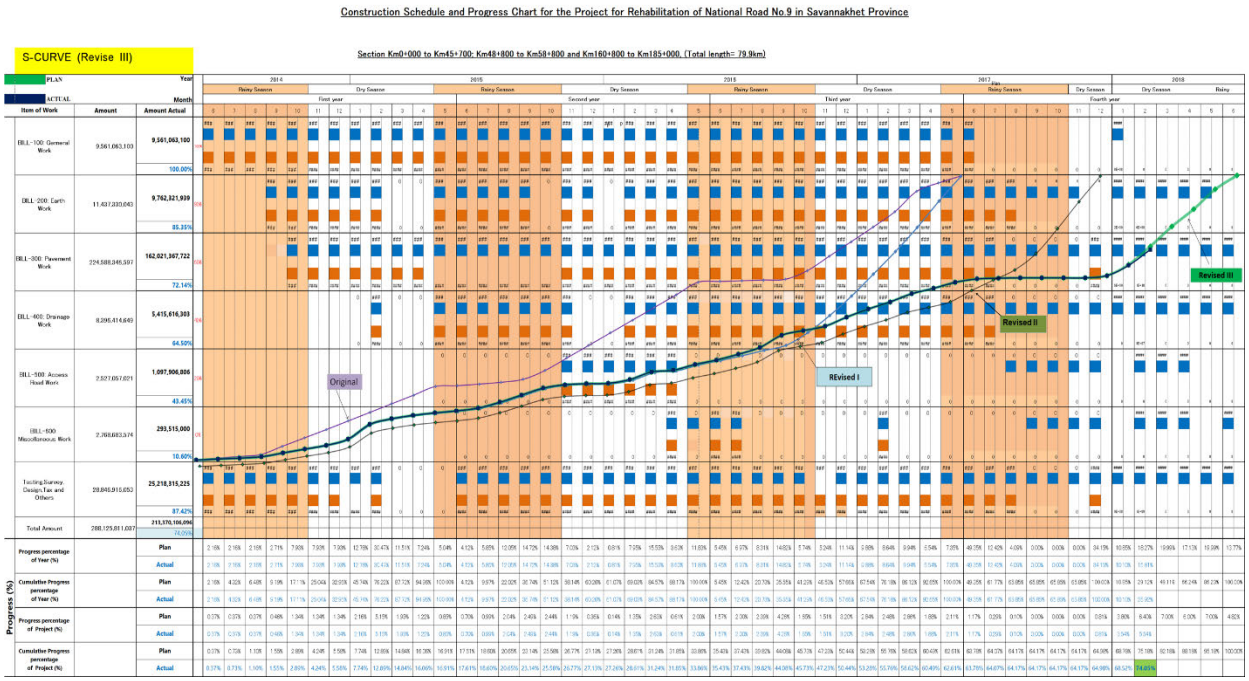
2. Contract Amount

- Total Amount: 288,125,811,037 kip
- Length: 79.9 km (0+000 – 45+7000, 48+800 – 58+800, 160+800 – 185+800)

3. Construction Period: 36 months (Original)

- 20th May 2014 – 20th May 2017 (36 months)
- 1st June 2017 – 31st December 2017 (7 months) First Approved Extended Contract Period
- 1st January 2018 – 30th June 2018 (6 months) Second Approved Extended Contract Period

Road No.8 started to conduct rehabilitation work in Section 4, and then completed with road marking remained in Section 4. Section 1-1, Section 1-2 and Section 2 were under rehabilitation. The progress of rehabilitation work was 74.05%(-1.13%) against plan (75.18%) at the end of January 2018. The Contractor suspended rehabilitation work from August 2017 to November 2017 due to delay of the interim payments and cash flow situation of the Contractor.



Source: JICA Expert Team

Figure 2.4.23 Progress Chart (Contract 1: Road No.8)

Initial Condition

Removal of Existing Asphalt Pavement

Base Course

Compaction


Repair of Base Course


Prime Court


Surfacing


Compaction


Site Survey


Weekly Meeting

Source: JICA Expert Team

Figure 2.4.24 Photo of Rehabilitation Work Section 4

5) Khounxay (Contract 2)

1. Summary of Contract

- Client: Department of Road (DOR), Ministry of Public Works and Transport
- Consultant: Lao Transport Engineering Consult (LTEC) and State Enterprise for Survey Design and Material Testing (SDMT)
- Contractor: Khounxay Phatthana Construction Co.,Ltd

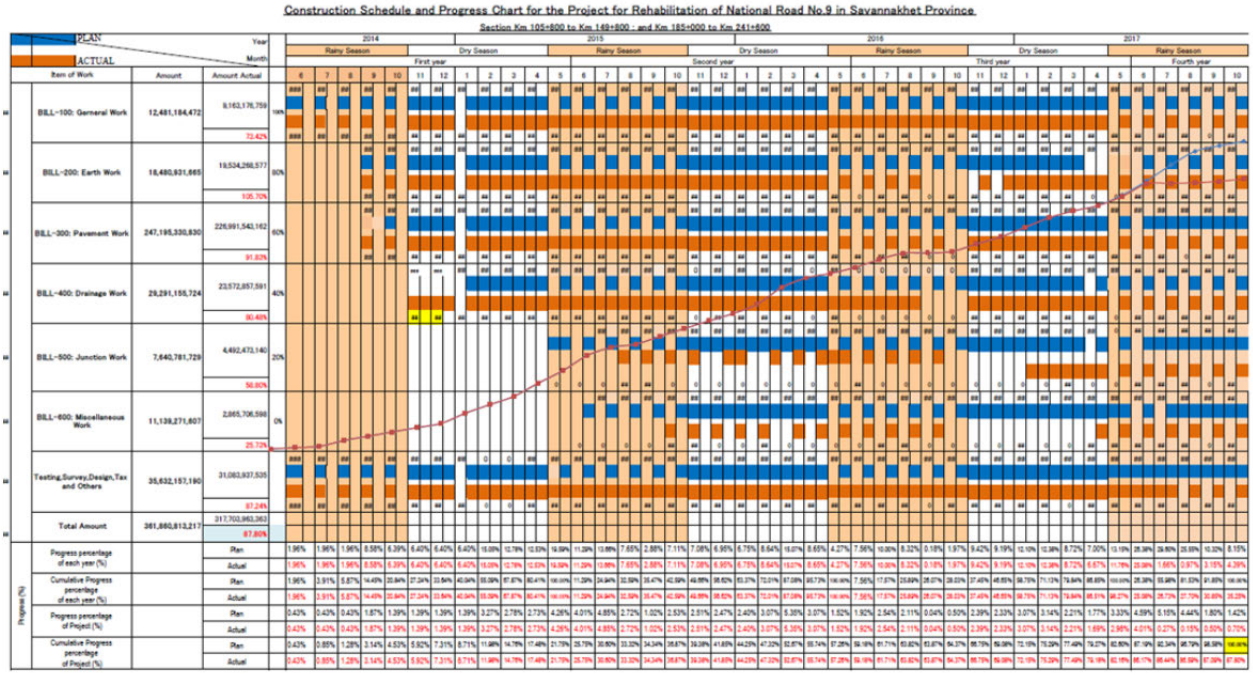
2. Contract Amount

- Total Amount: 319,004,783,256 kip
- Length: 100.6 km (105+800 - 149+800, 185+00 - 241+600)

3. Construction Period: 36 months (Original)

- 20th May 2014 – 20th May 2017 (36 months)
- 20th May 2017 – 20th October 2017 (5 months) Approved Extended Contract Period

Khounxay started to conduct rehabilitation work in Section 3, and then completed Section3 in September 2016. Khounxay also completed Section 5 (185+200~221+800) excepting for sign boards and road markings. The progress of rehabilitation work is 99.59% (-0.41%) against the plan (100.00%) at the end of October 2017. Since the work procedure almost reached the contract amount, Khounxay suspended rehabilitation work at this moment due to delay of the payment.



Source: JICA Expert Team

Figure 2.4.25 Progress Chart (Contract 2: Khounxay)

Initial Condition

Removal of Existing Asphalt Pavement

Removal of unsuitable material

Base Course

Compaction

Completion of Base Course work

Prime Court

Surfacing

Compaction

Completion of Compaction

Marking

Completion of Rehabilitation

Inspection for Section 3(26th Sep2016)

Inspection for Section 3(26th Sep2016)

Inspection for Section 3(26th Sep2016)

MPWT Minister Site Visit(16th Nov 2016)

Site Survey

Weekly Meeting

Source: JICA Expert Team

Figure 2.4.26 Photo of rehabilitation work Section 4

(4) Pilot Project Pavement Seminar on NR-9 in Savannakhet Province

1) Seminar of Asphalt Mix Design, Pavement Construction, and Design of Pavement Structure

The Expert Team organized 1-day seminar on 25th February 2016 in the KXN Contractor's site office in Savannakhet, where 27 trainees from DPWT, OPWT, LTEC, KXN, and R8EC attended. During the seminar, pre-test and post-test were conducted to evaluate the level of understanding/knowledge improved through the said seminar. The contents of the seminar focused on the asphalt mix design, pavement construction management, and the design of pavement structure.

Table 2.4.13 Time Table of the Seminar

Date	No.	Time	Title	The Content
25 Feb (Th)	1	9:00-9:15	Introduction/ Orientation	
	2	9:15-10:00	Pre-Test	Asphalt Mix Design
	3	10:00-11:30	Lecture	Asphalt Mix Design
	4	11:30-12:00	Achievement-Test	Asphalt Mix Design
		12:00-13:30	Lunch Break	
	5	13:30-14:00	Pre-Test	Pavement Construction Management
	6	14:00-14:45	Lecture	Pavement Construction Management
	7	14:45-15:00	Achievement-Test	Pavement Construction Management
		15:00-15:15	Break	
	8	15:15-15:45	Pre-Test	Design of Pavement Structure
	9	15:45-16:30	Lecture	Design of Pavement Structure
	10	16:30-16:45	Achievement-Test	Design of Pavement Structure

Source: JICA Expert Team

Pre-Test of Asphalt Mix Design at the Seminar

Lecture by CaRoL Expert

Explanation by Local Engineer

Explanation by Local Engineer

The results of pre-test and post-test are shown below and which implies that understanding of the lecture was evaluated in a satisfactory level in all three subjects.

Table 2.4.14 Test Results of Pre-Test and Post-Test

Asphalt Mix Design		Pavement Construction Management		Design of Pavement Structure	
Pre-Test	Achievement -Test	Pre-Test	Achievement -Test	Pre-Test	Achievement -Test
20%	96%	43%	99%	26%	98%

Source: JICA Expert Team

2) Seminar of Design of Pavement Structure 2, 3

The Expert Team organized 1-day seminar on 22nd April 2016 at OPWT M. Phin, where 27 trainees from DPWT, OPWT, LTEC, KXN, and R8EC attended. During the seminar, pre-test and post-test were conducted to evaluate the level of understanding/knowledge improved through the seminar. The contents of the seminar include the design of pavement structure (Structure 2: Weak subgrade treatment and Structure 3: AASHTO pavement design).

Table 2.4.15 Time Table of the Seminar

Date	No.	Time	Title	The Content
22 April (Fri)	1	14:00-14:10	Introduction/ Orientation	
	2	14:10-14:30	Pre-Test	Design of Pavement Structure 2
	3	14:30-15:00	Lecture	Design of Pavement Structure 2
	4	15:00-15:15	Achievement-Test	Design of Pavement Structure 2
		15:15-15:30	Break	
	5	15:30-15:50	Pre-Test	Design of Pavement Structure 3
	6	15:50-16:20	Lecture	Design of Pavement Structure 3
	7	16:20-16:35	Achievement-Test	Design of Pavement Structure 3

Source: JICA Expert Team

Seminar of Design of Pavement Structure

Photo of Attendance

Explanation by Local Engineer

Seminar of Design of Pavement Structure

The test results show that understanding of the lecture was evaluated in a satisfactory level in all two subjects.

Table 2.4.16 Test Results of Pre-Test and Achievement-Test

Design of Pavement Structure 2		Design of Pavement Structure 3	
Pre-Test	Achievement -Test	Pre-Test	Achievement -Test
26%	91%	49%	97%

Source: JICA Expert Team

3) Seminar of Portland Cement Concrete Pavement

The Expert Team organized 1-day Seminar on 23rd February 2018 at DPWT in Savannakhet, where 14 trainees from DPWT and KXN attended. The contents of the seminar was the Portland Cement concrete pavement which consisted of three subjects including Portland Cement concrete pavement mix design, construction management of concrete pavement, and concrete pavement structural design.

Table 2.4.17 Time Table of the Seminar

Date	No.	Time	Title	The Content
23-Feb	1	14:00-14:10	Introduction/ Orientation	
	2	14:10-14:25	Pre-Test	Portland Cement Concrete Pavement Mix Design
	3	14:25-14:50	Lecture	Portland Cement Concrete Pavement Mix Design
	4	14:50-15:00	Achievement-Test	Portland Cement Concrete Pavement Mix Design
		15:00-15:10	Break	
	5	15:10-15:25	Pre-Test	Construction Management of Concrete Pavement
	6	15:25-15:50	Lecture	Construction Management of Concrete Pavement
	7	15:50-16:00	Achievement-Test	Construction Management of Concrete Pavement
	8	16:00-16:15	Pre-Test	Concrete Pavement Structural Design
	9	16:15-16:40	Lecture	Concrete Pavement Structural Design
	10	16:40-16:50	Achievement-Test	Concrete Pavement Structural Design

Source: JICA Expert Team

Seminar of Portland Cement Concrete Pavement

Photo of Attendance

Like other pavement design seminar, the test results show that understanding of the lecture was evaluated in a satisfactory level in all subjects.

Table 2.4.18 Test Results of Pre-Test and Achievement-Test

Mix Design		Construction Management		Structural Design	
Pre-Test	Achievement -Test	Pre-Test	Achievement -Test	Pre-Test	Achievement -Test
26%	91%	32%	98%	44%	96%

Source: JICA Expert Team

2.4.6 Conduct a Pilot Project on Repair Work and Improve Capacities on Supervision and Quality Control for Rehabilitation of Cement Formed Asphalt in Vientiane Province

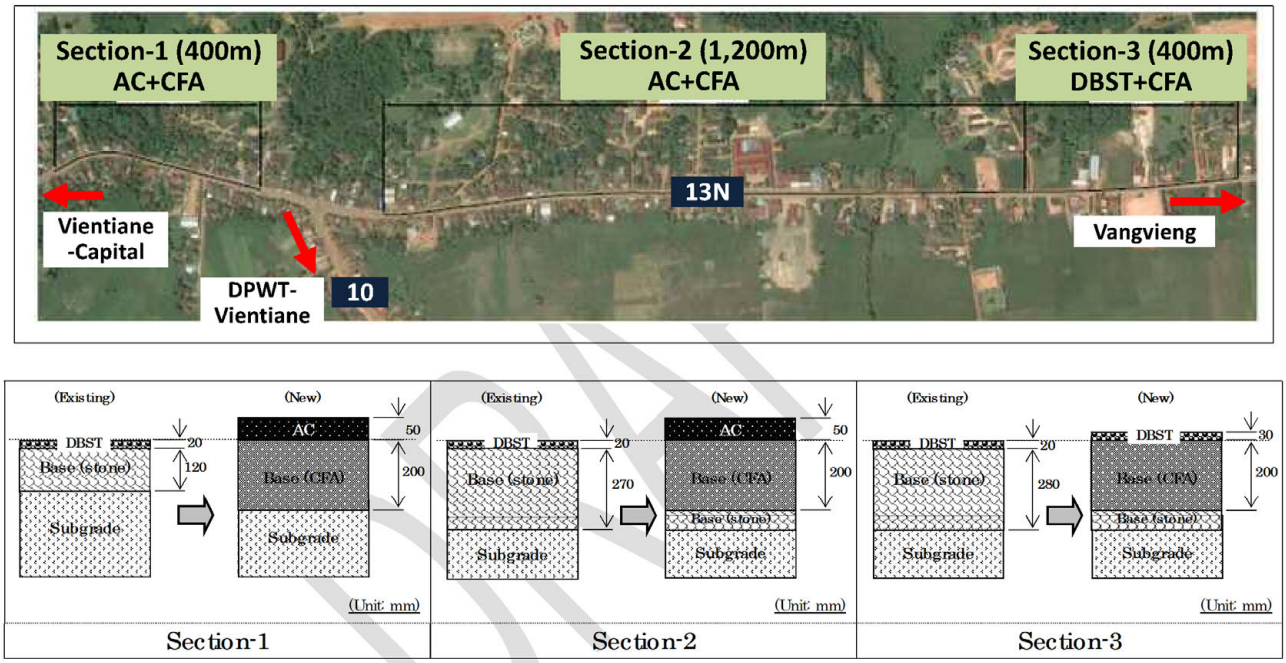
(1) Pilot Project of NR-13N

The Expert Team and DOR jointly implemented the Pilot Project by applying in-situ pavement recycling work called as Cement Foamed Asphalt (CFA) method. The CFA method is newly introduced in Laos and is expected to derive significant benefits in economic and environmental aspects.

