Federal Democratic Republic of Ethiopia
Addis Ababa City Roads Authority

Federal Democratic Republic of Ethiopia
Project for Development of Road Maintenance Capacity of Addis Ababa City

Project Completion Report

June 2019

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

KATAHIRA & Engineers International
PADECO Co., Ltd.
PASCO CORPORATION

EI
JR
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This Project Completion Report was jointly prepared by JICA Project Team and Addis Ababa City Roads Authority (AACRA), Ethiopian Counterpart of this Project. The contents of this report were prepared, reviewed and agreed by both sides.

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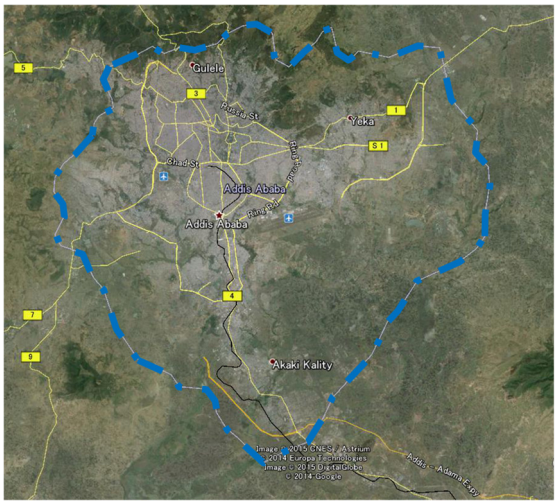
LOCATION MAP

Federal Democratic Republic of Ethiopia



Source: JICA Team prepared Based on UN Cartographic Section, Google Earth Pro

Data of Ethiopia	
Population (Million)	89.39
GNI Total (Million USD)	31,639.26
GNI per Capital (USD)	380
Economic Growth Rate (%)	7.3
Area (1,000 km^2)	1,104.30
Official Language	Amharic
Currency	Birr (ETB)
Exchange Rate (JICA Rate in April 2019)	
USD 1 = JPY 110.423	
ETB 1 = JPY 3.88518	

Source: Databook of Foreign Ministry Japan

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LIST OF ABBREVIATIONS

AACRA	Addis Ababa City Roads Authority
ACC	Accelerometer Sensor
BPR	Business Process Reengineering
CBR	California Bearing Ratio
C&M	Road Transportation Construction and Maintenance Core Process
CMDRD	Road Construction Maintenance Design Review and Implementation Directorate
COTS	Commercial off-the-shelf
C/P	Counterpart
DAC	Development Assistance Committee
DB	Database
DCP	Dynamic Cone Penetrometer
DT	Destructive Test

ERA	Ethiopian Roads Authority
ETB	Ethiopian Birr
EY	Ethiopian Year (EY 2011 means 2018/2019)
FWD	Falling Weight Deflectometer
GIS	Geographic Information System
GPS	Geographic Positioning System
GTP	Growth and Transformation Plan
IRI	International Roughness Index
JCC	Joint Coordinating Committee
JICA	Japan International Cooperation Agency
LDS	Laser Displacement Sensor
LOS	Level of Service
LRT	Light Rail Transit
M/D	Minutes of Discussion
MIS	Mobile Inspection System
NDT	Non-destructive Test
OFRMD	Own Force Road Maintenance Directorate
OJT	On the job training
PAS	Major Arterial
PCS	Pavement Condition Survey
PCSS	Pavement Condition Survey System
PCSV	Pavement Condition Survey Vehicle
PDCA	Plan-Do-Check-Act
PDM	Project Design Matrix
PO	Plan of Operation
QC	Quarter Car
RAM	Road Asset Registration Maintenance Planning Sub Process
RAMDD	Road Asset Management and Database Directorate
R/D	Record of Discussion
RMMS	Road Maintenance Management System
RMMW	Road Maintenance Management Works
RR	Ring Road
RSDP	Road Sector Development Program Phase
RTD	Road Transport Design Core Process
SAS	Sub Arterial
TAC	Technical Advisory Committee
VISS	Visual Inspection Supporting System
WS	Workshop

CHAPTER 1 BASIC INFORMATION OF THE PROJECT

1-1 Country

The Federal Democratic Republic of Ethiopia

1-2 Title of the Project

The Project for Development of Road Maintenance Capacity of Addis Ababa City

1-3 Duration of the Project

Planned: From July 2015 to July 2018 (37 months)

Actual: From July 2015 to July 2019 (49 months)

1-4 Background

Addis Ababa City is the principal commercial center of Ethiopia and is experiencing rapid urban growth. The population of the city has more than doubled every decade since the 1980s. According to the 2007 National Census, Addis Ababa City had a population of 2.7 million, though the Central Statistical Agency estimates the current population as 3.3 million, and extrapolation of similar growth rates push the population to about 3.6 million by 2020. Addis Ababa City has expanded its domain area (as of 2010 the City has an area of 527 km^2 divided in to ten sub cities).

Against a backdrop of steady economic growth in the past several years, the city has invested heavily in its road infrastructure and most recently it is developing mass transport systems. Two Light Rail Transit (LRT)[1] lines totaling 32 km, with 32 stations, have been completed. The road network in the city are expanding and is about 3,800 km, of which 47% is paved[2] (the total vehicle fleet registered in the city is about 426,500 in 2015). However due to the inadequate road maintenance, roads in the city are generally in bad condition and this is one of the causes for heavy traffic jam frequently seen in the city.

Proper maintenance of city roads is getting critical more than ever and it is urgently needed to develop the capacity of Addis Ababa City Road Authority (hereinafter referred to as "AACRA"), the authority in road maintenance, through establishment of the road maintenance cycle, formulation of road maintenance manual, structure of database and etc.

Under the circumstances mentioned above, AACRA requested the Government of Japan to conduct a Technical Assistance Project to enhance its road maintenance capacity in August 2013. Upon receiving the request, JICA carried out the Detailed Planning Survey in January 2015 and established the components of the Technical Assistance Project through the discussions with relevant authorities in Ethiopia. After getting through the required procedure in both governments, the Record of Discussion (hereinafter referred to as "R/D") was signed on April 20th, 2015. It was noted that this project falls in "Road and Bridge Development Program" under the Priority Area of Japanese Assistant Policy "Development of Economic, Social and Human Infrastructure".

[1] The LRT lines have been developed by the Federal Government through the Ethiopian Railway Corporation.

[2] City Government of Addis Ababa, Bureau of Finance and Economic Development, Socio-Ecinomic Profile of Addis Ababa, 2011/2012.

1-5 Overall Goal and Project Purpose

(1) Overall Goal: The Roads in Addis Ababa City are maintained in a sustainable way.

(2) Project Purpose: The management capacity of AACRA for road maintenance is enhanced.

1-6 Project Target Area

Target area is the paved roads under the jurisdiction of AACRA.

1-7 Project Implementation Agency

Addis Ababa City Roads Authority (AACRA)

1-8 Project Implementation Structure

1-8-1 Implementation Structure

As shown in Figure 1-8-1, the project implementation structure is composed of Technical Advisory Committee (hereinafter referred to as "TAC") and Joint Coordination Committee (hereinafter referred to as "JCC").