- High durability comparing with stone material
- Early traffic opening due to unnecessary curing work
- Short construction period by skipping a few work processes comparing with conventional method
- Cost reduction in entire pavement life cycle comparing with conventional method
- Reduce CO2 emission by saving fuel consumption and exhaust gas

The Pilot Project of the CFA is described below.

Project location	Km70 on Road No.13-North, Phonhong District, Vientiane Province
Project length	- Section-1: AC/CFA=400m - Section-2: AC/CFA=1,200m - Section-3: DBST/CFA=400m - Total: 2,000m
Project period (CFA & wearing course)	18/Mar – 08/Apr 2016
Work items	- In-situ recycled base course by CFA method - Wearing course by hot mix asphalt - Side drainage
Client	DOR/MPWT
Site management	DPWT/Vientiane Province
Contractor	Panyathilath Construction Co., Ltd.
Inputs by Japanese side	- Construction supervision: Mr. Ueda & Mr. Iwatsuki (OCG) - Quality control of CFA work: Mr. Fujinaga (WKK) - Operation & maintenance of stabilizer: Mr. Harada (WKK) - Stabilizer (WKK)



Source: JICA Expert Team

Figure 2.4.27 Project Location Map and Pavement Structure by Section

Place cement on existing road surface

Crushing & mixing by stabilizer

Initial compaction by tire roller

Forming road surface by grader

Finishing compaction by steel wheel roller

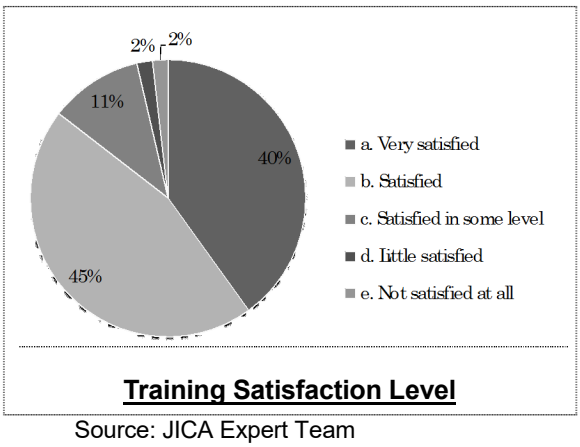
Spraying water on road surface

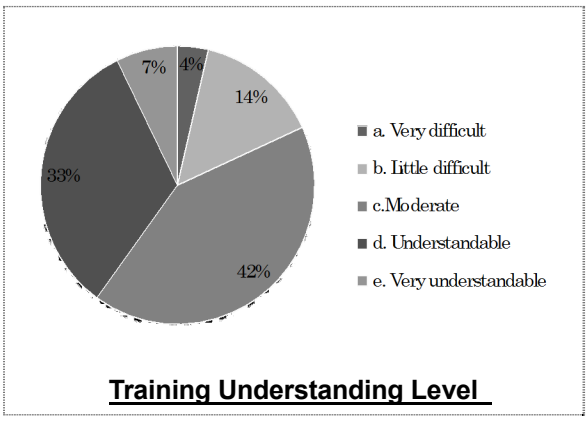
For the capacity building of DOR, DPWT Vientiane, OPWTs, and local contractors involved in the Pilot Project of the CFA, the workshop was organized on 29th March 2016 under the Project. The photos taken during the workshop are as shown in Figure 2.4.28. The details of evaluation of workshop are separately prepared and attached to the appendix.

Source: JICA Expert Team

Figure 2.4.28 Photos of Fieldwork Session

The overall assessment of workshop through the skill test implies that more than 80% of the participants were satisfied with the contents of workshop and also most participants were able to understand the contents of the CFA works.





Source: JICA Expert Team

Figure 2.4.29 Results of Questionnaire

2.5 Capacity Building for Overloading Control

2.5.1 Replacement of Weigh Scale

(1) Planning policy for weigh scale replacement

The Project aims at securing the following functions by restoring the weigh scale station in Laos and neighboring countries.

- Develop 24-hour operational capacity for overloading control through development of physical infrastructure including installation of weigh scale, paving approach road, signboards, etc.
- Improve reliability of the system, through installation of automated data collection, such as automated number plate reading and vehicle recognition systems and automated data store system into the server.
- Establish a monitoring system through installation of Closed-Circuit Television (CCTV) and automated data recording and data shared server, which enables the central government to monitor.

(2) Location of Weigh Scale

Donghen (KM 65) along National Road No.9 (NR-9)

(3) Specification of Weigh Scale

The following 4 optional weigh scale types are studied as alternative weigh scale types.

(Option 1) High speed Weigh In Motion (WIM) plus static weigh scale: All vehicles inspected along the main road. A WIM installed at a distance of 800m to 1km from the static weigh scale, which contributes to difficult operation. Highest investment cost.

(Option 2) Low speed WIM plus static weigh scale: Only heavy vehicles inspected along the service road. Most suitable in terms of operation and effectiveness for overloading control. Higher investment cost.

(Option 3) Static weigh scale (Single plate platform): Requires inspecting heavy vehicles at station. Most suitable if enforcement is in place. Most cost-effective

(Option 4) Static weigh scale (Axle-load weigh scale): Requires time consumed to inspect heavy vehicles.

Since DOT plans to replace three weigh stations in Savannakhet, Bolikhamsai and Luang Namtha and faces financial constraints, (Option 3) Static weigh scale was recommended for the Project and applied to other 2 weigh stations.

Specification	Cost	Effective-ness	Accuracy	Enforcement	Evaluation
(1) High speed WIM＋ Static weigh scale	C	A	A	C	B
(2) Low speed WIM＋ Static weigh scale	C	A’	A	A	A
(3) Static weigh scale (Single platform)	B	B	A	B	A
(4) Static weigh scale (Axle-load)	A	B	B	C	C

(4) Procurement method

One package combined of both civil works and procurement of weigh scale

(5) Implementation schedule

The schedule of the implementation, originally up to July 2017, was extended to December 2017 due to the increased scope of work and correction of defaults identified during the periodic and final inspection. The Project started from January 2017 and completed in December 2017 as shown in the following chart.

Update: 2016/11/7

	Event	2016									2017																				
		Nov			Dec			Jan.			Feb			Mar			Apr			May			Jun			July						
		10	20	30	10	20	31	10	20	30	10	20	31	10	20	31	10	20	30	10	20	30	10	20	30	10	20	30			
1	Detailed Design （JICA Expert Team)	D/D	=	=	=	⇒																									
2	Request for qualified contractor's List issued by JICA Expert Team		*																												
3	List of qualified contractors' list issued by MPWT			*																											
4	Approval of qualified contractors' list by JICA					*																									
5	Submission of draft tender documents to JICA from JICA Expert Team					*																									
6	Approval of tender documents by JICA					*																									
7	Invitation for tenderers (qualified contractors)					*																									
8	Distribution of tender documents to tenderers					*																									
9	Deadline of questionnaires					*																									
10	Deadline of answering to the questionnaires					*																									
11	Open bidding						*																								
12	Evaluation of tender						*																								
13	Contract negotiation and conclusion of contract							*																							
14	Commencement of Works								*																						
15	Completion of Works （210days from commencement day） and instection.										C/S	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	⇒	*	

(6) Bidding

The bidding for the Project was completed as the following schedule and Noukham Construction Co. Ltd. was awarded as the least bidder by December 2016.

- Request for a short list to C/P: 22nd August, 2016
- Selection of a short list of contractor: 9th September, 2016
- Qualification evaluation and confirmation of short-listed contractor: 5 short-listed contractors
- Submission of RFP: 29th November, 2016
- Site briefing: 8th December, 2016
- Deadline of Q&A : 15th December, 2016
- Deadline of answer: 19th December, 2016
- Bidders: 4 contractors attended

- Deadline of bid submission: 14:00 26th December, 2016
- Bid opening ceremony：14:30 26th December, 2016

(7) Modernization of the Weigh Scale

As a result of the bidding, Noukham Construction Co., Ltd. (NKC) was awarded and the contract signing was made between JICA Laos Office and the NKC on 8th February, 2017.

The work of the Project is consisted of two major components including rehabilitation of the weigh station and installation of modernized scale. The work of the Project was commenced soon after the signing and proceeded in accordance with the following schedule until the work completion in December, 2017.

Task No.	Description	Amount (USD)	Percent of Work (%)	Year 2017 1 Jan	2 Feb	3 Mar	4 Apr	5 May	6 Jun	7 Jul	8 Aug	9 Sep	10 Oct	11 Nov	%	Remarks
1	BILL-100: General Works	22,500.00	3.33%		1.07%	1.88%	0.07%	0.07%	0.07%	0.14%	0.01%	0.01%				
					1.07%	1.79%	0.07%	0.07%	0.07%	0.07%	0.080%	0.009%				
2	Bill-200: : Civil Works	325,847.49	48.15%			3.96%	14.36%	10.58%	11.68%	6.74%	0.83%					
						8.99%	0.44%	19.75%	7.64%	7.92%	3.40%					
3	Bill-300: Weigh Scale and System Works	270,510.00	39.98%				2.00%	9.99%	12.99%	4.66%	4.66%	4.66%				
										4.24%	31.74%	2.00%	1.00%			
4	Bill-400: Ancillary Works	65,501.20	9.24%			0.35%	2.34%	1.12%	2.08%	1.86%	1.07%	0.43%				
						0.35%		1.21%		0.17%	6.47%	0.63%				
		676,686.48														
LEGEND																
Scheduled Progress	Schedule	Monthly (%)		0.00%	1.07%	6.19%	18.76%	21.77%	27.83%	13.41%	6.57%	5.10%	0.00%			
Actual Progress		Cumulative (%)		0.00%	1.07%	7.26%	26.03%	47.80%	75.05%	88.40%	94.95%	100.00%	100.00%			
Scheduled Curve	Progress	Monthly (%)		0.00%	1.07%	11.03%	0.51%	21.03%	7.71%	12.41%	41.68%	2.63%	1.00%			
Actual Curve		Cumulative (%)		0.00%	1.07%	12.08%	12.59%	33.62%	41.33%	53.74%	94.32%	97.31%	98.31%			

The major works are shown in the following photos.

Scarifying existing ground.

Compaction of sub-grade.

Finishing surface of base course.

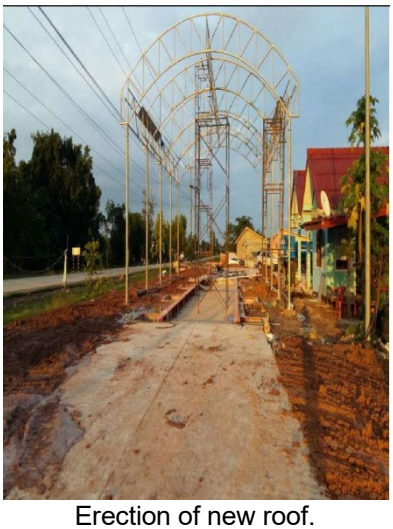
Placing wire-mesh on concrete pavement.

Finishing surface of concrete pavement.

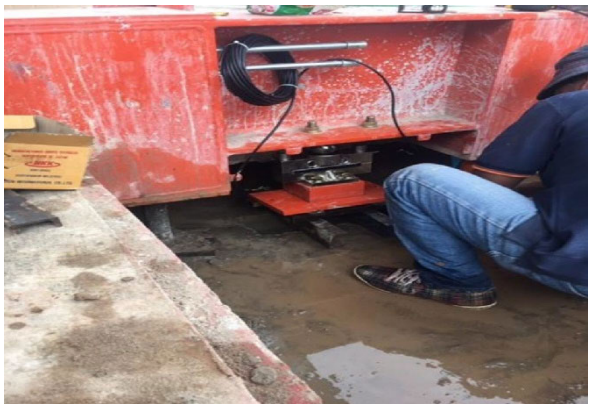
Install pipe culvert.

Curing of concrete of the scale foundation.

Place steel frame for the platform.



Erection of new roof.



Place load cell for measurement.

Place sensor of detecting vehicle.

Trial measurements work.

Monitor display of measurement result.

2.5.2 Development and Operation of Guideline

(1) Third Country Study Trip

The Study Trip aims to understand current situation and issues for operation and management of the weigh scale in a neighboring country and learn lessons as a good practice for installation and operation of the weigh scale.

1) 1st Study Trip in Thailand

- 7th June, 2016：Travel (Vientiane to Bangkok)
- 8th June, 2016: Meeting with TMS (Supplier of weigh scale system to DOH), Site visit, Meeting with DOH, Site inspection at the Central Control System
- 9th June, 2016: Meeting with Kristler Thailand (Supplier of weigh scale equipment), Site visit, Travel (Bangkok to Vientiane)

2) 2nd Study Trip in Thailand

- 19th July, 2016：Travel (Vientiane to Bangkok)
- 20th July, 2016: Meeting with SGS (Supplier of weigh scale system), Site visit
- 21st July, 2016: Meeting with TMS, Site visit, Travel (Bangkok to Vientiane)

  Note: TMS, SGS, Kristler are system makers and suppliers of weigh scales in Thailand

【Participants】

- Mr. Boualith PATHOUMTHONG (Deputy Director General of DOT)
- Mr. Bounpheng BOUDOUDONE (Acting Director of Road Transport Control Division/DOT)
- Mr. Sengchanh HOMSYLAHACK (Director of IT Division/ Cabinet Office/MPWT)

(1) Preparation of Operation Guideline

In collaboration with ADB Project, JICA Expert developed ‘Operation Manual for Overloading Control Enforcement’. Separately, the supplier of weigh control system in Donghen Weigh Station prepared ‘Operation Guideline for Donghen Weigh Station’, and submitted to and discussed with DOT.

'Operation Manual for Overloading Control Enforcement' is composed of the following contents.

i. Weighing Heavy Vehicles
ii. Portable Weighing Devices
iii. Permanent Weigh Stations
iv. Off-Loading Overweight Vehicles
v. Weigh Station Officer Duties

'Operation Guideline for Donghen Weigh Station' is composed of the following contents. This guideline was translated into Lao in order for local staff(s) in Donghen to make a daily use of the guideline.

i. Measurement system and its operation procedure
ii. Database management system and its operation procedure

(2) Intensive Training for Operation Guideline

On 26th and 27th March 2018, DOT and Expert Team co-hosted an intensive training for operation guideline of the Donghen Weigh Station, at DPWT Savannakhet and Donghen Weigh Station.

Intensive Training for Operation Guideline

Date/time：Day 1: From 9:00 a.m. to 4:00 p.m. 26th March 2018
Day 2: From 9:00 a.m. to 12:00 p.m.

Venue： Day 1: Conference Room, DPWT Savannakhet
Day 2: Donghen Weigh Station

Trainer： SGS (System supplier)

Participants：62 in total, including DOT, DPWT as well as Expert Team

Contents： (i) Measurement system and operation procedures
(ii) Database management system and operation procedures
(iii) Demonstration of measurement system and data management system

Demonstration of data management system (DPWT Savannakhet)

Demonstration of measurement equipment (Donghen Weigh Station)

Demonstration of measurement system (Donghen Weigh Station)

Figure 2.5.1 Intensive Training for Operation Guideline

2.5.3 Improvement of Monitoring Capacity for Recording and Reporting Operational Data

As described above, the Donghen Weigh Station was upgraded to obtain the following functions.

- Improve reliability of the system, through installation of automated data collection, such as automated number plate reading and vehicle recognition systems and store such data in the server.
- Establish a monitoring system through installation of Closed-Circuit Television (CCTV) and automated data recording and data shared server, which enables the ministry to monitor.

The following figures illustrate before and after update of Donghen Weigh Station

Operation of Weigh Station in Donghen before Upgrading Project (using Mobile Weigh Scale)

Operation of Weigh Station in Donghen after Upgrading Project

Operation of Weigh Station in Donghen after Upgrading Project

Automated number plate reading and vehicle recognition systems

Monitor and Server Room in DPWT Savannakhet

Figure 2.5.2 Before and After Update of Donghen Weigh Station

Also, the Project assisted to set up a computer server in IT Division of Cabinet Office, MPWT and to establish automated recording system in the server from Donghen Weigh Station to the MPWT. At the same time, the Project assisted to set up control rooms in DOT and DPWT Savannakhet and which enables DOT/DPWT Savannakhet to monitor on-time operation in Donghen Weigh Station and analyze the database and prepare the monitoring report.

Weighing Report

Ticket No.: 00000413
Plate No.: 43C030.60
Province: Savannakhet
Station:: SAVANNAKHET1
Number of Axial: 6
Number of Wheels: 22
Date/Time in: 2017/12/14 16:33:18
Distance: 1
Note:

	Weight(kg.)	Weight Limit(kg.)	Weight Overload (kg.)	
Shaft1	4,840.00	5,000.00	0.00	
Shaft2	12,650.00	10,000.00	2,650.00	
Shaft3	5,900.00	10,000.00	0.00	
Shaft4	6,380.00	8,200.00	0.00	
Shaft5	9,970.00	8,200.00	1,770.00	
Shaft6	4,680.00	8,200.00	0.00	
Shaft7	0.00	0.00	0.00	
Shaft8	0.00	0.00	0.00	
Shaft9	0.00	0.00	0.00	
Shaft10	0.00	0.00	0.00	Charge (KIP)
Total	**44,420.00**	**49,600.00**	**4,420.00**	**0.00**

Figure 2.5.3 Reporting Format for Weighing System

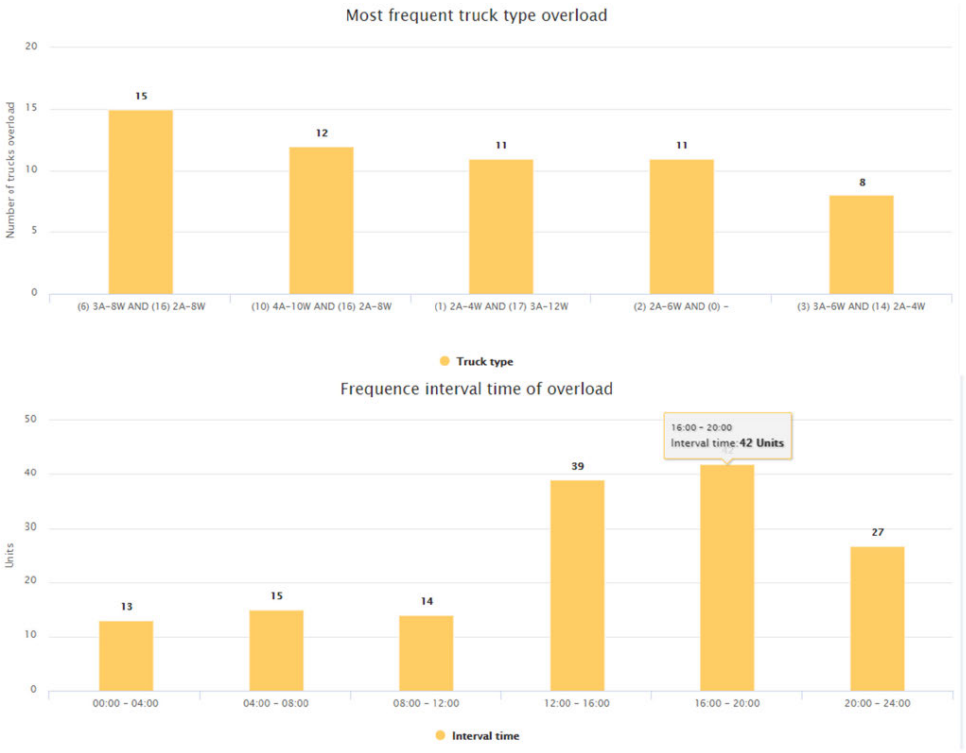


Figure 2.5.4 Part of Analysis Result

2.5.4 Dissemination for Overloading Control to Private Sector

On 23rd April 2018, DPWT Savannakhet and Expert Team jointly organized a half day workshop, aiming to disseminate overloading control rules and practices in Laos, inviting trucking companies registered in Savannakhet Province. The contents of the dissemination workshop are summarized below.

Dissemination Workshop for Overloading Control

Date/time：From 13:30 to 16:00, 23rd April 2018

Venue： Conference Room, DPWT Savannakhet

Facilitator： Expert Team

Participants：30 participants in total, including 6 trucking companies registered in Savannakhet, DOT, DPWTs and OPWTs

Contents： (i) Current issues on overloading in Laos and rational for overloading control

(ii) Comparison of overloading control regulation and measures in neighboring countries and Japan

(iii) Current regulation and measures taken for overloading control in Laos

(iv) Proposed overloading control regulation and measures by ADB and JICA

(iv) Outlook of Donhen Weigh Station

(v) Discussion on proposed overloading control regulation and measures by ADB and JICA

During the workshop, Expert Team conducted an interview survey to trucking companies and the result of the interview confirmed that there is a need to continue a series of nationwide dissemination campaign for overloading control, particularly to increase knowledge on the current regulation and measures taken for overloading control in Laos.

- All six companies registered as international trucking company which transports international cargo to/from Thailand and Vietnam.
- All six companies own their trucks and types of these trucks vary from right truck to semi-trailer.
- Major business is to transport different owners' cargo and there is less mixed cargo. Types of cargo varies depending on the consignee.
- Only one company among six well understands the current regulation for overloading control in Laos (e.g., vehicle dimension and maximum GVW).
- Only one company among six owns and uses a mobile weigh scale(s) to control the GVW and the remaining companies estimate cargo weight from cargo type and sometime invoice and control GVW.

2.6 Other Major Activities in the Project

2.6.1 External Training

(1) Outline of the Training

External trainings were conducted as part of the trainings for capacity improvement for road and bridge management. In the Project as shown in following table, three external trainings in Japan and an external training in Thailand were planned and implemented. Through these trainings, the trainees were expected to acquire following knowledge and skills:

- Organizational framework of road and bridge maintenance in Japan including organization structure, jurisdictions, human resource, equipment and budget
- Road and bridge maintenance system and its database
- Guideline for inspection, evaluation and repair of road and bridge maintenance
- On-site observation of up-to-date technology for routine maintenance

Based upon knowledge and skills gained from the external training, trainees were expected to understand the existing institutional capability for road and bridge maintenance and develop action plans for enhancement of the institutional and individual maintenance capacity.

At the end of training, the course evaluation was conducted by means of questionnaire in order to receive the feedback from trainees and to reflect the result in next external trainings. It consists of evaluation of curriculum and contents and evaluation on general arrangement of the training course.

(2) Trainees

Every external training, five trainees from the counterpart agencies were selected. For selection of the trainees, the following conditions and requirements were taken account.

- A person who receives a recommendation from Lao government
- A person who has been engaging in road and bridge maintenance for several years
- A person who can speak, write and read English fluently
- A person who is good enough to accomplish the training in terms of physical and psychological health (expectant mother may not attend the training in some cases)
- A person who does not belong to military service
- A person who has never attended previous trainings

The summaries of the external trainings in Japan and Thailand are explained below.

(3) External Training in Japan

1) 1st External Training in Japan

The 1st External Training was conducted in Japan for two weeks from 1st to 15th September 2012.

Name of training:	1st External Training in Japan for The Project for Improvement of Road Management Capability In Laos
Duration	2 weeks from September 01 to 15, 2012
Number of trainees	5 person
Venue:	Yamaguchi, Tokyo and Tsukuba

Table 2.6.1 List of Trainee 2012

No.	Name	Organization
1	Mr. Phitsaphonh Philavong	Deputy Director of National Road Administration Division (RAD), Department of Roads (DOR), MPWT
2	Mr. Sengmany Thammavong	Engineer of Road and Water Way Administration Division, DPWT Vientiane
3	Mr. Souvanh Sengchamphone	Deputy Director of Land Transportation Administration Section, DPWT Savannakhet
4	Mr. Vongsack Malivanh	Chief of Infrastructure section, PTRI
5	Mr. Sisomphone Southammavong	Chief of Engineering Section, PTTI

Evaluation Result

Each classroom lecture was conducted for one or two hours. The lectures were evaluated as understandable level according to the result of questionnaire survey. Besides, after the lectures were followed by active discussions among the lecturer and trainees. In the lectures in Yamaguchi, Mr. Sisomphone as a representative of the trainees made a presentation for brief explanation of the road and bridge condition in Laos in order to share the information between the lecturers and trainees.

In terms of site observations, trainings were evaluated reasonable generally based upon the answers of questionnaire. At the site, it was often recognized that many questions were raised by the trainees such as actual usage of vehicles and equipment for routine and periodic maintenance at local government offices. Furthermore to observe the real material for road and bridge construction at the institutional laboratories could supplement with the related lectures.

On the other hand, regarding training management, length of training, time allocation and venue were evaluated as appropriate based upon the result of questionnaire. Besides, most training materials were translated from Japanese to English properly and distributed to the trainees beforehand.

Output of the Training

As stated in the discussion among the trainees, trainees are able to apply acquired information and knowledge from the training to their own works. In particular, preparation of road and bridge maintenance plan and inspection sheet for routine maintenance was

considered for taking account of the manner used in Yamaguchi Prefecture and Ministry of Land, Infrastructure, Transport and Tourism in Japan (MLIT) Yamaguchi. As output of the external training in Japan, the following outputs were expected to be delivered.

- To prepare the training report and to share the knowledge by making presentation at 4th TWG
- To review the contents of the intensive training
- To review the road and bridge maintenance system including guideline for inspection, evaluation and repair

Photo of the Training

The following photos show the training.

Lecture at Traffic Center in Yamaguchi

Field Visit at Mountainous Roads in Yamaguchi

Field Visit at MLIT Branch Office in Yamaguchi

Lecture at NILIM in Tsukuba

Source: JICA Expert Team

Figure 2.6.1 1st External Training in Japan 2012

2) 2nd External Training in Japan

The 2nd External Training was conducted in Japan for 10 days from 31st of August to 11th September 2013.

Name of training:	2nd External Training in Japan for The Project for Improvement of Road Management Capability In Laos
Duration	10 days from August 31 to September 11, 2013
Number of trainees	5 person
Venue:	Yamaguchi and Tsukuba

Table 2.6.2 List of Trainee 2013

No.	Name	Organization
1	Mr. Siriphone INTHIRATH	General Director of PTTI
2	Mr. Sonephachanh SIVONGDAO	Engineer of RAD
3	Mr. Khamlune KHATHUMPHOM	PTRI
4	Mr. Sonemixay VORLABOUTH	Engineer of DPWT Vientiane
5	Mr. Phouxay PHOUNTHAVY	Engineer of DPWT Savannakhet

Evaluation Result

Each classroom lecture was conducted for one or two hours. The lectures were evaluated as understandable according to the result of questionnaire survey. Notably the lectures and field visits coordinated by MLIT Yamaguchi included useful contents such as “the maintenance system and organization of MLIT”, “roadside station”, and “maintenance and management of mountainous roads in Yamaguchi”. In the lectures in Yamaguchi, Mr. Siriphone as a representative of the trainees made a presentation for brief explanation of the road and bridge condition in Laos in order to share the information between the lecturers and trainees.

In terms of the field visits, the trainees had opportunities to view the low-cost road management techniques in mountainous area including slope protection measures and attention-seeking measures for road users.

Output of the Training

As stated in the discussion among the trainees, trainees are able to apply acquired information and knowledge from the training into their own works, in particular some road maintenance works and system done by MLIT Yamaguchi such as “organization and framework of MLIT Yamaguchi”, “roadside station” and “road management measures in the mountainous area”. Other information and knowledge which cannot apply in Laos immediately is also beneficial for the trainees to take them for consideration into future plans. For instance, the lecture and field visits by Central Nippon Expressway (NEXCO) could contribute to having practical idea for toll road construction in Laos which is currently under consideration in MPWT so as to increase road maintenance budgets. Furthermore, research works of infrastructure material deterioration and new technology of pavement done by Public Works Research Institute (PWRI) showed many practical information and technologies for the trainees to obtain importance of the laboratory system and new material knowledge. As an output of the external training in Japan, the following outputs are expected to be delivered.

- To prepare training report and to share the knowledge by making presentation at 2nd JCC
- To take account of the system and organization of MLIT Regional Bureau into the operation of Regional Office under DOR established in September 2013
- To review the road and bridge maintenance system based upon the “PDCA Cycle (Plan->Do->Check->Act)” explained by MLIT Yamaguchi
- To consider establishment or revitalizing of roadside stations along NR-9 and NR-13 for taking account of safety of road users and regional development

Photo of the Training

The following photos show the training.

Lecture at Yamaguchi Prefecture

Field Visit at Expressway in Yamaguchi

Field Visit at Bridge Renovation in Yamaguchi

Field Visit at PWRI

Source: JICA Expert Team

Figure 2.6.2 2nd External Training in Japan 2013

3) 3rd External Training in Japan

The 3rd External Training was conducted in Japan for two weeks from 20th July to 2nd August 2014.

Name of training:	3rd External Training in Japan for The Project for Improvement of Road Management Capability In Laos
Duration	14 days from July 20 to August 2, 2014
Number of trainees	5 person
Venue:	Nagasaki, Fukuoka

Table 2.6.3 List of Trainee 2014

No.	Name	Organization
1	Mr. Saphone PHOUNTHAVY	Trainer in road engineering, PTTI
2	Mr. Laythong PHOMMAVONG	Deputy Director of Technical Division(TD)/DOR, MPWT
3	Mr. Chanthavangso OUDOMDETH	Director of Infrastructure and Transport Division, PTRI
4	Mr. Bounpasong NOYKHAMNGON	Engineer of Road and Water Way Administration Division, DPWT VTE Province
5	Mr. Souksavanh NANTHAVONG	Engineer of Land Way Administration Section, DPWT Savannakhet

Evaluation Result

Each classroom lecture conducted for one or two hours at a lecture room in Nagasaki University. The lectures at the end collected many questions from the trainees. It was evaluated as understandable according to the result of questionnaire survey. On the first day of the training, discussions and introduction among trainers and trainees were made. Mr. Chanthavangso as a representative of the trainees made a presentation for brief explanation of the road and bridge condition in Laos so as to share the basic information among them.

In the lecture of road and bridge maintenance, the trainees learned importance of "prevention" according to the results of questionnaire. The lectures were evaluated very practical explaining how to use the equipment to enhance understanding the technical skills for inspection works in Japan and new technologies for the trainees. Field visits to surrounding Nagasaki City, Unzen reconstruction site and Higashi Kyusyu Highway construction area were also beneficial to the trainees. At these sites construction method, basic design and systems were discussed among the trainers and trainees.

Output of the Training

As stated in the discussion among the trainees, trainees are able to apply acquired information and knowledge about damages and causes of roads and other infrastructures from the training to their own works. The obtained information was shared in each organization of the trainees and was applied appropriately into their practical works. On the other hand, the explanation and documents by NEXCO encouraged understanding the international standards of road and highway construction and could apply to future road plan and management. Furthermore, the trainees gained the idea that providing long service life to the existing infrastructure could contribute to reducing the life cycle cost. To do so, the trainees recognized importance of maintenance. As an output of the external training in Japan, the following outputs are expected to be delivered.

- To prepare training report and to share the knowledge by making presentation at 5th JCC
- To take account of the idea of "prevention" into the road and bridge maintenance plan
- To introduce new equipment used in the practical class in the training for inspection by DPWT or trainings by PTTI if possible to procure in further project
- To consider establishment or revitalizing of roadside stations along NR-9 and NR-13 for taking account of safety of road users and regional development

Photo of the Training

The following photos show the training.

Lecture at Nagasaki University

Practical Class at Nagasaki University

Field Visit at Unzen Reconstruction Site

Field Visit at NEXCO Highway Construction Site

Source: JICA Expert Team

Figure 2.6.3 3rd External Training in Japan 2014

4) 4th External Training in Japan

The 4th External Training was conducted in Japan for two weeks from 16th to 29th August 2015.

Name of training:	4th External Training in Japan for The Project for Improvement of Road Management Capability In Laos
Duration	14 days from 16 to August 29, 2015
Number of trainees	5 person
Venue:	Nagasaki, Fukuoka

Table 2.6.4 List of Trainee 2015

No.	Name	Organization
1	Mr. Kittisack PHOMMAVONGSY	Trainer in Civil Engineering Section/PTTI
2	Mr. Phonephana PHROMMALA	Deputy Director of Technical Division(TD)/DOR, MPWT
3	Mr. Chanthavisith CHANTHOUMPHONE	Staff of Infrastructure and Transport Division(RMS team)/PTRI
4	Mr. Somchai SAPHAKDY	Engineer of Road and Water Way Administration Division, DPWT VTE Province
5	Mr. Akhalar INTHAVONGSA	Head of Unit in Land Way Administration Section, DPWT Savannakhet Province

Evaluation Result

Each classroom lecture conducted for one or two hours at a lecture room in Nagasaki University. The lectures at the end collected many questions from the trainees. It was evaluated as understandable according to the result of questionnaire survey. On the first day of the training, discussions and introduction among trainers and trainees were made. Mr. Phrommala as a representative of the trainees made a presentation for brief explanation of the actual road and bridge conditions in Laos so as to share the basic information among them.