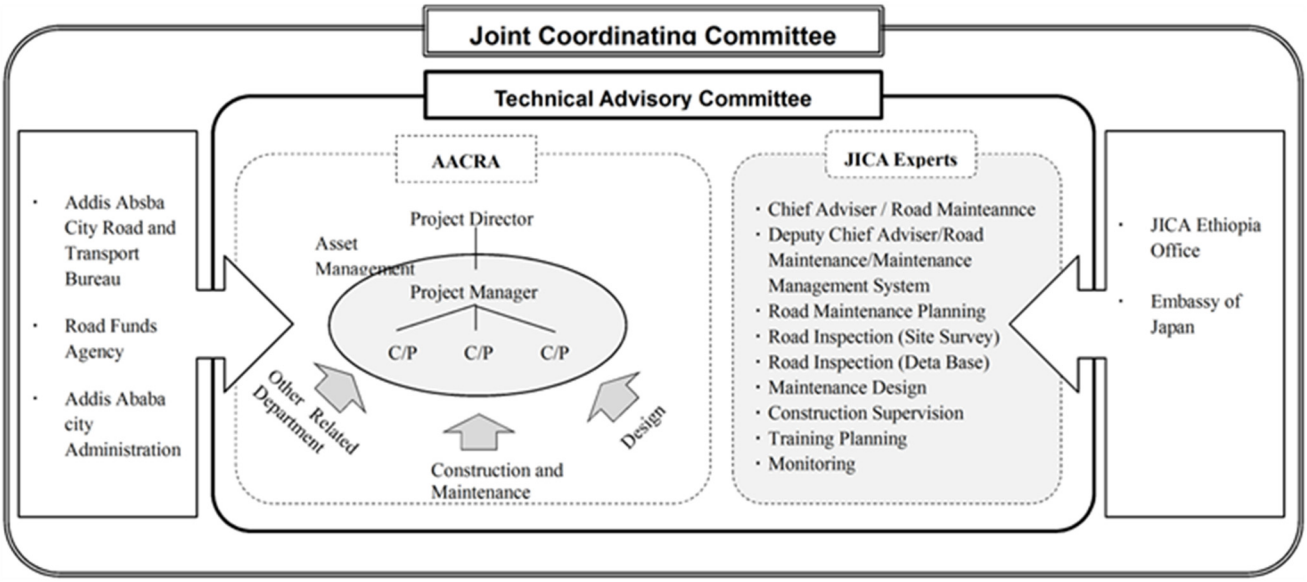


Figure 1-8-1 Implementation Structure

Outline of JCC and TAC is summarized in Table 1-8-1. The member of JCC was set as agreed at R/D and assigned in September 2015, and member of TAC was assigned after the 1st JCC. It was confirmed in November 2016 by AACRA that the name of JCC and TAC members are updated based on the restructuring of AACRA. Members before and after restructuring are presented in below.

Table 1-8-1 Outline of JCC and TAC before AACRA's re-structuring (November 2016)

Committee	Members		Frequency	Function
Joint Coordination Committee (JCC)	[Ethiopia Side] • General Director of AACRA (Project Director) • Director of AACRA RAM (Project Manager) • Director of AACRA RTD • Director of AACRA C&M • AACRA other related Department • Addis Ababa City Road and Transport Bureau • Addis Ababa City Administration • Road Funds Agency	[Japanese Side] • JICA Experts • JICA Ethiopia Office • Embassy of Japan in Ethiopia	Semi-Annually	Approve a work plan, review overall progress, monitor the Project, and exchange opinions on major issues that arise during the implementation of the Project.
Technical Advisory Committee (TAC)	[Ethiopia Side] • AACRA Project Director • AACRA Project Manager of RAM (Acting Chairperson) • AACRA RTD • AACRA C&M • AACRA other related Department	[Japanese Side] • JICA Experts	Monthly to Quarterly	TAC is to handle technical and structural issues of the Project; composed by Project Director, Project Manager, Counterpart Personnel, and JICA Experts.

Note:
- Road Transportation Construction and Maintenance Core Process: C&M
- Road Transport Design Core Process: RTD
- Road Asset Registration Maintenance Planning Sub Process: RAM

Table 1-8-2 Outline of JCC and TAC after AACRA's re-structuring (November 2016)

Committee	Members		Frequency	Function
Joint Coordination Committee (JCC)	[Ethiopia Side] • General Director of AACRA (Project Director) • Deputy Director General of AACRA Engineering Stream, Road Asset Management (Project Manager) • Director of AACRA RAMDD • Director of AACRA CMDRID • Director of AACRA OFRMD • Director of AACRA Planning, Budget and Strategic Management Directorate • Director of AACRA Regional Asset Management • Director of AACRA Research & Technology Adaptation Directorate • Director General of Human Resources & Facility Management Directorate • Director of AACRA other related Directorate • Addis Ababa City Road and Transport Bureau • Addis Ababa City Administration • Road Funds Agency	[Japanese Side] • JICA Experts • JICA Ethiopia Office • Embassy of Japan in Ethiopia	Semi-Annually	Approve a work plan, review overall progress, monitor the Project, and exchange opinions on major issues that arise during the implementation of the Project.
Technical Advisory Committee (TAC)	[Ethiopia Side] • General Director of AACRA • Deputy Director General of AACRA Engineering Stream, Road Asset Management (Project Manager) • Director of AACRA RAMDD • Director of AACRA CMDRID	[Japanese Side] • JICA Experts	Monthly to Quarterly	TAC is to handle technical and structural issues of the Project; composed by Project Director, Project Manager,

Committee	Members		Frequency	Function
	• Director of AACRA OFRMD • Director of AACRA other related Department			Counterpart Personnel, and JICA Experts.

Note:
- Own Force Road Maintenance Directorate: OFRMD
- Road Construction Maintenance Design Review and Implementation Directorate: CMDRID
- Road Asset Management and Database Directorate: RAMDD

1-8-2 JCC Meeting and Technical Advisory Committee (TAC)

(1) Joint Coordination Committee Meeting (JCC Meeting)

As shown in Table 1-8-3, JCC Meetings were held during the project period to report the progress of the Project, to discuss issues and challenges, and to submit updated Project Monitoring Sheets.

Table 1-8-3 Record of JCC Meeting

SN	Date	Status	Participants	PMS
1	August 17, 2015	Completed	18	Version 1
2	February 18, 2016	Completed	23	Version 2
3	September 15,2016	Completed	20	Version 3
4	April 4, 2017	Completed	23	Version 4A
5	October 4, 2017	Completed	21	Version 5
6	April 3, 2018	Completed	23	Version 6A
7	October 4, 2018	Completed	37	Version 7
8	May 22, 2019	Completed	32-	Completion Report

(2) Technical Advisory Committee (TAC)

A total of 7 times TAC meeting were held during the project period as shown in Table 1-8-4. Since technical issues and concern of each activity were addressed and discussed through trainings and OJTs, TAC were not held after January 2017 until February, 2019.