In the lecture of bridge maintenance, the trainees could learn about “Steal Bridge” which information hardly obtained due that never constructed in Laos yet. Also tunnel has not constructed in Laos yet, however the necessity is recognized. Therefore, such lectures were helpful for considering future road and bridge infrastructure plans. Field visits to surrounding Nagasaki City, Kumashiro Bridge reconstruction site and the bridge factory in Kurume were also beneficial to the trainees. At these sites construction method, basic design and systems, materials, and way of public consultation were discussed among the trainers and trainees.

Output of the Training

As stated in the discussion among the trainees, they are able to apply acquired information and knowledge about road maintenance and advanced technologies from the training to their own works and plan. The obtained information was shared in each organization of the trainees and was applied appropriately into their practical works. On the other hand, the explanation by Oriental Shiraishi Corporation encouraged understanding the international standards of bridge construction, keeping the safety for construction workers and importance of public awareness for local citizens in the surrounding area could apply to future infrastructure plan including steal bridge development and construction management. Furthermore, the trainees gained the idea that providing long service life to the existing infrastructure could contribute to reducing the life cycle cost. To do so, the trainees recognized importance of maintenance. As an output of the external training in Japan, the following outputs are expected to be delivered.

- To prepare training report and to share the knowledge by making presentation at 7th JCC
- To bring the survey method of road crack acquired by this training into their road maintenance works.
- To review their check sheet compared to ones used in Nagasaki.
- To consider procurement of the equipment used in the practice which clarifies invisible crack for the routine road maintenance or the road maintenance training by PTTI

Photo of the Training

The following photos show the training.

Opening Lecture at Nagasaki University

Practical Class at Nagasaki University

Field Visit at Kumashiro Bridge Reconstruction Site

Field Visit at Bridge Factory in Kurume

Source: JICA Expert Team

Figure 2.6.4 4th External Training in Japan 2015

(4) External Training in Thailand

1) 1st External Training in Thailand

The 1st External Training in the third country was conducted in Thailand for 11 days from 13th to 23rd October 2014.

Name of training:	1st External Training in Thailand for The Project for Improvement of Road Management Capability In Laos
Duration	11 days from October 13 to 23, 2014
Number of trainees	5 person
Venue:	Bangkok, Phitsanulok

Table 2.6.5 List of Trainee in Thailand 2013

No.	Name	Organization
1	Mr. Phitsaphonh PHILAVONG	Deputy Director of National Road Administration Division (RAD), Department of Roads (DOR), MPWT
2	Mr. Sisomphone SOUTHAMMAVONG	Chief of Engineering Section, PTTI
3	Mr. Soulitha THANYAKEO	Engineer of Infrastructure Division, PTRI
4	Mr. Korrakan PHIMPHANHAK	Deputy director of road-water way section, DPWT Vientiane
5	Mr. Souvanh SENGCHAMPHONE	Deputy director of road management section, DPWT Savannakhet

Evaluation Result

Each lecture conducted for one or two hours in general at a room in Department of Highway (DOH) under Ministry of Transport and Communications, Thailand. Most of the lectures, explanation of field visits and discussions were done in Thai language. According to the answers of questionnaire, all trainees stated the lectures and field visits were understandable. Similarity of language and customs between both countries Laos and Thailand seems to promote an understanding during the trainings.

In the lecture of road and bridge maintenance, advanced technologies of inspection and repair works in Thailand were introduced. The lecture helped to update the trainees' knowledge on the new technologies for maintenance. The trainees in general satisfied with the lectures and field visits in Thailand. However time allocation was suggested to be revised in next training since some trainees stated the time for the field visit was too tight and short.

Output of the Training

The knowledge and information obtained from the training could be applied to the existing works for road and bridge maintenance. As output of the external training in Thailand, the following outputs are expected to be delivered.

- To prepare training report and to share the knowledge among counterparts
- To take account of the technology and standard used in Thailand into the road and bridge maintenance plan
- To formulate cooperative relation between Laos and Thailand in terms of road and bridge construction and maintenance

Photo of the Training

The following photos show the training.

Lecture at DOH

Introduction of Laboratory in DOH

Field Visits on Bridge Inspection in Bangkok

Field Visit on Road Construction Site in Phitsanulok

Source: JICA Expert Team

Figure 2.6.5 1st External Training in Thailand 2013

2) 2nd External Training in Thailand

The 2nd External Training in the third country was conducted in Thailand for 4 days from 6th to 9th November 2017.

Name of training:	2nd External Training in Thailand for The Project for Improvement of Road Management Capability In Laos
Duration	4 days from November 6 to 9, 2017
Number of trainees	7 person
Venue:	Bangkok, Salaburi

Table 2.6.6 List of Trainee in Thailand 2013

No.	Name	Organization
1	Mr. Litta KHATTIYA	Deputy Director General of DOR/MPWT
2	Mr. Laythong PHOMMAVONG	C/P, Deputy Head of Technical Division/MPWT
3	Mr. Boualith PATHOUMTHONG	Deputy Director General of DOT/MPWT
4	Mr. Chanthavangso OUDOMDETH	Head of Infrastructure and Transport Division/PTRI
5	Mrs. Saykham THAMMANOSOUTH	Deputy Director General of PTTI
6	Mr. Soumountha SOMCHANMAVONG	Director of DPWT Vientiane Province
7	Mr. Prasongsinh CHALEARNSOUK	Director of DPWT Savannakhet Province

Evaluation Result

The training carried out for management level of counterparts under Department of Highway (DOH), Ministry of Transport and Communications, Thailand. Most of the lectures included essences utilizing in Laos. Particularly, lecture of public-private-project (PPP) including explanation of advantages and issues was useful for the trainees since PPP scheme has newly introduced in Laos. Furthermore, capacity building and budget planning for overloaded vehicle control were practical lesson for the trainees because a weigh scale was setting up in the pilot province.

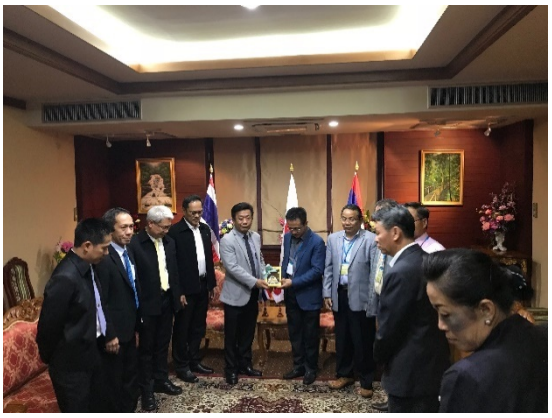
Output of the Training

The knowledge and information obtained from the training could be applied to the existing works for road and bridge maintenance system, PPP planning and implementation, overload vehicle control, highway planning, and capacity building. As mentioned above, practical information about overload vehicle control could use for the activities in CaRoL. Sharing the information and data about border traffic was beneficial for not only the trainees but also DOH.

This training contributed to make a good relationship between two ministries in Laos and Thailand since hereafter MPWT might have a project in cooperation with DOH under integration of ASEAN countries.

Photo of the Training

The following photos show the training.



Opening at DOH

Center of Overload Control in DOH

Field Visits of Highway Construction in Saraburi

Lecture in DOH

Source: JICA Expert Team

Figure 2.6.6 2nd External Training in Thailand 2017

2.6.2 Achievement of Project Output and Purpose assessed by Capacity Assessment Survey

In order to evaluate achievement of the project output and purpose, capacity assessment surveys were conducted.

In Phase 1, the surveys were carried out to assess the capacity of C/Ps in DPWT Savannakhet and Vientiane by using structured questionnaires. The questionnaire consisted of seven major categories related to their duties and responsibilities and the counterpart as a representative of organization assessed the present capacity, ranking by following five levels.

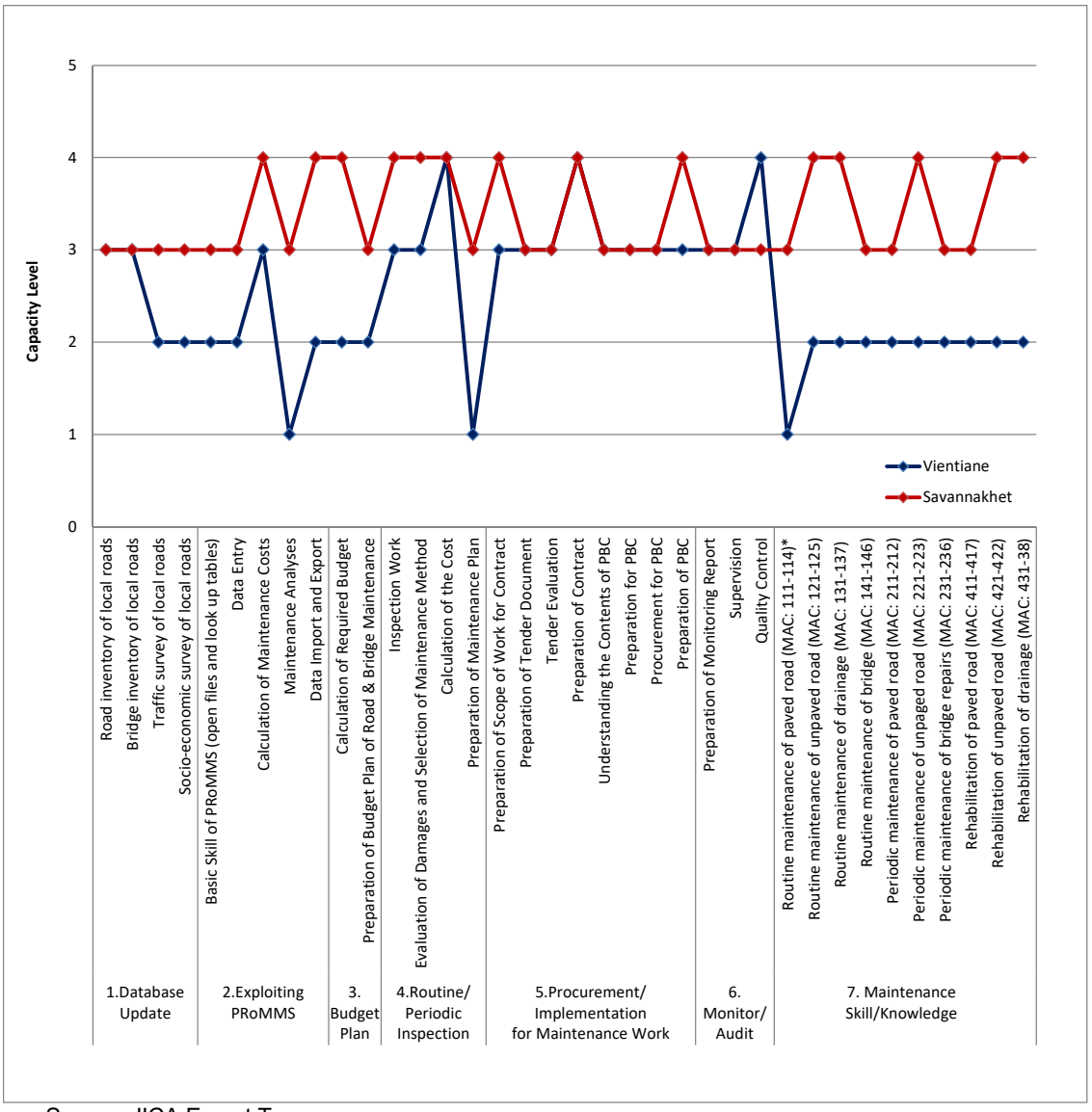
Major duties and responsibilities for road and bridge maintenance

- Database Update
- Exploiting PRoMMS
- Budget Plan of Road and Bridge Maintenance
- Routine/Periodic Inspection
- Procurement / Implementation for Maintenance Work
- Monitor / Audit
- Maintenance Skill/ Knowledge

Evaluation levels

- Level 1: Procedures/routines under development (none)
- Level 2: Operated with external support
- Level 3: Operated with limited external support
- Level 4: Operated without external support
- Level 5: Able to act as advisor and trainer (full capacity)

The following figure illustrates results of the capacity assessment survey conducted in August 2014.



Source: JICA Expert Team

Figure 2.6.7 Assessment of Capacity in DPWT Savannakhet and Vientiane Provinces

As the figure shows, the capacity of DPWT Savannakhet indicates relatively higher than Vientiane Province.

This questionnaire survey was also conducted in October 2012 during the commencement of the Project as baseline survey. Compared to the baseline capacity, ability of the C/Ps in DPWT Savannakhet can be judged to improve during the course of the Project. One of the largest contributors is implementation of the Pilot Project on NR-9 which includes all-aspect practices for road and bridge maintenance as OJT throughout the period of Project Phase 1. Meanwhile, DPWT Vientiane has not shown improvement compared to the baseline survey although the respondent has been changed due to the transfer in the organization. Even the staffs attended all the trainings and workshops organized by the Expert Team in Phase 1, it could not cultivate their capacity significantly due to lack of practical operations. Absence of OJT and Pilot Project for daily maintenance work in Vientiane may result in lower capacity attained though the Project.

In Phase 2, the similar surveys were carried out that the management class people assed the capacity of their staffs in all the counterpart agencies by using structured questionnaires. The questionnaire consisted of five major categories related to their duties and responsibilities and the counterpart as a representative of organization assessed the present capacity, ranking by following five levels.

Major duties and responsibilities for road and bridge maintenance

- Data verification and analysis
- Maintenance planning
- Procurement
- Performance monitoring and evaluation
- Maintenance skill and knowledge

Evaluation levels

- Level 1: Procedures/routines under development (none)
- Level 2: Operated with external support
- Level 3: Operated with limited external support
- Level 4: Operated without external support
- Level 5: Able to act as advisor and trainer (full capacity)

The following table shows results of the capacity assessment survey conducted in August 2014 and April 2017.

Table 2.6.7 Capacity Assessment by Management Class in 2014 2017

Category	DOR		DPWTs		PTRI		PTTI	
	2014	2017	2014	2017	2014	2017	2014	2017
1. Data verification and analysis	4.0	4.0	2.7	4.0	3.6	3.8	2.0	4.0
2. Maintenance planning	3.7	4.5	3.1	4.0	4.0	4.0	2.7	3.6
3. Procurement	4.0	4.0	3.3	4.1	n.a.	n.a.	4.0	5.0
4. Performance monitoring and evaluation	4.0	4.0	3.2	3.8	n.a.	n.a.	3.0	4.0
5. Maintenance skill and knowledge	5.0	5.0	2.7	4.0	n.a.	n.a.	4.0	5.0

Note: Procurement, monitoring & evaluation, maintenance are out of PTRI's duties.
Source: JICA Expert Team

According to the result of assessment for three years from 2014 to 2017, the capacities generally has been improved. In particular capacities of road maintenance in DPWTs could be said to upgrade because of the practical lectures and training such as carrying out the Pilot Projects. Looking at the other counterpart, the road maintenance capacities were judged as improved. However there are only few categories reaching to "Level 5: able to act as advisor and trainer (full capacity)". Continual capacity development therefore is still needed for the counterpart.

CHAPTER 3. MATTERS ARISING, ACTIONS TAKEN AND LESSONS LEARNED DURING THE PROJECT

3.1 Matters Arising and Actions Taken

Following a narrative summary of the PDM of the Project, the outputs of each project activity, matters arising during the course of the Project and actions taken to address these matters are summarized as following table.

(1) Maintenance Planning Ability for Road and Bridge Maintenance Is Enhanced.

1-1 Review current situation and obtain baseline capabilities on maintenance planning works.	
Progress	・ The Expert Team carried out questionnaire surveys in Nov 2011– Feb 2012 for DPWTs in all 17 provinces (increased to 18 provinces in 2013) in order to understand road/bridge maintenance planning and budgeting capability. As the results, the average skill level of PRoMMS operators was 3.3 points (3.0: Operated with limited external support, 4.0: Operated without external support).
Problems and Countermeasures	・ During the initial stage of the Project, JICA Expert and the World Bank identified lack of operational and management capacity of road management system and discussed and agreed that JICA Expert provides technical assistance to manage the RMS/PRoMMS while the World Bank provides financial support for inventory and condition survey and database update.
1-2 Improve data collection method/work for RMS/PRoMMS	
Progress	・ PTRI held 3-days trainings for PRoMMS data collection and operation in Oct 2012 and Nov 2013 and Oct 2014 inviting DPWT staffs in total of all provinces in order to improve their skills. ・ For measurement of road roughness, PTRI and the Expert Team procured VIMS with technical support provided by Dr. Nishikawa from Nagasaki University in Japan. Since 2013, VIMS has been operated for IRI survey and the survey result was incorporated into the RMS. ・ In April 2017, the function of operation of RMS/PRoMMS was transferred from the PTRI to DOR, which the PTRI continues to function as a system manager of RMS/PRoMMS. Accordingly, JICA Expert provided technical assistance to DOR through OJT for operation of RMS/PRoMMS and VIMS/DRIMS.
Problems and Countermeasures	・ After completion of the World Bank's Lao Road Sector Project Phase 1, the RSM/PRoMMS was not regularly updated due to lack of technical skills and financial capacity to manage the system. Therefore, JICA Expert and the World Bank confirmed necessity of inhouse capacity building to operate the management system. Accordingly, PTRI updated the database of the national road, through inventory and condition surveys and DPWTs update the PRoMMS database of the local road, which contributes to inhouse capacity building.
1-3 Improve and update RMS/PRoMMS and update through the trial run in the pilot provinces.	
Progress	・ PTRI and the Expert Team held PRoMMS data collection survey training for two days in each pilot provinces in Nov 2012 due to encourage skill of DPWT/OPWT staffs. ・ The Expert Team improved identified problems of PRoMMS/RMS such as compatibility with OS, database software and problems found during PRoMMS training. ・ Since 2012, PTRI has continued to conduct RMS inventory surveys for entire national road network. ・ Likewise, DPWTs has continuously conducted PRoMMS inventory surveys for local road network since 2012.

Problems and Countermeasures	・ Following the discussion with the World Bank, JICA Expert supported PTRI/DPWTs to update the road database in entire Laos, including pilot provinces and the World Bank supported the fund for inventory and condition surveys for entire road network. ・ In April 2017, the function of operation of RMS/PRoMMS was transferred from the PTRI to DOR, which the PTRI continues to function as a system manager of RMS/PRoMMS. Accordingly, JICA Expert provided technical assistance to DOR through OJT for operation of RMS/PRoMMS and VIMS/DRIMS.
1-4 Draft optimum road maintenance plan in the pilot provinces using RMS/PRoMMS.	
Progress	・ Since 2012, PTRI has combined RMS and PRoMMS data and analyzed and developed Annual Road Asset Report every year, which contains mid-and long-term optimum road maintenance plan under budget constraint scenario.
Problems and Countermeasures	・ Ditto
1-5 Draft optimum road maintenance budget plan in the pilot provinces using RMS/PRoMMS.	
Progress	・ Since 2012, DOR has set aside most of RMF for rehab of the national road and plans to develop optimum road maintenance plan/budget plan once all national roads become in a maintenance condition. ・ In 2016, DPC reviewed RMF considering mid- and long-term maintenance budget and revised RMF Act.
Problems and Countermeasures	・ Requires a close coordination with ADB project since ADB project will oversee the RMF and revise RMF law which requires RMS/PRoMMS analysis result.
1-6 Conduct on-the-job training for maintenance budget plan and database upgrade of RMS/PRoMMS.	
Progress	・ PTRI held PRoMMS training inviting DPWT staffs from all provinces in Oct 2012 and Nov 2013. The training consisted of lectures and exercises for the road maintenance planning by using PRoMMS. ・ The Expert works with PTRI for data collection and analysis of RMS/PRoMMS.
Problems and Countermeasures	・ As mentioned above, in April 2017, the function of operation of RMS/PRoMMS was transferred from the PTRI to DOR. Since the PTRI continues to function as a system manager of RMS/PRoMMS and acquired sufficient capacity to operate the RMS/PRoMMS, the PTRI is able to assist the DOT to operate and maintain these systems.
1-7 Monitor progress of the activities and evaluate maintenance planning capability	
Progress	・ A survey on individual capacity development was conducted in April 2017 and the result indicates that PTRI has improved capacity level from 3.6 (data verification) and 4.0 (planning) in 2014 to 4.3 (data verification) and 4.5 (planning) in 2017. Accordingly, five (5) PTRI officers out of (7) seven in total has acquired trainers' capacity and overall capacity level has improved toward the target (5.0)
Problems and Countermeasures	・ Nil

(2) Technical Manuals for Road/Bridge Maintenance are Prepared.

2-1. Review and revise existing technical manuals, including Condition Survey Manual, Inventory Manual and Slope Protection Manual.	
Progress	・ In order to understand current situation and needs of the users of existing manual, interview with the users such as implementation organizations and local contractors was conducted to define the principle of the revision of the manual. ・ Technical Manuals were developed by such similar components as Inspection, Evaluation and Execution.
Problems and Countermeasures	・ Nil
2-2. Develop technical manuals including Inspection, Evaluation and Repair manuals.	
Progress	・ The Expert Team and counterparts, including DOR, PTTI and PTRI, established a working group with objectives of development and revision of the technical manual. ・ The members of the working group translated the manual into Lao. ・ The Expert Team and counterparts developed Technical Manuals Version-1 (English/Lao) and submitted 200 copies to DOR. ・ The Expert Team and counterparts reviewed and revised Performance-based Contract and developed its operational manual. ・ In collaboration with ADB Project, the MAC (Maintenance Activity Code) was reviewed and revised and standard specification for maintenance was drafted in line with the proposed revision of MAC.

Problems and Countermeasures	・ In 2012, the DOR introduced Performance-based Contract for maintenance of paved roads. However, this PBC was terminated in the following year. Responding to a request by the DOR, JICA Expert assisted the DOR to revise the technical specifications of PBC and prepared bidding documents and the operational guide. ・ At the timing of completion of the Phase 1, JICA Expert recommended to institutionalize the technical manuals, by developing technical specifications and reflecting these specifications in the maintenance contract. Following these recommendations, JICA Expert in collaboration with ADB Project, drafted a technical specification for maintenance works.
2-3. Monitor utilization of technical manuals and evaluate their usage and relevance.	
Progress	・ Intensive Trainings for dissemination of the manuals were conducted 4 times in total at the pilot provinces. ・ Physical maintenance works, such as Pilot Projects and bridge maintenance works in Savannakhet Province successfully completed using the developed manual at pilot province under the supervisor of DPWT staff with technical supported by the Expert Team. ・ In Oct 2016, the MPWT organized Sam Sang workshop where all DPWT staffs attended and the technical manuals distributed to these DPWT staff. ・ The Expert Team and counterparts organized 4 day workshops in 4 different provinces on the revised PBC where all DPWTs and around 90 private contractors attended. ・ DOR implemented a pilot PBC (a total road length of around 200 km) between Jan 2015 and Jan 2016, to test the revised PBC. ・ A survey on individual capacity development was conducted in April 2017 and the result indicates that DOR has improved technical level from 4.0 (data verification), 4.0 (planning), 4.0 (procurement), 4.0 (monitoring and evaluation) and 5.0 (maintenance skill and knowledge) in 2014 to 4.0 (data verification), 4.5 (planning), 4.0 (procurement), 4.0 (monitoring and evaluation) and 5.0 (maintenance skill and knowledge) in 2017 and DOR has achieved trainers capacity particularly in maintenance skill and knowledge (5.0) and maintenance planning (4.5) by 2017. ・ PTTI has improved technical level from 2.0 (data verification), 2.7 (planning), 4.0 (procurement), 3.0 (monitoring and evaluation) and 4.0 (maintenance skill and knowledge) in 2014 to 4.0 (data verification), 3.6 (planning), 5.0 (procurement), 4.0 (monitoring and evaluation) and 5.0 (maintenance skill and knowledge) in 2017 and PTTI has achieved trainers' capacity particularly in procurement (5.0) and maintenance skill (5.0) by 2017.Accordingly, (3) DOR/PTTI officers and three (3) PTTI officers have acquired trainers' capacity and overall capacity level of DOR and PTTI have improved toward the target (5.0)
Problems and Countermeasures	・ Requires a close coordination with ADB project since part of ADB's scope of work include review/finalization of CaRoL technical manuals.

(3) Capability of Physical Road/Bridge Maintenance Work in the Pilot Provinces is Enhanced.

3-1. Review current situation and obtain baseline capabilities on physical maintenance works and formulate training plan and monitoring plan.	
Progress	・ Confirmed the technical capability and knowledge concerned to maintenance work by interview corresponding staffs (at both central and provincial levels) and local contractors.
Problems and Countermeasures	・ Nil
3-2. Conduct on-the-job training (OJT) to DPWT engineers in the pilot provinces on routine maintenance work, including inspection, small repair and quality control.	
Progress	・ As explained above, 5-days intensive trainings aimed at gaining understanding of the technical manuals were conducted 4 times for DOR, DPWTs, OPWTs and local contractors in the pilot provinces. ・ Following the request by DOR, revision of PBC including preparation of contract documents and procedure manuals was conducted. 4-days intensive trainings aimed at gaining understanding of revised PBC were conducted 4 times for DOR, DPWTs, OPWTs and local contractors in the pilot provinces as well. ・ By using the budget for bridge maintenance in DPWT Savannakhet Province, DPWT/OPWT staff and local contractors completed repair works by using the manuals with the technical supports by the Expert Team. ・ The Expert and counterpart organized one-day workshop for implementation of a pilot CFA (Cement Formed Asphalt).

Problems and Countermeasures	・ In order to roll out the project outcome and activities, the PBC is under the full operation applying to 321 km road sections in the southern provinces under the ADB Project.
3-3. Evaluate OJT on routine maintenance work and improve training modules and training programs.	
Progress	・ The Expert Team confirmed capability and improvement degree of the engineers through the lecture and skill test in the intensive training program.
Problems and Countermeasures	・ Nil
3-4. Develop the procedures to conduct OJT on routine maintenance work as an official function of MPWT.	
Progress	・ Force account routine maintenance unit was proposed, and it was discussed in JCCs and TWGs and TOR for establishment of maintenance unit was prepared. ・ Regional Offices were established under the umbrella of DOR, similar to organizational structure of MLIT. (As of now, Regional Office was restructured and new Maintenance Division established under DOR where 25 Project Mangers assigned to oversee the maintenance of each province)
Problems and Countermeasures	・ Nil
3-5. Conduct Pilot Project on repair work for supervising and quality control of Asphalt Concrete pavement in Savannakhet Province	
Progress	・ The Expert Team and counterparts implemented a series of pilot projects along the National Road 9 in Savannakhet Province. Which includes (i) 3.1 km road rehab (1st year), (ii) 15.8 km sport maintenance (2nd year) and (iii) around 180 km major rehab (from 3rd year till now). ・ The Expert Team provides technical assistance, including preparation of concept plan, design review and assistance to supervision works for implementation of pilot projects. ・ The Expert Team and counterparts implemented a pilot CFA project in Vientiane Province. Which includes 2.0 km rehab using CFA method for replacement of basecourse.
Problems and Countermeasures	・ Nil
3-6. Monitor progress of the activities and evaluate capabilities on physical maintenance works	
Progress	・ A survey on individual capacity development was carried out in April 2017 and the result indicates that DOR has improved technical level from 4.0 (data verification), 4.0 (planning), 4.0 (procurement), 4.0 (monitoring and evaluation) and 5.0 (maintenance skill and knowledge) in 2014 to 4.0 (data verification), 4.5 (planning), 4.0 (procurement), 4.0 (monitoring and evaluation) and 5.0 (maintenance skill and knowledge) in 2017. ・ DPWTs in pilot provinces has improved technical levels from 2.8 (data verification), 2.8 (planning), 3.3 (procurement), 3.2 (monitoring and evaluation) and 2.7 (maintenance skill and knowledge) in 2014 to 3.8 (data verification), 4.0 (planning), 4.0 (procurement), 3.8 (monitoring and evaluation) and 4.0 (maintenance skill and knowledge) in 2017. Accordingly, DOR and the DPWTs in two (2) pilot provinces have acquired capacity level of over 3.0 in all aspects of maintenance activities.
Problems and Countermeasures	・ Nil

(4) Capability of Physical Road/Bridge Maintenance Work in the Pilot Provinces is Enhanced.

4-1. Review current institutional framework for overloading control and suggest approaches to address institutional issues to develop sustainable overloading control.	
Progress	・ Following the discussion and site survey result, JICA Expert and DOT confirmed to renew the weigh station in Donghen in Savannakhet. ・ DOT acquired approval from the Ministry to upgrade the Modernized Weigh Staions in 3 provinces and to renew the weigh station in Donghen in Savannakhet as part of the pilot project. ・ The Expert Team and counterpart from DOT reviewed specification of weigh scale and agreed with single-platform static weigh scale as an optimum option among several alternatives. ・ The Expert Team provided a support for bidding (preparation of specification, contract document, preparation for bidding). ・ In Dec 2016, JICA organized a bid open ceremony and negotiated with the least bidder. In Feb. 2017 the contracts of contractor, replacement of weigh station and procurement of weigh scale were concluded. ・ In Dec 2017, the construction of weigh station in Donghen was completed after a final joint inspection by JICA and DOT.

Problems and Countermeasures	・ Pilot projects in Bolikhamxay and Luang Namtha are planned by own budget and supporting by ADB and WB. ・ Specification and documents using for Donghen weigh station shared with ADB and WB
4-2. Design, procure and install weigh bridges at one location along National Road No.9.	
Progress	・ In May 2016, the Expert Team and counterpart organized a workshop on modernized weigh scale, inviting makers and suppliers from Thailand. ・ In June and July 2016, the Expert Team and 3 counterparts attended study tours in Thailand to meet weigh scale makers and suppliers and to make site visits. ・ Draft operational manual for overloading control was prepared with supports from ADB project and submitted to DOT ・ Intensive training for operation manual was conducted in Mar. 2018 involving DOT and DPWTs
Problems and Countermeasures	・ Nil
4-3. Develop operational manual(s) and conduct on-the-job training (OJT) for overloading control in the pilot province.	
Progress	・ Together with ADB Project, the operational manual for overloading control was drafted and accepted by the DOT. ・ The supplier of the weigh bridge and its system prepared an operational manual and DOT and JICA Expert jointly organized an intensive training for operation of the Donghen Weigh Station in March 2018.
Problems and Countermeasures	・ In order to strength over-loaded control, establishment of new organization and revision of relevant law were discussed with DOT and ADB project
4-4. Develop regular check – reporting system and legal framework for strict enforcement on overloading control in the pilot province.	
Progress	・ The monitoring system, which the Project supported and introduced at the weigh station in Savannakhet (Donghen), enables to monitor the operation of the main road and the weighing station by the CCTV camera both at the MPWT headquarter and at DPWT Savannakhet. ・ The data server, which the Project supported and introduced at the weigh station in Savannakhet (Donghen), automatically saves the measurement result (including the fine amount) both at MPWT headquarter and at DPWT Savannakhet.
Problems and Countermeasures	・ Nil
4-5. Disseminate the activities (4.1 to 4.4) to private trucking companies/forwarders/major shippers.	
Progress	・ In April 2018, JICA Expert together with DOT and DPWT Savannakhet hosted dissemination workshop, involving trucking companies and freight forwarders.
Problems and Countermeasures	・ Nil
4-6. Assess progress of the activities and evaluate institutional capabilities for overloading control.	
Progress	・ In April 2018, a monitoring survey was carried out in Donghen Weigh Station to monitor the performance of the system and operation.
Problems and Countermeasures	・ Nil

3.2 Lessons Learned from the Project

3.2.1 Coordination with Other Donors

For the successful implementation of the Project and rolling out the outcome of the Project, coordination with other donors is essential. The Expert Team organized regular meetings with the World Bank and Asian Development Bank (ADB) to update the progress of the Project. In the course of these meetings, the Expert Team and World Bank and ADB discussed and confirmed demarcations among the road management projects to avoid duplications among these projects and which were reflected to drafting TORs for the World Bank's and ADB's projects.

The achievement of the Project shows that as a result of the coordination with the WB, the database of the RMS and PRoMMS is to be updated under the financial support by the WB, following the survey implementation and budget plan developed by the Expert Team and PTRI. ADB has started Road Sector Governance and Maintenance Project (2016 to 2021) and the scope of ADB Project includes (i) review and finalization of technical manuals prepared under the Project and (ii) implementation of PBC routine maintenance, tested in the Project as a pilot project. The Expert Team closely worked with ADB consultant team to generate synergy effects between ADB and JICA and accomplish a sustainable road management system.

WB also commenced Lao Road Sector Project Phase 2 (2018 to 2021) and the scope of WB project includes (i) implementation of PBC maintenance for local roads and (ii) update of RMS, incorporating climate resilient factors into the system. Like ADB Project, the Expert Team will also closely work with WB consultant team to accomplish a sustainable road management system since the scope of these two projects overlaps and the Project could provide an effective input to the WB project.

3.2.2 Utilization of External Resource

The executing agency involved in the Project should acquire various road and bridge maintenance and management skills and measures, including the state of arts maintenance measures. As a result, he/she becomes able to select most effective and optimum maintenance solution in practice. To do so, during the course of the Project, the Expert Team invited short-term external experts.