Table 1-8-4 Record of TAC Meeting

SN	Date	Status	No. of Participants
1	September 7, 2015	Completed	AACRA 10, JICA Exp. 3
2	October 27, 2015	Completed	AACRA 8, JICA Exp. 5
3	March 22, 2016	Completed	AACRA 6, JICA Exp. 3
4	July 15, 2016	Completed	AACRA 6, JICA Exp. 6
5	September 26, 2016	Completed	AACRA 9, JICA Exp. 3
6	January 27, 2017	Completed	AACRA 8, JICA Exp. 4
7	February 15, 2019	Completed	AACRA 9, JICA Exp. 4

1-9 Project Team Structure

Project Team (JICA Team) structure is shown in Figure 1-9-1 below.

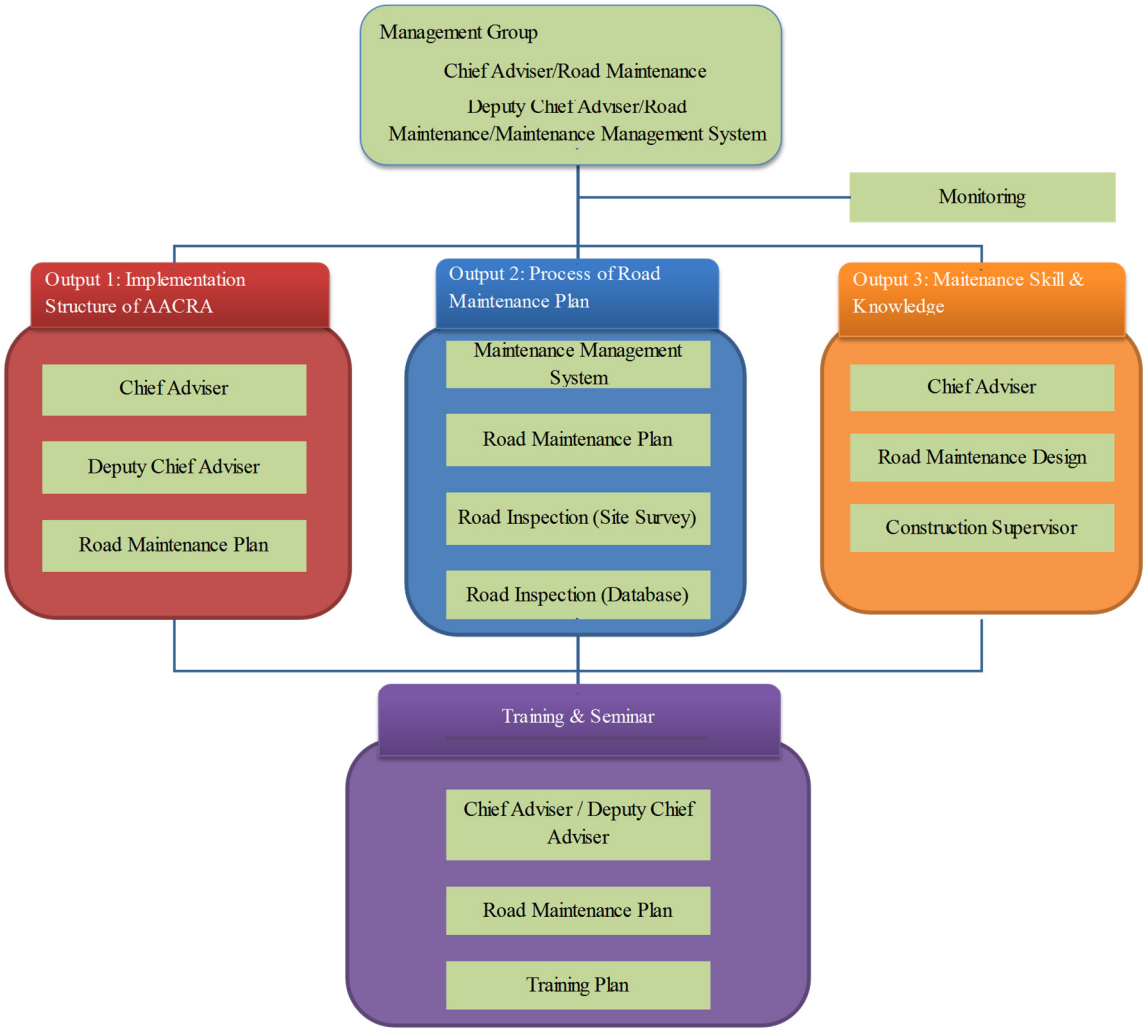


Figure 1-9-1 Project Team Structure

Name and role of each Expert assigned by JICA are shown in Table 1-9-1 below. Experts who were assigned for very limited period or for qualified role are not listed.

Table 1-9-1 List of Experts of JICA Team

Name	Position & Role
Hiroshi HONDA	Chief Adviser / Road Maintenance
Kazuya AOKI	Deputy Chief Adviser / Road Maintenance / Maintenance Management System
Seiji KADOOKA / Hidemasa NOBUTANI / Yayoi NISHIHAMA	Road Maintenance Plan
Toshiyasu TSUCHIYA / Ryusuke KANEKO	Road Inspection (Site Survey)
Kohei SAKAI	Road Inspection (Database)
Keiichi MURAKAMI	Road Maintenance Design
Kiyoshi MUKAI	Construction Supervisor
Chiaki YAMADA	Training Plan
Naomi NAKATSUBO / Akiko MIYAKAWA	Monitoring
Michael Asnake	Engineering Service for All Area

1-10 Reporting

In accordance to the Contract between JICA and JICA team, every 6 months, monitoring sheets were updated based on the actual progress of each activity and discussions with Counterparts and submitted to JICA Ethiopia Office as shown in Table 1-10-1 below.

Table 1-10-1 Schedule of Monitoring Sheet Submission

Project Year	Version	Date
1st Year July 2015-June 2016	1	Agreed and submitted on Aug. 20, 2015
	2	Agreed and submitted on Feb. 18, 2016
2nd Year July 2016-June 2017	3	Agreed and submitted on Sep. 15, 2016
	4	Submitted on Jan. 27, 2017 (JICA only)
	4A	Agreed and submitted on April 5, 2017
3rd Year July 2017-June 2018	5	Agreed and submitted on Oct. 4, 2017
	6	Submitted on Feb. 28, 2018 (JICA only)
	6A	Agreed and submitted on April 3, 2018
4th Year July 2018-June 2019	7	Agreed and submitted on OCT. 4, 2018
	Completion Report	Submitted and agreed on May 22, 2019 at 8th JCC meeting

CHAPTER 2 RESULTS OF THE PROJECT

2-1 Inputs to the Project

2-1-1 Inputs by the Japanese Side

(1) Experts assigned by JICA

In the R/D signed on April 20, 2015, JICA committed to assign more than 8 experts. At the time of the contract between JICA and Consultant (JICA Team), both parties agreed to send 9 experts, which increased to a total 11 experts through the amended contract in January 2016. Table 2-1-1 shows the list of expert including their assignment period (based on the amended contract signed in May 2018) in Ethiopia.