For instance, Dr. Nishikawa, an assistant professor of Nagasaki University, was engaged to introduce the VIMS/DRIMS and provide technical assistance for the roughness survey to update the database of the RMS. Another example is that SIKA, Thai-based maintenance material supplier, was invited to the intensive training for bridge maintenance and gave lectures at the said training and demonstrated the up-to-date bridge maintenance methods to the local trainees. Also, World Kaihatsu Kogyo, a Japanese contractor, was involved for introducing CFA (Cement Foamed Asphalt) method as part of the pilot project and testing CFA in 2 km road section along the National Road No.13 North. Lastly, DOH of Ministry of Transport in Thailand, was engaged as a training institute, where C/Ps of the Project received the training course for road and bridge management as the third country training.

3.2.3 Counterpart's Ownership

The Expert Team emphasized counterpart's commitment and ownership are the key to realize a self-reliant maintenance cycle, and accordingly, has been seeking for financial contributions by the counterpart agencies. To realize this, the Expert Team regularly organized the JCC and TWG to share the progress and achievement of the Project among the counterparts, which contributes the counterparts to understanding importance and necessity of the Project. Also, during the initial stage of the Project, the JICA provided financial supports to implement pilot projects, which also contributes to increasing the counterpart's understanding for the importance on road management practices. Also, the budget planning cycle in Laos was well considered in planning and implementing the Project.

As a result, both JICA and DOR/DPWT jointly provided funding for implementation of the pilot projects (15.8 km spot improvement along National Road No.9 and 2.0 km CFA along National Road No.13 North). Also, the Expert Team supported DOR to prepare the concept design and preliminary cost estimate of 180 km rehabilitation works along National Road No.9. Following this, since 2014, the DOR has been funding for implementation of these rehabilitation works as part of the pilot project. At the time of Terminal Evaluation, the counterpart agencies set aside their own fund at a total amount of 76.5 million USD and allocated it for implementation of series of pilot project.

3.2.4 Rolling-out of the Project

As stated in the PDM of the Project, the outcome and activities of the Project is limited to two pilot provinces: Vientiane and Savannakhet Provinces. However, the road network, particularly that of paved roads, has been expanding annually and the needs for road maintenance and management skill and knowledge were required in the entire Laos. During a series of JCC and TWG, the counterpart agencies frequently requested for the role out of the project outcome in other provinces.

To realize rolling-out of the Project to other provinces, the PTTI, as a focal point of the training center in the implementing agency, has been fully involved in the Project, working together with the Expert Team to draft the technical manuals, organize the intensive training and OJT in the course of the Project. Also, the road management system and database update, of which the project outcome was also limited to two pilot provinces, was successfully improved and updated for the entire road network, using financial support provided by the World Bank. The Expert Team also revised Performance-based Contract and provided a series of intensive trainings for all DPWTs and local contractors in Laos and accordingly, the DOR implemented pilot Performance-based Contract in 4 selected provinces as a pilot project.

CHAPTER 4. ACHIEVEMENT OF PROJECT OUTPUT AND PURPOSE

4.1 Achievement of Project Output and Purpose assessed by Mid-term Review Mission

The JICA dispatched the Mid-term Review Mission between 23rd March and 5th April, 2014. The Mid-term Evaluation Mission, composed of three members from JICA and private consulting firm, evaluated performance and achievement derived from the Project, by the structured questionnaire and interview surveys to concerned organizations.

The following discussion summarizes the achievement of the Project and the recommendations provided to attain the overall goal of the Project at the time of Mid-term Review.

4.1.1 Achievement of Project Output

The progress of the Project is assessed well progressing as the planned output is to be achieved.

Indicator 1: PTRI has been exposed to VIMS with the support by Nagasaki University. Intensive training programs on data collection were organized in 2012 and 2013, which targeted DPWT staff members from all 17 provinces.

Indicator 2: DOR and PTRI have completed planned activities. With the support by the WB, data in RMS/PRoMMS had been updated and analysis of the data had been made by PTRI. A report of the data analysis had been submitted to DOR. Cost estimation of road maintenance at provincial level had been prepared by all DPWTs.

Indicator 3: Two-time road rehabilitation works were done as Pilot Projects in Savannakhet Province.

4.1.2 Achievement of Project Purpose

Output 1: RMS/PRoMMS operators were trained both at the PTRI and at DPWTs.

Output 2: The manuals have been reviewed and revised and translated into Lao. The records prepared by the Project showed that 61 deteriorated road sections were rehabilitated in Year 1 and 67 deteriorated road sections were repaired in Year 2.

Output 3: Over 150 staff members of DOR, DPWT and PTRI have been trained on the subjects of road maintenance, bridge maintenance, slope maintenance and performance-based contract under the Project.

In the course of the project implementation, MPWT has gone through reorganization. As a result, newly established offices named Regional Offices under DOR are now responsible for maintenance of national roads. Official roles and responsibilities of the Regional Offices are unknown to the project members, so that there is a difficulty in making necessary alignment between the actual national road maintenance structure and the proposed maintenance unit by the Project.

4.1.3 Summary of Mid-Term Evaluation Results

(1) Relevance: High

The Lao Government has set the road development sector especially maintenance works as one of the priority areas of development. Similarly, MPWT has stated the importance of proper road maintenance to increase national roads to a higher standard in the document called 'Communication, Transport, Post and Construction Development Plan from 2001-2005 and 2010-2020'.

According to the Japan's Country Assistance Policy for Laos issued in April 2012, development of economic and social infrastructure is one of the priority areas for assistance. JICA has extensive and long experience of assisting developing countries including countries nearby Laos. Hence lessons learned from such projects come as useful and meaningful advantages.

(2) Effectiveness: Fairly High

The Project has been making steady progress towards achievement of the project purpose. As continuous efforts are being made by both Lao and Japanese sides, it is expected that the project purpose is going to be achieved by the project termination.

(3) Efficiency: Fairly High

The Experts in the relevant field of expertise and experience have been dispatched as originally planned. The Expert Team consists of mainly Japanese nationals and one Lao national has brought added value. Approval processing time by the Lao side can be faster to save time and to maximize the use of equipment and machines given to DPWT Vientiane.

In accordance to the reorganization of DOR, the Expert Team has suggested to review the current JCC membership. Donor coordination has been made between the Project and other development partners such as the WB, ADB and KfW in the course of the project implementation.

(4) Impact: Fairly High

Some positive impacts were identified owning to the project implementation. DOR, PTTI, PTRI and DPWTs (Savannakhet and Vientiane Provinces) have moved forward in human resource development in the field of road maintenance.

If all concerned players such as the project members from the Lao side continue to practice what they have learned in the Project and work with other development partners such as the ADB, KfW and WB, the Lao side may be able to achieve the overall goal

(5) Sustainability: Fair

Policy aspect: the Project will continue to be aligned to the policy direction set by MPWT and/or Government of Laos (GOL).

Institutional aspect: MPWT, including DOR is in the course of reorganization. The feasibility for establishment of the maintenance unit in pilot provinces, proposed by the Project, needs to be reviewed.

Technical aspect: Technical sustainability is going to be relatively high. The progress of the technical capacity development of the selected staff members of DOR, PTTI, PTRI and DPWTs is going well and as planned.

Financial aspect: Financial sustainability of the Project is going to be relatively low. Most of counterpart departments are struggling to find funds in order to perform tasks given as per their mandate(s).

4.1.4 Conclusion and Recommendations at the time of Mid-term Review

The progress of the Project towards achievement of the project purpose is well on track owning to the positive factors such as (1) provision of the inputs from both Lao and Japanese as planned and (2) execution of the planned activities as scheduled for the most part.

Some observations were made on how the established maintenance unit in Savannakhet and the know-how acquired through the project implementation be adapted to the newly established four Regional Offices. Also, knowledge and technology acquired by DPWT Vientiane under the Project has not been demonstrated owning to unavailability of funds to execute a Pilot Project in Vientiane Province. Moreover, obstacles and negative factors were foreseen for sustainability of the Project. The main reason for this assessment is based on the past and current balance between the revenue and the expenditure of RMF.

As a result of the Mid-term Review Mission, following recommendations were made.

(1) Securing adequate budget for road maintenance

The Project needs to work closely with the WB in ways of sharing information and providing feedback to identify ways forward to increasing the RMF revenue and testing feasibility of the maintenance under the PPP scheme. Discussion needs to be made at the

JCC to seek for self-sustainable funding such as toll booth installation for user fee collection along the National Road No.9 under the Project.

(2) Alignment with the outcome of the reorganization of DOR

New offices referred as Regional Offices are set up at four different geographical areas. The Project shall review the relevancy of the maintenance unit set-up in Savannakhet Province under the Project, so that necessary alignment between the management unit in Savannakhet and the Regional Offices can be made. If needed, the JCC shall discuss and approve the modification of the PDM accordingly.

(3) Intervention to overloaded trucks

Inclusion of DOT as the JCC member may be sought to share a common understanding regarding the cause-effect relation of overloaded trucks and share responsibilities of overcoming the challenge between DOR and DOT and others concerned.

(4) Direction of Pilot Project implementation

The responsibilities of the necessary cost for Pilot Projects have shifted from the Japanese side to the Lao side gradually during the project implementation. Especially from a viewpoint of sustainability of the Project, the agreed arrangement of responsibilities between the two sides shall be in effect for the remaining project period.

The discussion should be continued at the JCC that the agreed implementation arrangement for the third pilot project be practiced when the anticipating funds is made available to Vientiane Province.

4.2 Achievement of Project Output and Purpose assessed by Terminal Evaluation Mission

The JICA dispatched the Terminal Evaluation Mission between 23rd March and 7th April, 2017. The Terminal Evaluation Mission, composed of three members from JICA and private consulting firm, evaluated performance and achievement derived from the Project, by the structured questionnaire and interview surveys to concerned organizations.

The following discussion summarizes the achievement of the Project and the recommendations provided to attain the overall goal of the Project.

4.2.1 Measurement of Results

(1) Perspective of the Project Purpose

(Indicator 1) RMS/PRoMMS database has been updated throughout the project period (2012-2016) by PTRI/DPWT. The Terminal Evaluation Team confirmed that database in road and bridge information in all provinces are properly updated and maintained. Furthermore, the Terminal Evaluation Team confirmed that the data in the table above obviously contains data in pilot provinces. Therefore, RMS/PRoMMS in the pilot provinces are properly improved and updated.

(Indicator 2) The Terminal Evaluation Team also confirmed that DOR prepares maintenance budget plan annually in the pilot provinces, following analysis by RMS/PRoMMS. In concrete, RMS analysis report has been regularly updated by PTRI and submitted to DOR. DOR has injected most of RMF to National Road and rehabilitation works, following the RMS analysis.

(Indicator 3) The indicator can be measured mainly as annual damaged distance in IRI and in road condition (scored as 1 to 6) based on the results of the road condition survey and annual maintenance distance of pilot provincial road (National Road No.9), consequently, the results indicate that annual damaged distance of national road in both IRI and road condition in National Road No.9 seems to be decreased as compared with the data in 2002. Furthermore, the Project already rehabilitated a total of 199.4km in National Road No.9. Accordingly, it is expected that distance of preventive maintenance (routine maintenance and periodic maintenance) will be increased in National Road No.9.

(Indicator 4) There is no number of overloaded trucks surveyed at national road(s) at the time of Terminal Evaluation since a weight scale at Donghen is not installed yet.

Considering the fulfillment of the four (4) indicators and level of achievement of four (4) Outputs, the Project Purpose is likely to be partially achieved by the end of the Project period since there is no actual achievement of Output 4 caused by delay in procurement process of a weight scale and relevant apparatus.

(2) Output 1

(Indicator 1-1) Total number of RMS/PRoMMS operation officers in Public Works and Transport Research Institute (PTRI) is amounted to 7. Currently, a total of seven (7) RMS/PRoMMS operation officers work in PTRI. Six (6) PTRI officers among seven (7) officers participated in various trainings. Also, five (5) PTRI officers among seven (7) officers were invited in various trainings as trainers.

The JICA Expert Team conduced survey on individual capacity development in April 2017 and the result indicates that PTRI has improved capacity level from 3.6 (data verification) and 4.0 (planning) in 2014 to 4.3 (data verification) and 4.5 (planning) in 2017. Accordingly, five (5) PTRI officers out of (7) seven in total has acquired trainers' capacity and overall capacity level has improved toward the target (5.0).

(Indicator 1-2) It is not necessary to measure capacity of DPWT for PRoMMS analysis since the analysis function of PRoMMS has been centralized and transferred to PTRI and DPWT has no mandate to analyze and develop the budget plan for Local Roads based on the PRoMMS analysis. The indicator is excluded as an indicator for evaluation.

(Indicator 1-3) The Terminal Evaluation Team confirmed that RMS/PRoMMS database are regularly (once a year) updated throughout the Project implementation period by PTRI/DPWTs. The actual disbursement of RMF implies that more funds were channeled to rehabilitation of National Roads, which follows optimum maintenance plan suggested based on RMS/PRoMMS analysis.

Output 1 is expected to be achieved by the end of the Project with regards to the fulfilment of the three (3) indicators.

(3) Output 2

(Indicator 2-1) The Project developed the drafts of Technical Manuals for Road, Bridge Maintenance, and Slope Protection in February 2014 and submitted MPWT in September 2014. Technical manuals are now under review work by selected sub-working group, which is scheduled to be finalized by August 2017.

(Indicator 2-2) A total of 200 copies of draft manuals were disseminated during Sarm Sarng Workshop in October 2015 and MPWT distributed them to DPWTs.

Output 2 is expected to be achieved by the end of the Project with regards to the fulfilment of the two (2) indicators.

(4) Output 3

(Indicator 3-1) A total of 86 DOR officers in total (99 DOR officers in total) attended in various training. Twenty two Project Managers in DOR's Maintenance Division in total and all Project Managers attended at least one training (seminar/workshop/intensive training). Also, 341 DPWT/Office of Public Works and Transport (OPWT) officers in total attended in various trainings. Fifty five DPWT officers in Land Transport Management Section in the pilot provinces (56 DPWT officers in the pilot provinces in total) and almost all DPWT officers in the pilot provinces in charge of maintenance attended at least one training (seminar/workshop/intensive training). Accordingly, more than 80% of maintenance officers in the pilot provinces and DOR participate in seminars/workshops/trainings conducted under the Project.

(Indicator 3-2) Three (3) DOR/ Public Works and Transport Training Institute (PTTI) officers and three (3) PTTI officers attended in intensive technical manual trainings as trainer (manual and PBC).

The JICA Expert Team conduced survey on individual capacity development in April 2017 and the result indicates that DOR has improved technical level from 4.0 (data verification), 4.0 (planning), 4.0 (procurement), 4.0 (monitoring and evaluation) and 5.0 (maintenance skill and knowledge) in 2014 to 4.0 (data verification), 4.5 (planning), 4.0 (procurement), 4.0 (monitoring and evaluation) and 5.0 (maintenance skill and knowledge) in 2017 and DOR has achieved trainers capacity particularly in maintenance skill and knowledge (5.0) and maintenance planning (4.5) by 2017.

PTTI has improved technical level from 2.0 (data verification), 2.7 (planning), 4.0 (procurement), 3.0 (monitoring and evaluation) and 4.0 (maintenance skill and knowledge) in 2014 to 4.0 (data verification), 3.6 (planning), 5.0 (procurement), 4.0 (monitoring and evaluation) and 5.0 (maintenance skill and knowledge) in 2017 and PTTI has achieved trainers' capacity particularly in procurement (5.0) and maintenance skill (5.0) by 2017.Accordingly, (3) DOR/PTTI officers and three (3) PTTI officers have acquired trainers' capacity and overall capacity level of DOR and PTTI have improved toward the target (5.0).

(Indicator 3-3) A total of 86 DOR officers attended in various trainings (99 DOR officers in total). A total of 341 DPWT/OPWT officers attended in various trainings (326 DPWT officers in Lao PDR including 56 DPWT officers in the pilot provinces). In addition, 234 private contractors attended in various trainings.

The JICA Expert Team conduced survey on individual capacity development in April 2017 and the result indicates that DOR has improved technical level from 4.0 (data verification), 4.0 (planning), 4.0 (procurement), 4.0 (monitoring and evaluation) and 5.0 (maintenance skill and knowledge) in 2014 to 4.0 (data verification), 4.5 (planning), 4.0 (procurement), 4.0 (monitoring and evaluation) and 5.0 (maintenance skill and knowledge) in 2017.

DPWTs in pilot provinces has improved technical levels from 2.8 (data verification), 2.8 (planning), 3.3 (procurement), 3.2 (monitoring and evaluation) and 2.7 (maintenance skill and knowledge) in 2014 to 3.8 (data verification), 4.0 (planning), 4.0 (procurement), 3.8 (monitoring and evaluation) and 4.0 (maintenance skill and knowledge) in 2017. Accordingly, DOR and the DPWTs in two (2) pilot provinces have acquired capacity level of over 3.0 in all aspects of maintenance activities.