Table 2-1-1 List of Experts and their Assigned Period

Experts			Assigned Period (MM)	
Expert Title / Responsibility	**Name**	**Affiliation**	**Plan**	**Actual**
Chief Advisor / Road Maintenance	Mr. Hiroshi HONDA	KEI	11.00	12.10
Deputy Chief Advisor / Road Maintenance / Maintenance Management System	Dr. Kazuya AOKI	PASCO	13.50	13.53
Road Maintenance Plan	Mr. Seiji KADOOKA	PADECO	15.00	8.80
	Mr. Hidemasa NOBUTANI			1.00
	Ms. Yayoi NISHIHAMA			4.23
Inspection System Development	Mr. Katsuya HONMA	PASCO	0.5	0.50
Road Inspection (Site Survey)	Mr. Yoshiyasu TSUCHIYA	PASCO	8.00	5.00
	Mr. Ryusuke KANEKO			3.70
Road Inspection (Database)	Mr. Kohei SAKAI	PASCO	5.50	6.67
Road Maintenance Design	Mr. Keiichi MURAKAMI	KEI	7.50	6,47
Construction Supervisor	Mr. Kiyoshi MUKAI	KEI	10.50	10.50
Training Plan	Ms. Chiaki YAMADA	PADECO	4.50	2.60
Monitoring	Ms. Naomi NAKATSUBO	KEI	4.50	0.87
	Ms. Akiko MIYAKAWA			3.93
Theory of Pavement Deterioration	Dr. Kiyoshi KOBAYASHI	KEI	0.23	0.23
Total			**80.73**	**80.13**

Task and responsibility of each expert including the level of involvement (main role: M/ supporting role: S) is shown in Table 2-1-2 below.

Table 2-1-2 Task and Responsibility of Expert

Expert Title / Responsibility	Name	Assigned Task		Level
Chief Advisor/ Road Maintenance	Hiroshi HONDA	Team Leader		
		1-1	Review Implementation Structure of AACRA, and Compile Suggestions for the Structure Improvement	M
		2-1	Review the road maintenance cycle of AACRA, compile PDCA checklist and revise the checklist if necessary	S
Deputy Chief Advisor/ Road Maintenance/ Maintenance Management System	Kazuya AOKI	Deputy Team Leader		
		1-1	Review Implementation Structure of AACRA, and Compile Suggestions for the Structure Improvement	S
		1-2	Convene Technical Advisory Committee	M
		1-5	Share information of road condition in the City with Road Fund Agency and City Administration to request the budget for road maintenance	M
		1-6	Promote Public Relation Activities on road maintenance in the City	M

Expert Title / Responsibility	Name	Assigned Task		Level
		2-1	Review the road maintenance cycle of AACRA, compile PDCA checklist and revise the checklist if necessary	M
		2-4	Prepare and revise Medium/Long term Road Maintenance Plan based on the inventory data (System Development)	M
		2-4	Prepare and revise Medium/Long term Road Maintenance Plan based on the inventory data (Maintenance Plan)	S
		2-5	Annual Maintenance Plan	S
Road Maintenance Plan	Seiji KADOOKA/ Hidemasa NOBUTANI/ Yayoi NISHIHAMA	1-1	Review Implementation Structure of AACRA, and Compile Suggestions for the Structure Improvement Implement Pavement Condition Survey	S
		1-2	Convene Technical Advisory Committee	S
		1-5	Share information of road condition in the City with Road Fund Agency and City Administration to request the budget for road maintenance	S
		1-6	Promote Public Relation Activities on road maintenance in the City	S
		2-4	Prepare and revise Medium/Long term Road Maintenance Plan based on the inventory data (Maintenance Plan)	M
		2-5	Annual Maintenance Plan	M
Inspection System Development	Katsuya HONMA	2-2	Conduct road inspection in the City (System Development)	M
Road Inspection (Site Survey)	Yoshiyasu TSUCHIYA/ Ryusuke KANEKO	1-4	Conduct Training of AACRA staff for road maintenance, maintenance planning, maintenance management system, etc.	M
		2-2	Conduct road inspection in the City	M
Road Inspection (Database)	Kohei SAKAI	1-4	Conduct Training of AACRA staff for road maintenance, maintenance planning, maintenance management system, etc.	M
		2-3	Develop and update road inventory (Database) of AACRA, including road condition, traffic volume, unit cost etc.	M
Road Maintenance Design	Keiichi MURAKAMI	3-1	Select Pilot Projects for maintenance works from the annual road maintenance plan	M
		3-2	Share the information pilot projects between/ within Road Asset Management Process, and Construction and Maintenance Process	S
		3-3	Conduct the detailed investigation and design specification of pilot projects	M
		3-5	Feedback achievements and experiences of pilot projects into the next annual maintenance plan	S
Construction Supervisor	Kiyoshi MUKAI	3-1	Select Pilot Projects for maintenance works from the annual road maintenance plan	S
		3-2	Share the information pilot projects between/ within Road Asset Management Process, and Construction and Maintenance Process	M
		3-4	Assist AACRA to execute pilot project	M
		3-5	Feedback achievements and experiences of pilot projects into the next annual maintenance plan	M
		3-6	Organize a workshop/ seminar of pilot project for ERA and road agencies at reginal and municipal level	M
Training Plan	Chiaki YAMADA	1-3	Prepare a training plan for AACRA's staff	M

(2) Training of Counterpart Personnel (Training in Japan)

In addition to the training of AACRA staff in Addis Ababa through seminars, workshops and OJTs, two trainings in Japan were provided. The first training in Japan was conducted from August 23 to September 6, 2016 for 16 days. The Second training was conducted from August 23, 2017 to September 6, 2017 for 16 days inviting 5 participants from AACRA. Detail of the two trainings in Japan is reported and submitted to JICA.

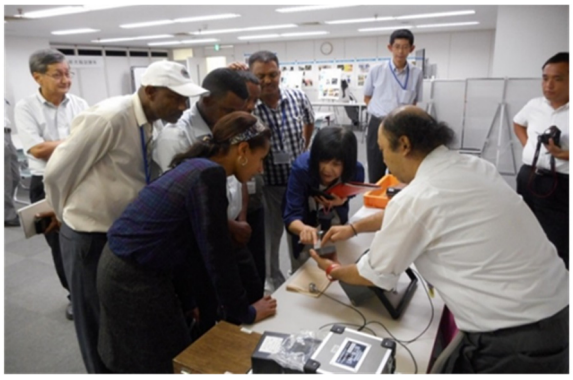



Figure 2-1-1 Photos of Training in Japan

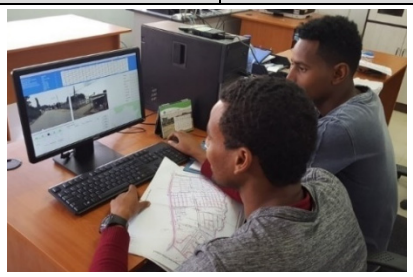
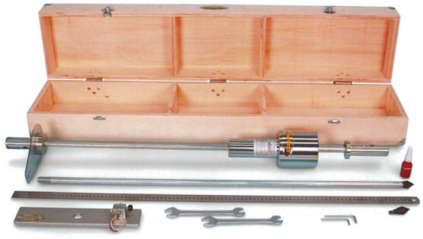
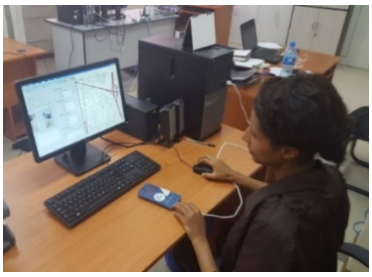

Figure 2-1-2 Photos of OJT

(3) Provision of Machinery and Equipment

Procurement procedure of some machineries and equipment was amended in early stage of the Project. Table 2-1-3 shows the detail of the machinery and equipment procured. With respect to the amendment and progress of the procurement, detailed explanation was made in the Project Monitoring Sheet (from Version 1 through 7) attached as Appendix-6.

Table 2-1-3 List of Machinery and Equipment procured

Equipment and Machinery	Component	Responsible Agency for Procurement	Original Planed Procured Date	Procured Date*	Remark
Inspection Equipment (Pavement Condition Survey Vehicle)	• 1 Vehicle • Equipment to be fitted on the PCSV • PCS FOR data storage and Data Processing • External Hard Disc	JICA	Jan. 2016	Vehicle was procured and transferred to AACRA in May 2016. A part of equipment (PCs) was procured in Apr. 2016, and the rest of equipment was delivered in Jan. 2017. PCSV assembly was completed at the end of Jan. 2017.	After initial maintenance, PCSV and other equipment were handed to AACRA on Jan. 31, 2017

<table>
<tr><th>Equipment and Machinery</th><th>Component</th><th>Responsible Agency for Procurement</th><th>Original Planed Procured Date</th><th>Procured Date*</th><th>Remark</th></tr>
<tr><td></td><td colspan="3"> 
Pavement Condition Survey Vehicle</td><td colspan="2"> 
PCs for Data Storage and Data Processing</td></tr>
<tr><td rowspan="2">Structural Testing Instrument</td><td>• 2 set of Dynamic Cone Penetrometer (DCP)
• 1 set of Asphalt Core Cutter
• 1 set of Diesel Generator (3kw)</td><td>JICA Team</td><td>Jul. 2017</td><td>Instruments was procured at the end of Jun. 2017 from Japan and arrived Addis Ababa on the Jul. 22, 2017.
Generator was procured in Sep. 2017 and transferred on Oct. 11, 2017.</td><td>After training and trial usage of the instrument, handed to AACRA in Oct.2017.</td></tr>
<tr><td colspan="3"> 
DCP</td><td colspan="2"> 
Trial Operation</td></tr>
<tr><td>Maintenance Management System</td><td>• 1 set of Desktop Computer
• 1 GIS Software
• Main System is Developed</td><td>JICA Team</td><td>Apr. 2016</td><td>Arc GIS was installed in Apr. 2016. The whole system was delivered to AACRA in Jul. 2017, after the completion of assembly of PCSV (the end of Jan. 2017).</td><td>Trial usage and model data input was started in Jul. 2016.
Official hand over to AACRA will be at the end of the Project in Jun. 2019.</td></tr>
<tr><td rowspan="2">Visual Inspection Supporting System</td><td>• 5 set of Smartphones
• 1 GIS Software
• Application System (developed)</td><td>JICA Team</td><td>Mar. 2016</td><td>Smartphone was procured in Feb. 2016, and GIS was installed in Apr. 2016.</td><td>Handed to AACRA in Apr. 2016. The system was updated several times since then.</td></tr>
<tr><td colspan="3"> 
Site Inspection</td><td colspan="2">  </td></tr>
</table>

Equipment and Machinery	Component	Responsible Agency for Procurement	Original Planed Procured Date	Procured Date*	Remark
Supplement PC for Data Compiling in Regional Offices	• 2 set of Notebook PCs • 2 set of Monitors	JICA Team	Dec. 2018	PC 2 sets with monitor and accessories were procured locally in Dec. 2018.	Officially handed over to AACRA on Dec. 10, 2018.
Supplement Tablet Type of Terminal for Visual Inspection in Regional Offices	• 5 set of Tablet (can be used as smartphone)	JICA Team	Jan. 2019	Procured in December 2018. Delivered and handed over to AACRA Feb. 6, 2019	After handed over to AACRA, Application for Visual Inspection shall be installed.

2-1-2 Input by the Ethiopian Side

(1) Personnel

Project Manager was identified under R/D and assigned in late August 2015. The rest of counterpart personnel was selected through the progress of the Project. In November 2015, three personnel for inspection activity were assigned, and further two more road and transport engineers were assigned in June 2016. After new organization introduced in November 2016, number of counterpart personnel was considerably increased as 5 regional offices were newly established in the road asset management department. In total approximately 16 personnel were assigned as counterpart.

(2) Furnished Office Space and Facilities

Since the project commencement in July 2015, a project office (Room 318) was allocated at AACRA, and office furniture was also installed for eight experts.

(3) Traffic Survey and Pilot Project in Addis Ababa City

Though AACRA promised to provide traffic survey data in M/D, it was found through the baseline survey that AACRA did not take any traffic survey data. Therefore, JICA Team had to conduct the project activities without traffic survey data. As for the pilot project, both parties (AACRA and JICA Team) jointly selected a series of pilot projects among the list of annual repair works.

(4) Administrative and Operational Expense

Expense agreed at R/D was secured and handled by the Ethiopian Side.

2-2 Activities

2-2-1 Baseline Survey

At the beginning of the Project JICA team conducted the baseline survey based on the following methods.

1. Careful reading of documents and records provided by AACRA

2. Meetings with stakeholders

3. Questions and answers with AACRA's departments concerned

The results of baseline survey were incorporated into the Work Plans as much as possible. Some were reflected into the PDM in the course of work. Unfortunately, as mentioned previously it was found that no traffic survey record is available and a meeting with City Administration was not actualized.

2-2-2 Work Plan

To accomplish the project purpose agreed between JICA and AACRA, JICA Team proposed following basic policies for the implementation of the Project. The Work Plan was prepared based on these policies and submitted to JICA on July 13, 2015.

Policy 1	Road Maintenance Cycle: Establish a proper road maintenance cycle in which required information is shared with departments and organizations concerned (Figure 2-2-1).
Policy 2	Maintenance Management System: Establish a proper and user-friendly maintenance management system which covers all activity required for road maintenance such as inspection, planning, information sharing, and output preparation based on the Japanese sophisticated technique.
Policy 3	Pilot Project: Conduct the technical transfer with respect to the design, implementation, and feedback of record of road maintenance through the pilot project jointly carried out.
Policy 4	Public Relation: Try to set up the structure for the public relation which is easily comprehensible and promotes community participations.
Policy 5	Study and Training: Conduct the technical transfer through trainings in Japan, seminars, workshops, and OJTs in Addis Ababa, and their synergy.