Output 3 is expected to be achieved by the end of the Project with regards to the fulfilment of the three (3) indicators.

(5) Output 4

(Indicator 4-1) The Project planned to install a new weigh scale and its apparatus including paving, approach road, signboards, etc., at Donghen along National Road No.9, and its procedures for installing the weigh bridge is undergoing and the installation will be completed by August 2017.

(Indicator 4-2) There is no data and information obtained since project activities regarding checking axle load at pilot weigh station(s) have not yet implemented as of the Terminal Evaluation. After the set of a new weigh scale and its apparatus at Donghen is installed and appropriately operated, the data and information is going to be obtained and analyzed.

(Indicator 4-3) There is no data in percentage of overloaded trucks surveyed at pilot weigh station obtained since project activities regarding checking axle load at pilot weigh station(s) have not yet been implemented as of the Terminal Evaluation.

Output 4 is expected not to be achieved by the end of the Project in September 2017 since it is impossible for the Project to implement some of the relevant activities.

(6) Overall Goal

(Indicator 1) RMS/PRoMMS database has been updated throughout the project period (2012-2016) by PTRI/DPWT. The Terminal Evaluation Team confirmed that the table shows that database in road and bridge information in all provinces are properly updated and maintained.

(Indicator 2) The Terminal Evaluation Team also confirmed that DOR prepares maintenance budget plan annually in all provinces, following analysis by RMS/PRoMMS.

In concrete, RMS analysis report has been regularly updated by PTRI and submitted to DOR. DOR has injected most of RMF to National Road and rehabilitation works, following the RMS analysis.

(Indicator 3) The indicator can be measured as annual damaged distance in IRI and in road condition (scored as 1 to 6) based on the results of the road condition survey, consequently, the results indicate that annual damaged distance of national road in both IRI and in road condition seems to be decreased as compared with the data in 2002. Furthermore, the results of annual damaged distance (km), percentage of damaged distance and expenditure for national road maintenance works obviously indicate that expenditure for routine and periodic maintenance work in both in % and in amount of expenditure are increased, in particular, from 2013/14 to 2015/16. Recently, road surface is so maintainable that DOR is able to set aside a certain amount of financial resources for preventive maintenance (routine maintenance and periodic maintenance). Consequently, damaged road distance is expected to be decreased annually.

(Indicator 4) There is no actual data in number of overloaded trucks surveyed at pilot weigh station obtained as described in indicator 4 of Project Purpose..

Because of the fulfillment of the indicators 1, 2 and 3, there may be positive perspective to achieve the Overall Goal three to five years after the termination of the Project if actual data for the indicator 4 is obtained and fulfilled.

4.2.2 Summary of Evaluation Results

(1) Relevance

The relevance of the Project is high.

1) Consistency with Lao development plans/strategy

In Outcome 1 (sustained inclusive economic growth) of the 8th NSEDP, the Plan refers to construction (infrastructure) of road, railways, development aviation facilities in “Sustained and in Inclusive Economic Growth (Output 1)” and transportation integration in “Regional and International Cooperation and Integration (Output 7)” as necessary components. So as to facilitate transportation integration, “linkages within the country, and integration and linkages with the regional and international levels”, the Plan suggests that improving and expanding infrastructure ASEAN main roads including National Road No. 9 be focused. Therefore, the Project is consistent with the development strategy of the country.

2) Consistency with the Japanese assistance strategy for Lao PDR

The Project is regarded as one of the components of “Development of transport networks” under “Development of Economic and Social Infrastructure”, which is one of the priority areas of the Japanese Government for the assistance to Lao PDR. Therefore, the Project is consistent with the Country Assistance Policy of Japan since it puts emphasis on development of transport (roads and bridges) networks through capacity development of the Lao Government in road maintenance management, which would lead to economic and social development in Lao PDR.

Therefore, the Project is consistent with the Japanese assistance strategy for Lao PDR.

(2) Effectiveness

The effectiveness of the Project is medium.

The Project was determined to add one project component (output) on controlling overloaded vehicles in November 2015 and demonstrates an intention of tackling with one of the sensitive and challenging issues in the road and transport sectors, which a variety of stakeholders need to be involved with. The Project is going to complete the installation of a weigh station by August 2017; accordingly, the relevant activities will not be implemented during the implementation period.

Causal relationship between Outputs 1 to 4 and the Project Purpose is strong since (i) improvement and updates of RMS/PRoMMS and development of a road maintenance plan (Output 1), (ii) development of technical manuals (Output 2), (iii) conducting on-the-job training through routine maintenance works and rehabilitation works (Output 3) and (iv) controlling overloading in pilot province(s) (Output 4) is indispensable to the attainment of capacity development in maintaining roads and bridges in the pilot provinces (Project Purpose). Achievement levels of Outputs 1, 2, and 3 are relatively high while that of Outputs 4 is undermined because of delay in completing the procurement process of a weight scale at Donghen along National Road No.9.

In verifying the achievement level of the Project Purpose, attaining the achievement of the Project Purpose is premised on the achievement of each Output. Therefore, the achievement level of the Project Purpose will be lower than expected due to a short of achievement level of Output 4. However, the following positive incidents/aspects such as utilization of VIMS, updating of RMS/PRoMMS database and practicing the CFA method regarding the achievement of the Project Purpose have been observed:

Therefore, the Project Purpose is likely to be partially achieved by the end of Project at the time of the Terminal Evaluation.

(3) Efficiency

The efficiency of the Project is medium.

One of the distinct features of the Project is high level of commitment of the Government of Lao PDR as demonstrated in the number of C/Ps and priority allocation of the budget. With regards to quality and quantity, input from the Lao and Japanese sides such as allocation of C/Ps, allocation of Japanese experts, provided equipment, Japan and the third country training, offices and facilities are appropriate and utilized. In particular, C/P institutions implement pilot projects in cooperation with local contractors and consultant with financial contribution from the Lao side. Also, assignment of Lao JICA expert who received higher education in Japan in bridge maintenance appropriately complemented other project activities such as project coordination. With regards to timing, there is no serious delay observed in implementing project activities since the commencement of the Project except delay in procurement process of a weight scale and the relevant apparatus.

Project activities on Output 1, 2 and 3 utilizing project inputs have produced Outputs 1, 2, and 3 at a satisfactory level in spite of difficulties in achieving Output 4 within the project implementation period.

(4) Impact

The impact of the Project is relatively high.

C/Ps and engineers from MPWT and DPWT are attempting to apply techniques and knowledge such as asphalt mix design, pavement construction, and design of pavement structure obtained from the Project to day-to-day maintenance activities, which would lead to the attainment of the Overall Goal.

The on-going Japanese grant project in Savannakhet Province, the Project for the Rehabilitation of the Bridges on National No.9 adopted “steel-concrete composite slab bridge” with weathering treatment, taking into consideration of lower life cycle cost through construction and maintenance of bridge, which was derived from the Project.

PTTI autonomously developed training curriculum with 14 training clusters including “Road Asset Management and Maintenance” in March 2017. The institution is expected to conduct technical training, utilizing technical manuals developed by the Project in “Road Asset Management and Maintenance” training once they are revised and officially authorized.

RMS/PRoMMS improved by the Project is going to be modified by adding a new component (new survey items) on climate changes into the systems by the World Bank, revised PBC and its relevant documents will be used for other provincial and district roads by the World Bank and ADB and, technical manuals will be taken over for provincial and district roads by ADB. The outcomes of the Project are going to be disseminated to other provinces by development partners.

The Lao side, DPWT and local contractors (Road No.8 and Khounxay), has acquired sufficient technical skills in constructing asphalt concrete pavement through the road rehabilitation of National Road No. 9 (excluding 58-km Japan Grant Aid section) in Pilot Project (Phase III). It is expected that Road No.8 and Khounxay will contribute to the quality road maintenance in the country.

Newly appointed 22 project managers in DOR are expected to contribute to establishing a better maintenance mechanism since each manager is assigned in a specific province since he may be dedicated for maintenance activities such as monitoring maintenance activity performance and effective reporting system under clear job mandates and responsibilities. The concept raised of establishing the maintenance mechanism in DOR is derived from experiences of the trainees who observed the maintenance system in external training in Japan.

(5) Sustainability

Overall sustainability of the Project is expected to be relatively high.

1) Institutional sustainability

The institutional sustainability is relatively high since the capacity development in road and bridge maintenance is highly consistent with the Lao development strategy as described in “(1). Relevance.”

2) Organizational sustainability

The organizational sustainability is relatively high. Almost all C/Ps (eight (8) out of ten (10) who has been appointed) have been engaged with the Project since its commencement. MPWT including DOR will be the main the governmental institution in charge of road and bridge maintenance in the future even though MPWT is still in the process of reorganization.

3) Financial sustainability

The financial sustainability is medium. Revenue of RMF (Currently, it is renamed as Road Fund (RF)) continues to increase its revenue by more than 30% on average annually from 2001-02 to 2015-16. However, RMF has been able to cover only about 20% to 30% of the total demands for road and bridge maintenance all over the country, which lowers the sustainability to some extent.

During the implementation of the Project, C/P institutions fully set aside operational budget and born investment cost, for various pilot projects, which obviously indicates that C/P institutions will continue to secure funding even after the completion of the Project.

4) Technical sustainability

The technical sustainability is relatively high.

C/Ps accept and begin to adopt the techniques and knowledges provided by the Project. Moreover, the Terminal Evaluation Team found that the techniques and knowledge were disseminated to some private contractors as well as DOR, PTRI and DPWT. PTRI are fully involved with data collection for RMS and PRoMMS annually, moreover, PTRI improves the systems and updates the database by themselves. PTTI, DOR and PTRI are fully engaged in developing technical manuals and acquired techniques and knowledges to accomplish these activities on their own.

Finally, as with Output 3 with regard to On-the-Job training through pilot projects, DOR and DPWTs assigned themselves as project managers of pilot projects and engineers from DOR, DPWTs and private contractors acquired techniques in executing AC road pavement works technically sufficiently such as asphalt mix design and design of pavement structure. Road Sector Governance and Maintenance Project (RSGMP) by ADB and Lao Road Sector Project Phase II (LRSP2) by the World Bank will take over and continue some project activities, which is expected to enhance the technical sustainability.

4.2.3 Conclusion and Recommendations at the time of Terminal Evaluation

(1) Conclusion

Due to some delayed activities on Output 4, the achievement level of the Project Purpose will be lowered than expected at the termination of the Project even though strong ownership of C/P institutions has contributed to the current moderate achievement level of the project outcomes.

Consequently, the Project has produced its outcomes at a satisfactory level except Output 4 with high relevance, medium effectiveness, medium efficiency, relatively high impact and relatively high sustainability. In response that situation, the Terminal Evaluation Team suggests that the duration of Project be extended so as to ensure that sufficient period of implementation is assured for the achievement of Output 4 the Project Purpose.

(2) Recommendations

1) Extension of Project Implementation Period

(For JICA) The Terminal Evaluation Team suggests that the duration of Project be extended for six (6) months (up to March 2018) so as to ensure that sufficient period of implementation is assured for the achievement of Output 4 and the Project Purpose based on the results of the Study.

2) Technical Assistance to DOR on RMS/PRoMMS Utilization

(JICA Expert Team) In response to the transfer of main responsibility for analysis and formulation of maintenance planning based on RMS/ PRoMMS to DOR from PTRI, the JICA Expert Team needs to provide assistance to strengthen DOR capacity in improvement of RMS/PRoMMS, update of database and development of road maintenance plans that were dedicated for PTRI once the reorganization is officially approved within the Ministry. The JICA Expert Team proposes that the activities be scheduled from October 2017 to February 2018.

3) Recommendations for the Remaining Period of the Project

(i) Staff Allocation for Newly-Established Divisions/Unit within MPWT and DPWT

(For DOR and DPWT Savannakhet) During the on-going process of reorganization of MPWT, DOR and DPWT Savannakhet need allocate sufficient number of personnel for newly established divisions within MPWT (Project Monitoring Division, Planning and Cooperation Division, National Road Administration Division, Local Road Division) and newly-established unit (Maintenance unit) within DPWT Savannakhet.

(ii) Completion of Installation of Weigh Station

(For JICA Expert Team and C/Ps) The Project needs to complete the installation of the weigh scale and its relevant apparatus at Donghen by August 2017 as scheduled. It is because the specification of the weigh scale to be installed is going to be adopted to two other Donor-sponsored sites at Luangnamtha and Borikhamxay provinces.

(iii) Dissemination/ Rolling out of Project Outcomes

(a) Technical Manuals

(For JICA Expert Team, DOR, and PTTI) The Project needs to complete the revision of technical manuals in road, bridge and slope by August 2017 as scheduled and need to disseminate the outcomes of revised manuals by distributing them to all the potential DPWTs in provinces that have AC-paved road infrastructures and OPWTs in the potential provinces. PTTI needs to utilize technical manuals in training curriculum “Road Asset Management and Maintenance” once they are officially authorized.

(b) Revised PBC Document and Operational Manual

(For JICA Expert Team) The Project needs to complete the process of taking over the revised PBC document and operational manual developed by the Project to Lao Road Sector Project Phase II and Road Sector Governance and Maintenance Project.

(iv) Coping with Controlling Overloading

(For C/P Institutions) C/P institutions (DOT) need to establish and maintain the implementation structure by allocating sufficient human and financial resources.

(For DOT) It is practically important for the transport sector and DOT to execute strict enforcement of penalty on overloading. DOT needs to put the severe enforcement into practice as soon as possible once the implementation structure is established. DOT needs to secure sufficient human and financial resources so as to maintain Transport Patrol Authority once the decree underlying the new institution is official approved.

CHAPTER 5. RECOMMENDATIONS FOR ACHIEVING OVERALL PROJECT GOAL

5.1 Recommendations for Short-term Actions

Following the PDM design concept, the overall goal of the Project, saying Roads and bridges in Laos are properly maintained, is expected to be achieved within 3 years after completion of the Project. Accordingly, considering the achievement level of the Project, explored in Chapter 4, this section provides recommendations for short-term activities (within 3 to 5 years after completion of the Project).

(1) Rolling out project outputs applying to WB and ADB Projects

As mentioned in the lessons learned from the Project (Chapter 3) and recommendations at the time of Terminal Evaluation (Chapter 4), the Project has been implemented in collaboration with related projects of other donors such as those of the World Bank and ADB from the beginning of the project period. Accordingly, the project outcome has been successfully in the track to be rolled out. In order to ensure the project outcome is rolled out to the World Bank and ADB Projects[1], the following recommendations are made, which require short-term actions.

(Road Management System and Database Update) VIMS/DRMS, introduced in the Project under the technical support by Nagasaki University, was procured by the World Bank's Lao Road Sector Project Phase 1 and 6 sets of VIMS/DRIMS were delivered to DOR in 2017. Also, ADB's Lao Road Sector Governance and Maintenance Project (2016 -2021) plans to procure road management equipment and tools (database server, personal computer, HDM-4 and GIS software, GPS, etc.) for the operation purpose of the RMS. It is recommended that, utilizing these equipment and tools, the DOR should continuously update and operate the RMS and its database, under the technical cooperation of the World Bank's Lao Road Sector Project Phase 2 (2018-2021). In

[1] Projects of WB and ADB are described as follows. "Lao Road Sector Project Phase 2 (2018-2021)" by WB consists following four components: 1) rehabilitation and maintenance of local roads in six provinces in northern and central region including Oudomaxay, Phongsaly, Houaphan, Xiengkhouang, Xayabouly, Bolikhamxay, 2) capacity building for planning of sector development, establishing road asset management system, and institutional designing for PPP, 3) contingency fund for urgent rehabilitation works, and 4) project management. "Lao Road Sector Governance and Maintenance Project (2016-21)" by ADB consists of following three components: 1) capacity building of road asset management including overloading control, revising regulation related to RMF, establishment of road asset management system and finalization of technical manuals, 2) institutional capacity building of road asset management including enforcement of proper bidding process and contractor management and road maintenance by communities, and 3) rehabilitation and road maintenance by PBC for national and local roads (320km) in three provinces in southern region, Attapeu, Salavan, Xekong.

addition, it is recommended that the DOR should continue to reflect the analysis result of the RMS in the maintenance plan and the budget plan.

(Technical Manuals and Standard Specifications) The Road, Bridge, Slope Maintenance Manuals and Standard Specifications drafted in the Project are currently being revised, following the revision of MAC (Maintenance Activity Code) in the ADB Project. In addition, the bidding documents and draft specifications of Performance-based Contract, revised in the Project, are now in a full utilization in the southern provinces in the ADB Project. It is recommended that the DOR and related departments should finalize these technical manuals and specifications, though holding various technical seminars and workshops, reflecting the outcomes during the operation of manuals and specifications at the site, and also referring to the results of utilization of these manuals and specifications in the ADB Project.