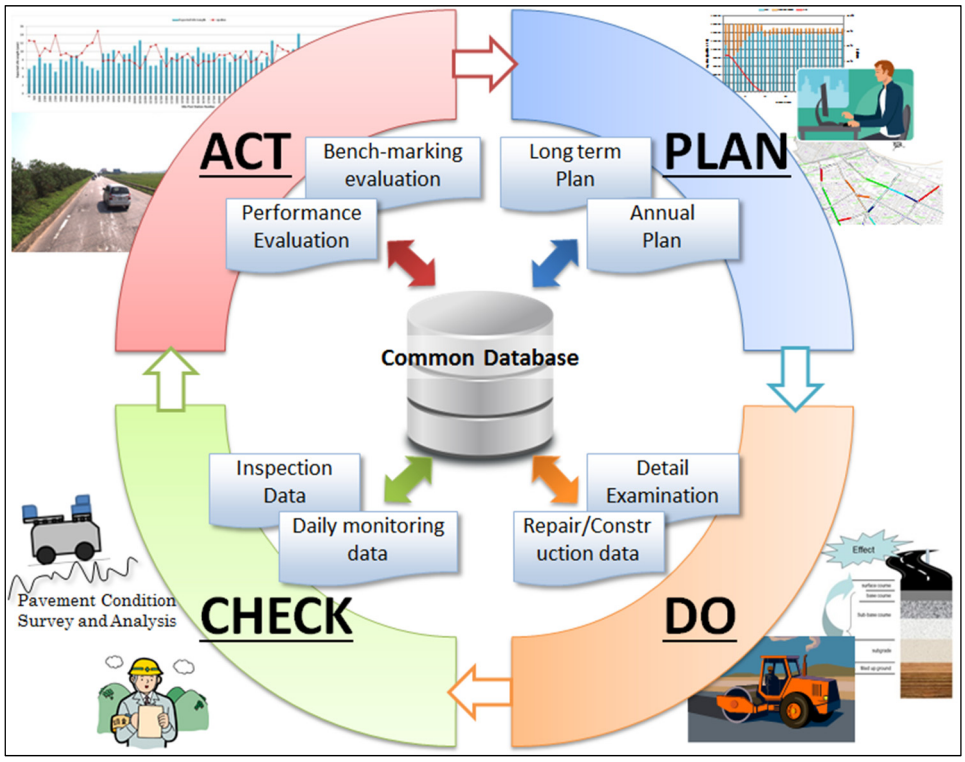


Figure 2-2-1 Road Maintenance Cycle (Plan-Do-Check-Act)

2-2-3 Framework of Activities

Framework of each activity to achieve the project purpose is summarized in Table 2-2-1. A phrase of "Road Management System Developed under the Project" was added to Activities 2-4 and 2-5. Also, a phrase of "formulated under the Project" was added to Activity 3-1. These amendments were approved in the 2nd JCC held on February 18, 2016. The Project applies the same activity numbers as those in the Work Plan throughout the Project. The details of the project activities with detailed process management were explained in the Monitoring Sheets from Ver. 1 through Ver. 7 included in Appendix-6 of this completion report.

Table 2-2-1 Project Activities

Output	Project Activities		
	PLAN		ACTUAL
1. The implementation structure of AACRA for road maintenance is improved.	1-1	Review Implementation Structure of AACRA, and compile suggestions for the structure improvement	Review Implementation Structure of AACRA, and compile suggestions for the structure improvement
	1-2	Convene Technical Advisory Committee (TAC)	Convene Technical Advisory Committee (TAC)
	1-3	Prepare a Training Plan for AACRA Staff	Prepare a Training Plan for AACRA Staff
	1-4	Conduct training of AACRA staff for road maintenance: road inspection, maintenance planning, maintenance management system, etc.	Conduct training of AACRA staff for road maintenance: road inspection, maintenance planning, maintenance management system, etc.
	1-5	Share Information of road conditions in the City with Road Funds Agency and the City Administration to request the budget for road maintenance	Share Information of road conditions in the City with Road Funds Agency and the City Administration to request the budget for road maintenance
	1-6	Promote public relations (PR) activities on road maintenance in the City	Promote public relations (PR) activities on road maintenance in the City
2. The process for formulating road maintenance plans is established.	2-1	Review the road maintenance cycle of AACRA, compile the PDCA checklist, and revise the checklist if needed	Review the road maintenance cycle of AACRA, compile the PDCA checklist, and revise the checklist if needed
	2-2	Conduct road inspections in the City	Conduct road inspections in the City
	2-3	Develop and update the road inventory (database) of AACRA, including road condition, traffic volume, unit costs, etc.	Develop and update the road inventory (database) of AACRA, including road condition, traffic volume, unit costs, etc.
	2-4	Prepare and revise a medium-long-term road maintenance plan based on the above inventory data	Prepare and revise a medium-long-term road maintenance plan using Road Maintenance Management System developed under the project.
	2-5	Prepare the annual road maintenance plan	Prepare the annual road maintenance plan using Road Maintenance Management System developed under the project.
3. The maintenance skills and knowledge of AACRA technical staff are improved.	3-1	Select pilot projects for maintenance works from the annual road maintenance plan	Select pilot projects for maintenance works from the annual road maintenance plan formulated under the project.
	3-2	Share the information of pilot projects between/within Road Asset Management Process and Construction and Maintenance Process	Share the information of pilot projects between/within Road Asset Management Process and Construction and Maintenance Process
	3-3	Conduct the detailed investigations and design specifications of the pilot projects	Conduct the detailed investigations and design specifications of the pilot projects
	3-4	Assist AACRA to execute pilot projects	Assist AACRA to execute pilot projects
	3-5	Feedback the achievements and experiences of pilot projects into the next annual road maintenance plan	Feedback the achievements and experiences of pilot projects into the next annual road maintenance plan
	3-6	Organize a workshop/seminar of the pilot projects for Ethiopian Roads Authority (ERA) and road agencies at regional and municipal level	Organize a workshop/seminar of the pilot projects for Ethiopian Roads Authority (ERA) and road agencies at regional and municipal level

2-3 Achievement of the Project

Achievement of the Project is summarized in this section from the following viewpoints.

1) Outputs and Indicators
2) Project purposes and Indicators
3) Summary of Project Deliverables

2-3-1 Outputs and Indicators (Target values and actual values achieved at completion)

Based on the PDM, the achievement of project outputs and project indicators are evaluated in Table 2-3-1 and Table 2-3-2 respectively.

Table 2-3-1 Achievement of Project Output

<table>
<tr><th>Project Outputs</th><th>Status of Achievements</th></tr>
<tr><td>1. The implementation structure of AACRA for road maintenance is improved.</td><td>Achieved
1) Based on the advice made by JICA Team in Aug. 2015, number of Asset Management Department was increased from 9 to 17 in Nov. 2015.
2) Location and extent of damage can be identified and be registered by use of Visual inspection support system composed of Smartphone and GIS System developed by JICA Team.
3) Collected data can be shared with Road Maintenance and Construction Department by using the Database developed.
4) Through the 5 regional offices newly established in Nov. 2016 and increase of the staff number engaged in road maintenance activity, the number of inspected sections were increased dramatically.
5) Through the Pavement Condition Survey System including Vehicle, the area inspected has increased and inspection time required has shortened very much.
6) Through the introduction Road Maintenance Management System (RMMS), the prioritized location to be repaired will be obtained.
7) Through the introduction of PDCA Cycle, communication among departments concerned with road maintenance has been improved significantly.</td></tr>
<tr><td>2. The process for formulating road maintenance plans is established.</td><td>Achieved
1) The capacity for data collection has been improved through the developed systems and have allowed inspectors to collect data with correct and simplified manner.
2) Annual inspection schedule has been established consisting; a) periodical inspection using Pavement Condition Survey System (PCSS), b) visual inspection, and c) emergency patrol.
3) In addition to the data inspected, the data of repair method was collected and stored in the database.
4) In order to strengthen the data collection capacity, PCSS and Visual Inspection Support System were introduced and technology on these system developments were transferred to engineers of AACRA.
5) The process from data collection to maintenance planning through selection of locations requiring repair works was established.
6) PDCA Cycle in the road maintenance works were established through proper conduct of each activity mentioned above, and the road maintenance planning process was established.</td></tr>
<tr><td>3. The maintenance skill and knowledge of AACRA technical staff are improved</td><td>Achieved
1) Following 2 pilot projects were successfully conducted as scheduled.
<table>
<tr><th>Selected Points</th><th>Fist Pilot Project (2016)</th><th>Second Pilot Project (2017)</th></tr>
<tr><td>Selection Timing</td><td>October, 2016</td><td>October, 2017</td></tr>
<tr><td>Implementation Period</td><td colspan="2">During dry season from November to March</td></tr>
<tr><td>Targeted Road</td><td colspan="2">Paved trunk roads such as Ring Road, PAS and SAS,</td></tr>
<tr><td>Targeted Damage</td><td>Surface damage</td><td>Structural damage</td></tr>
<tr><td>Repair Method</td><td>- Pot hole patching
- Crack sealing</td><td>~~- Cutting overlay~~
- Pavement replacement</td></tr>
</table>
2) Defects on the surface are considered to be caused by the failure below surface such as base course or subgrade. In this case, a structural investigation below ground needs to be carried out. Thus, Dynamic Cone Penetrometer (DCP) with Core Cutter was introduced for the investigation, and investigation technology in implementation and result analysis were transferred to the technical staff of AACRA.
3) By using the DCP, a structural failure was found in a subgrade and, full scale repair works including replacement of subgrade and base course were carried out (the 2nd Pilot Project).
4) Through the 2nd Pilot Project, the importance of the preventive maintenance was well acknowledged and technology on DCP is transferred to the AACRA engineers. Currently DCP is well used for the investigation.</td></tr>
</table>

Project Outputs	Status of Achievements
	5) Importance of safety management and quality control (such as asphalt surface cutting, temperature control of hot mix asphalt) was transferred. 6) The cutting overlay proposed at the 2nd Pilot Project were not implemented due to the lack of equipment (Milling Machine).
	   
	Second Pilot Project

Table 2-3-2 Achievement of the Project Output Indicators

Verifiable Output Indicators	Status of Achievement Level
1-1. Suggestions for improving the implementation structure of AACRA for road maintenance is compiled and presented at the 7th JCC (September 2018).	<u>Achieved</u> 1) Based on the baseline survey, in Aug. 2015, JICA Team made an advice to AACRA to ungently settle the situation on the lack of staff number of the Asset Management Department (Process at that time). Accordingly, the number of Asset Management Department staff was increased from 9 to 17 in Nov. 2015. 2) Following to the assignment of new Director General in Aug. 2016, a full-scale reorganization was conducted in Nov. 2016. As a result, 4 Deputy Director Generals were newly assigned and 5 Regional Offices were established to conduct meticulous road inspection and maintenance namely change from centralized structure to decentralized structure. 3) In order to find out current status of AACRA' staff, a questionnaire survey was carried out in May 2017. More than 100 staff provided their answer. The results shows that there is only minimum number of staff has claim and/or issues. For example, toward the question "the degree of satisfaction with existing job and/or responsibility", only 4 among 103 staff, answered "Bad or Very Bad". Typical claim was that work did not meet with their educational background. Base on the survey results, JICA Team concluded that reorganization was not required at this point. 4) By the way, according to the information from very senior management, as the reorganization of AACRA is still in progress, further observation will be required.
1-2. Road map on institutional strengthening to act on the suggestions is prepared by AACRA, by March 2019 to be incorporated into the	<u>Will be achieved</u> 1) Addis Ababa City Government is currently ongoing restructuring of all Bureaus in the City Government and agencies under the City including AACRA. 2) City's road map will be announced by the end of March 2019. (As of May 20, no announcement was made) 3) Based on the road map indicated by the City, AACRA will start its

<table>
<tr><th>Verifiable Output Indicators</th><th>Status of Achievement Level</th></tr>
<tr><td>budget FY Jul/2019 - Jun/2020 if necessarily.</td><td>restructuring of the organization.
4) In this proposed restructuring, Business Process Reengineering (BPR) method will be applied.</td></tr>
<tr><td>1-3. More than 100% of the approved budget on the basis of Annual Road Maintenance Plan are allocated since the 3rd project year.</td><td><u>Achieved</u>
1) The approved budget and the actual implemented amount for pavement maintenance works in the 3rd project year (2017/2018 and Ethiopian Year 2010) shows that the amount actually implemented was 254.6 million ETB which was more than the approved budget of 195.9 million ETB. From Ethiopian Year 2007 (2014/2015) To be described.
2) Comparison between the approved budget and the actual implemented amount from Ethiopian Year 2007 (2014/2015) through Ethiopian Year 2011 (2018/2019) is shown in the following table.
<table>
<tr><th>Ethiopian Year</th><th>Approved (Mil. ETB)</th><th>Implemented (Mil. ETB)</th></tr>
<tr><td>2007 (2014/2015)</td><td>42.8</td><td>58.5</td></tr>
<tr><td>2008 (2015/2016)</td><td>29.9</td><td>41.9</td></tr>
<tr><td>2009 (2016/2017)</td><td>308.8</td><td>244.1</td></tr>
<tr><td>2010 (2017/2018)</td><td>195.9</td><td>254.6</td></tr>
<tr><td>2011 (2018/2019)</td><td>484.3</td><td>Not yet</td></tr>
</table>
Note; In the original PDM, this verifiable indication was “More than XX% of the requested budget on the basis of annual maintenance plan are allocated since the 3rd project year.”. This was revised because of following reasons
(a) As the variation of the difference between the requested amount and the approved amount are not stable in each year, it is very difficult for JICA Team to predict the approved budget.
(b) Since JICA Team was not able to meet the City Administration who decides the majority of the annual budget, the decision-making process of the budget based on the requested amount is unknown.</td></tr>
<tr><td>1-4. Trainings on road maintenance is conducted targeting AACRA staff</td><td><u>Achieved</u>
1) In order to maximize the effect of technical transfer through the Project, the three approaches were combined; a. On the-job training (OJT), b. Workshop, and c. training in Japan.
2) The 3-training approach applied are summarized in the following table.
<table>
<tr><th>Type of Training</th><th>Application</th></tr>
<tr><td>On-the-job training (OJT)</td><td>AACRA staff and JICA Team jointly conducted activities throughout the project period. Through the OJTs, technology will be transferred. OJT is applied to enhance practical skills and detailed knowledge.</td></tr>
<tr><td>Workshop (WS)</td><td>WS in Addis Ababa were implemented once in every 3 months depending on the needs. WS is applied for trainees to acquire theoretical knowledge and understand role of respective positions under the entire road maintenance cycle. If agreed, the KAIZEN method is also introduced to enable each AACRA staff to improve/optimize the own tasks by themselves.</td></tr>
<tr><td>Training in Japan</td><td>In order to learn maintenance technology and management in Japan, training in Japan was conducted twice in the project period of 3 years, at the beginning of 2nd year and 3rd.
The participants shared their knowledge acquired in the training to other AACRA staff in “feedback session” as well as the daily works.</td></tr>
</table>
3) In addition, in order to strengthen the sustainability after completion project, JICA Team has conducted Intensive Training from Jan. 2019 through Apr. 2019.with respect to the database, inspection support system, PCSS, RMMS and planning works for the staff who already were trained them in the early stage of the Project.</td></tr>
</table>