(Overloading Control) The Project supported renewal of Donghen Weigh Station in Savannakhet, installing single platform weigh bridge as well as vehicle and number plate scanners, as part of the Modernized Weight Station Projects in 3 provinces initiated by DOT (Savannakhet, Bolikhamxai, Luangnamta). The construction of Donghen Weigh Station was completed in December 2017, and an intensive training on the operation of the measuring and data management system was held in March 2018, and the station started its operation in April 2018. DOT/DPWT Savannakhet need to establish and maintain an operation and management structure by allocating sufficient human and financial resources in order to operate the weigh station. Also, as for the remaining two weigh stations in Bolikhamxai and Luangnamta, the World Bank and ADB Projects are ready to support renewal of these stations, and therefore, it is recommended that DOT should upgrade these weigh stations following the concept and specification of the Donghen Weigh Station. At the same time, DOT should upgrade remaining 25 nationwide weigh stations, following its implementation plan DOT prepared.

	WB (LRSP2) 2018-21	ADB RSGMP 2016-21	JICA CaRoL 2011-18	KfW RIP 2010-2019
1. Policy and legal framework	Strategic planning	Overloading control RMF ICT Master Plan		
2. Institutional framework	Cabinet Office (IRAM) DOR (System management)	DOT (Overloading control)	PTRI (RMS System Manager) DPWT(Maintenance unit) PTTI (Training)	Village Maintenance Committee (VMC) PTTI (Training)
3. Planning and budgeting	IRAM RMS with Climate resilient		RMS/PROMMS Road Master Database	
4. Procurement and implementation	LR rehab/maintenance (PBC) Weigh scale	NR and LR rehab/maintenance (PBC) Weigh scale	NR AC rehab NR AC routine maintenance Pilot PBC CFA Weigh scale	LR improvement/ maintenance (VMC)
5. Technical specification and manual	Climate resilient PBC for LR	Design Manual PBC for NR/LR Road/Bridge/ Slope maintenance	PBC Road/Bridge/ Slope maintenance	Climate resilient VMC Procedure

Source: JICA Expert Team

Figure 5.1.1 Rolling-out Project Output and Activities

(2) Approval of technical manuals/specifications and utilization by executing agencies

The Road, Bridge, Slope Maintenance Manuals and Standard Specifications drafted in the Project are currently being revised by the ADB Project. It is recommended that these technical manuals and specifications should be formally approved by the MPWT and institutionalized, being utilized by the implementing agencies such as DOR and DPWTs and local contractors. Therefore, the DOR should cooperate with DOLA (Department of Legislation Affair) to put these technical manuals and specifications for ministerial approval process.

(3) Continuous support in the area of asset management by Japan

As mentioned above, the Project has been implemented in collaboration with related projects of other donors such as those by the World Bank and ADB from the beginning of the project period. Accordingly, part of the project outcome has been successfully rolled out. Meanwhile, the need for improving the capacity of the executing agency for bridges and slope maintenance is still inevitable. And the skills and knowledge for asset management including bridge maintenance in Japan is well applicable to developing countries (Also, other donors' supports are not available in bridge maintenance in Laos). Accordingly, it is recommended that Japan should take an initiative and provide

continuous supports in the area of asset management, particularly in the area of bridge maintenance and management.

(Group and Region Focused Training) The Nagasaki University has been engaged in JICA's "Group and Region Focused Training for Bridge Maintenance and Management" between 2016 and 2018. The said training program involves over 20 countries' administrators and engineers on bridge maintenance from all over the world and holds one month intensive trainings in Tokyo and Nagasaki. This training contributes to technology transfer on bridge maintenance and management technology through field tours and experiential learning, and class room lectures as well as experiments of bridge inspection/repair, applying to bridge maintenance and management methods in Japan. This training program is expected to be extended and continue after 2018, and therefore, it is recommended that the executing agency in Laos should dispatch trainees to these training courses on Bridge Maintenance and Management to improve the bridge maintenance technology and capabilities.

(Utilization of JICA Scholars) In 2017, JICA newly established the "JICA Scholarship Program in JICA's Development Initiative for Road Asset Management" aiming to train core human resources in developing countries in the field of asset management. In the said scholarship program, two staffs from DOR and PTTI and one staff from DOT were enrolled as trainees in Nagasaki University and Hokkaido University respectively by October 2017 and officially proceeded to the university academic courses (doctor degrees in Nagasaki University and mater degree in Hokkaido University) from April 2018. It is recommended that the executing agency should fully utilize these expertise, applying to the bridge maintenance and management technology (doctor degrees in Nagasaki University) and overloading countermeasures (mater degree in Hokkaido University) by using the knowledge and skills that these staffs acquire in the academic courses in Japan.

(Technical Assistance) In Laos, approximately 3,000 bridges including 1,400 bridges on the national roads exist, in which 13% of the bridges on national roads need repair works or rebuild urgently. Furthermore, slope failure happens often in rainy season due to luck of slope protection and/or limited road maintenance in mountainous area in Laos. The Terminal Evaluation Mission provided several recommendations for continuous technical assistance to the executing agencies. These recommendations were made toward technical assistance for bridge and slope maintenance. These recommendations are that, fully utilizing bridge inventory database and draft bridge maintenance manual, the following area should be considered for further technical assistance to establish a sustainable bridge maintenance cycle: (a) Improvement and update of BMS and its database and (b) Improvement of capacity in detailed bridge inspection/evaluation/physical maintenance works, utilizing cost-effective technologies such as image analysis and vibration soundness test. Also, for slope maintenance, in order to mainstream preventive slope maintenance as climate resilient adaptation technology, the following areas should be considered for further technical assistance: (a) Improvement of capacity in slope inspection/evaluation/physical maintenance works utilizing Japanese disaster management technologies such as aero photo image analysis and (b) Risk assessment on natural disaster and preparation of a hazard map.

In line with these recommendations, the DOR officially requested Japan's technical assistance entitled " Capacity Building Project for Improvement of Quality Management for Bridge Construction and Maintenance in Lao PDR". Accordingly, it is recommended that JICA should continue to support executing agencies to improve technical and management capacity in the field of bridge maintenance. It is also recommended that JICA should also support executing agencies to achieve technology transfer for managing quality control, taking advantage of Japan's knowledge and experience in this area.

	Road	Bridge	Slope
1. Policy and legal framework	WB (Strategic Planning) ADB (Overloading Control, RMF, ICT Master Plan)		
2. Institutional framework	JICA (Overloading control Maintenance unit) KfW (VMC)	Missing Link	
3. Planning and budgeting	JICA (RMS/PROMMS) WB (IRAM)		WB (RMS with Climate resilient)
4. Procurement and implementation	WB (LR rehab/ maintenance (PBC)) ADB (NR and LR rehab/maintenance (PBC) JICA (NR AC rehab, NR AC routine maintenance, Pilot PBC, CFA) KfW (LR improvement/ maintenance (VMC))		WB (Climate resilient measures) ADB (Slope protection) KfW (Climate resilient measures)
5. Technical spec. and manual	WB (Climate resilient, PBC for LR) ADB (PBC for NR/LR, Design Manual, Road/Bridge/ Slope maintenance JICA(PBC, Road/Bridge/ Slope maintenance) KfW (Climate resilient, VMC Procedure)		

Source: JICA Expert Team

Figure 5.1.2 Donor's Focus Area for Road Management Project and Missing Link

5.2 Recommendations for Long-term Actions

In order to achieve a sustainable road maintenance cycle by improving self-reliant capacity of the executing agency, and hence achieve the overall goal of the Project, this section provides recommendations for mid- to long-term activities (within 5 to 10 years after completion of the Project).

(1) Formulation of road maintenance policy

The executing agency should develop long-term development policies in the field of road maintenance and management These policies include development visions for the HR (Improvement of technical maintenance skills, improvement of maintenance and management planning skills, HR training programs, etc.), organizational system (maintenance method including contracting method, role of national and local governments, registration of local contractors and its performance evaluation, bridge and slope maintenance division, etc.), budgeting (revenue and expenditure of the Road Maintenance Fund, long-term maintenance needs forecast and potential financial resources, debt management, etc.). However, there are no such long-term policies/strategies available in Laos, and the executing agencies respond to address technical and administrative issues in road management in an ad-hoc approach. Therefore, the executing agency should formulate a road maintenance and management policy, which defines the vision of road maintenance and management in the long term, as well as the strategies and actions and the roles of concerned departments to achieve these visions.

(2) Compliance of Road Maintenance Fund Act and Securing Maintenance Resources

The Road Maintenance Fund Act was revised by the Prime Minister's order in June 2016. The main contents of the revised RMF are 1) additional financial resources to the RMF (registration fee of the license plate, road user tax added as part of RMF), 2) budget allocation (budget allocation to National Road slightly reduced from 80% to 74% of the fund, while that of Local Road increased from 10% to 18%). The revenue of the Road Maintenance Fund has doubled in the past five years (mainly due to the increase in fuel levy and fuel consumption), revenues reached 93 million US dollars in 2015/16 (It was reported that about 30% of expenditure is spent for covering debt of maintenance and construction contract in the past years).

Meanwhile, according to the forecast made by the ADB Project, there is a considerable amount of maintenance needs at 800 million USD for the next 10 years for the National Road alone. Therefore, it is recommended that the executing agencies should allocate the fund, particularly for maintaining the National Road, complying with the revised Road Maintenance Fund Act, and to fulfill the needs of maintenance for both National Road and Local Road, the executing agencies should increase and secure the sufficient amount of the fund, for instance, by regularly and planned increasing the fuel levy.

(3) Building an Organizational Capacity for Post World Bank and ADB Projects

Both ADB's Lao Road Sector Governance and Maintenance Project (2016-2021) and the World Bank's Lao Road Sector Project Phase 2 (2018-2021) will complete in 2021. It is recommended that the executing agencies should develop a self-reliant organizational capacity for road maintenance and management by completion of these two projects. To do so, specific recommendations are as follows.

(Road Maintenance and Management) Since the Project was commenced, the organizational administration structure in DOR has undergone frequent changes throughout the project period. At the beginning of the Project, DOR had RAD and LAD respectively to maintain and manage the national roads and local roads. In 2013, these two divisions were merged and divided into four nationwide Regional Offices. However, following the abolishment of Reginal Office in 2014, a new Maintenance Division was established, and 25 Project Managers nationwide are currently in charge of maintaining the national roads. Also, in 2017, the operation of the RMS/PRoMMS that PTRI has been in charge has been transferred to DOR. Since it takes considerable amount of time for the executing agency to function in acquiring and maintaining technology and systems, it is recommended that the DOR should maintain the current organizational structure until sufficient capacity is acquired.

(Bridge Maintenance and Management) About 1,400 bridges spreads nationwide on the national roads in Laos, while about 3,000 bridges exist all over the country including those on the local roads. Until now, preventive bridge maintenance has not been in place and bridges were maintained and/or rehabilitated when damaged or malfunctioned. One of these contributors to absence of preventive maintenance in Laos is the lack of human resources in bridge design and management in the executing agency. Accordingly, it is recommended that the DOR should establish a division specializing in bridge maintenance, securing human resources and budget to the division, establishing and improving the technical capability of bridge maintenance and management.

(Overloading Control) DOT needs to improve the overall institutional capacity securing adequate human and financial resources for overloading control. Taking an example of management issues for overloading control, under the current regulation, overloaded vehicles are fined according to the mileage and excess weight and the basis for calculating these fines is ambiguous. Therefore, it is recommended the DOT to impose a new regulation, collecting fines according to excess weight. In addition, since the degree of the damage to the pavement depends greatly on axle weight of the heavy vehicles, it is recommended that the DOT to revise a current regulation shifting from the current gross vehicle weight control to the axle weight control. These recommendations have been proposed by the ADB Project and the DOT already has taken into account for a revised regulation for overloading control. Besides it is proposed that PMO should take actions to reopen all weigh stations in the country and to strengthen the penalty for overloaded trucks since the notice on abolition of overloading control issued in 2011 is still in force.

The monitoring system, which the Project supported and introduced at the weigh station in Savannakhet (Donghen), enables to monitor the operation of the main road and the weighing station by the CCTV camera both at the MPWT headquarter and at DPWT

Savannakhet, and the server automatically saves the measurement result (including the fine amount) both at MPWT headquarter and at DPWT Savannakhet. These systems are expected to contribute to strict operation and enforcement by the operator(s) in the weigh station. Therefore, it is recommended that the DOT should introduce the same or similar monitoring system to other weigh stations, including those in Bolikhamxai and Luangnamta as pilot Modernized Weigh Stations DOT is proceeding to implement. Furthermore, it is recommended that DOT should take actions, following advices that the Project and ADB project provides for strengthening the operation system of over-loaded control including 7/24 hour operation of weigh station, introducing free weigh inspection certificate for competent trucking companies/drivers, joint inspection with traffic police and random inspection by using mobile scale.

The DOT aims to establish a Transport Patrol Authority that specializes in monitoring vehicles including overloading vehicles, and has already drafted the establishment bill of the said authority. While the roles of the DOT are becoming diversified, such as traffic safety, overloading control, automobile registration, public transportation, etc., establishing such an authority dedicated to monitoring vehicles is considered sufficiently relevant and it is recommended that MPWT should move forward for approval process of the establishment bill at an early stage.

(4) Development of Framework on Asset Management Among Private and Public Sector and Academic Institutions

The concept of road infrastructure asset management in the MPWT was introduced in late 1990s when the World Bank developed Road Maintenance Fund and introduced a road management system. And when the World Bank completed Lao Road Sector Project Phase 1 in 2010, JICA and ADB subsequently supports the MPWT to continue to develop road infrastructure asset management as a system. In general, the conventional approach in infrastructure asset management is to improve individual and technical capacity (inspection→diagnosis→action). In addition, the recent approach is to improve the upstream organizational and institutional capacity (plan→implementation→evaluation) to maximize the benefit derived from infrastructure asset management at the minimum cost required. In Japan, technical skills and individual knowledge (inspection → diagnosis→action) is accumulated in research institutions such as universities, government and private contractors, while organizational and institutional capacity (plan→implementation→evaluation) is developed in the government agency such as local governments and regional development bureaus. In addition, as part of "Strategic Innovation Program (SIP)", the Cabinet Office of Japan is promoting the establishment of asset management technology and human resource development jointly together with public and private sector and academic institutions.

In Laos, multiple donors including JICA provide supports for improving capacity in the field of asset management to the executing agency. On the other hand, no donors have been actively involved in technical supports for research institutions in Laos. Due to the shortage of experts, lack of research equipment and budget at research institutions, engineering department at National University of Laos still cannot offer the doctoral degree in structural engineering. Also, since there is no official technical and engineering qualification certified in Laos such as a professional engineer, incentives for local

engineers are minimal to evaluate technicians' skills and to maintain their technology. Therefore, it is recommended that Japan and Laos should further strengthen collaboration among ministries and agencies, research institutes such as universities, and that the two countries will jointly develop a framework for human resource development of asset management.

5.3 Short-term Action Plan (Tentative)

Following the recommendations made for achieving the overall project goal, the JICA Expert prepared the following short-term action plan.

Table 5.3.1 Short-term Action Plan (Tentative)

Action	Implementing Agency	Supporting Agency	2018	2019	2020	2021	2022	Note
1. Rolling out Project Outcome								
1) RMS System Improvement and Database Update								
i. Inventory/condition survey and database update	DOR	WB/PTRI						Own funding from 2021
ii. Data analysis and reporting	DOR	WB/PTRI						Ditto
iii. Maintenance planning and budgeting in line with data analysis	DOR	WB						
2) Technical Manuals and Specifications								
i. Finalization of manuals and specifications	DOR	ADB						
ii. Application of these manuals/specifications to the project	DOR	ADB						
iii. Revision of manuals and specifications (when required)	DOR	ADB						Revised every two years
3) Overloading Control								
i. Full operation of Donghen Weigh Station	DOT/DPWT							
ii. Renewal of Bolikhamxai and Luangnamta Weigh Stations	DOT/DPWT	ADB/WB						
iii. Upgrading of remaining 25 weigh stations	DOT							
iv. Imposing a new regulation overloading control including revised maximum weight and fine calculation	DOT							
v. Establishment and operation of Transport Patrol Authority	DOT							
2. Official Approval of Technical Manuals and Specifications	DOR, DOL	ADB						
3. Provision of Technical Support in Asset Management								
i. Group and Region Focused Training	MPWT/DOR	JICA						Group and Region Focused Training for Bridge Maintenance and Management (2019-21, Tentative)
ii. Utilization of JICA Scholars	MPWT/DOR/DOT							Scholars complete in 2020 and 2021
iii. Provision of technical assistance	DOR	JICA						Capacity Building Project for Improvement of Quality Management for Bridge Construction and Maintenance (2019-21, Tentative)

Source: JICA Expert Team