Verifiable Output Indicators	Status of Achievement Level
	  Training in Japan
1-5. Public understanding and cooperation on road maintenance is enhanced.	Achieved 1) JICA Team investigated the internet environment and found that the condition of is not sufficient to conduct all the following media services. (a) Reporting System by Citizens (b) Television and Radio (c) Leaflet (d) Promotion Video (e) Web-site 2) Taking into account the existing circumstances practically, JICA Team provided (c) Leaflet to introduce road maintenance and inspection, and (d) Promotion Video to introduce and to recognize the works of AACRA and importance of road maintenance to other stakeholders and citizens. 3) In addition, two seminars were held. The first seminar was held on April 18, 2017 to introduce this project to public. 94 people were attended. Dr. Kobayashi professor of Kyoto University, Japan was invited as the special lecturer. The second seminar was held on May 10, 2019 to report the outputs introduced or developed in this project to the public. 72 people were attended. Dr. Kinoshita Assist. Professor in Gifu University, Japan was invited as the special lecturer.   First Seminar (DG of AACRA) Second Seminar (DG of AACRA)
2-1. PDCA Checklist is developed by January 2016.	Achieved The PDCA Checklist was developed and presented in the 2nd JCC held on Feb. 18, 2016. And it was reviewed and updated through OJTs.
2-2. AACRA Annual and Mid/Long term Road Maintenance Plan contains necessary items based on the PDCA checklist are formulated using Road Maintenance Management System developed under the Project, from the	Achieved 1) Road roughness data, IRI, and road image data collected by the PCSV have been processed and registered to the database system in the RMMS. 2) Road damage data, such as crack, rut, pothole and raveling, collected using the visual inspection support system have been registered to the database system in the RMMS. 3) Annual maintenance plan was formulated based on the actual road condition data registered in the RMMS. 4) Deterioration prediction model are prepared using the time-series data of road condition registered in the RMMS and Mid/Long term road maintenance plan (budget plan) was formulated.

Verifiable Output Indicators	Status of Achievement Level
beginning of the 4th project year.	5) Annual and Mid/Long term maintenance plan contain necessary items, such as repair method, repair cost and prioritization, based on the PDCA check list. 6) AACRA's staff in Asset Management and Database Directorate are trained through OJT on data processing, data registration, road maintenance planning and RMMS operation.
2-3. AACRA Annual and Mid/Long term road maintenance plan are formulated in consideration of Life Cycle Cost on Road	Achieved 1) Deterioration performance of pavement in the strategic road was evaluated using the time-series data of road condition registered in the RMMS. 2) Bench-Marking evaluation was estimated to find out the critical pavement sections where deterioration speed is comparatively rapid. 3) Repair prioritization was made based on the critical pavement sections estimated by Bench-Marking evaluation in consideration of life cycle cost of pavement.
3-1. Technical Transfer on Road maintenance skills and knowledge targeting AACRA technical staff are conducted.	Achieved 1) 2 pilot projects were planned and implemented. 2) AACRA Technical staff (Construction and Maintenance Department) were trained through OJTs during implementation period. 3) After the pilot project, Workshops were provided to review the findings, problems encountered and matters to be improved. 4) By using DCP, ground conditions under surface was investigated and the results was reflected to the design. 5) Technical transfer is conducted not only to AACRA staff but also to staff in other stakeholders through Seminar held in May 2019.
3-2. Number of preventive maintenance works executed are increased through the implementation of the project.	Partially Achieved 1) Some of surface failures were predicted to be caused by the failures under the surface. In order to find these underground failures, a structural investigation was carried out. JICA Team introduced DCP as the instrument. Through the results of DCP, AACRA engineers understood the importance of the preventive maintenance, that is a one of maintenance method to avoid any further surface damage. 2) Based on the understanding of the importance of structural investigation and preventive maintenance, several preventive maintenances in the annual maintenance work were planned. However, most of the preventive maintenances planned have not been conducted due to the lack of equipment. 3) Though the future effect of the preventive maintenance is much more than of surface treatment, the preventive maintenance tends to be larger scale work comparing to the surface treatment (refer to the photos of Pilot Project No.2). It may be one of reasons why the preventive maintenance is not often conducted.

2-3-2 Project Purposes and Indicators (Target values and actual values achieved at completion)

The achievement of the project purposes and project indicators are evaluated in Table 2-3-3.

Table 2-3-3 Achievement of the Project Purposes

Project Purposes	Status of Achievements
The management capacity of AACRA for road maintenance is enhanced.	Almost Achieved 1) Based on the achievement of the project purpose indicators shown below, it is clear that the management capacity of AACRA for road maintenance has been improved significantly during the course of the Project, particularly in portions of "Plan ", "Check" and "Action" of PDCA (Plan-Do-Check-Action) cycle. 2) As for the "Do" of PDCA cycle which is the implementation of maintenance work, the lack of equipment caused a limitation in the selecting the most suitable repair method. This is the reason why the Project Purpose is evaluated as "Almost Achieved". 3) The engineers in the Own Force Road Maintenance Directorate have sufficient knowledge in the maintenance work such as technology, process, and material and equipment required. To improve the maintenance capacity further, providing required equipment and training for its usage is a critical factor.

Table 2-3-4 Achievement of Project Purpose Indicators

<table>
<tr><th>Project Purpose Indicators</th><th>Status of Achievements</th></tr>
<tr><td>1. AACRA's capacity to secure the budget for road maintenance is enhanced.</td><td>Achieved
1) AACRA did not request the road maintenance budget in last 3 years of the Ethiopian Years 2007 (2014/2015), 2008 (2015/2016) and 2009 (2016/2017) , due to the lack of road condition data.
2) By use of the visual inspection support system, accurate road condition data could be collected since the Ethiopian Year 2009 (2016/2017) and AACRA first started to request the annual road maintenance budget for the next Ethiopian Year 2010 (2017/2018).
3) As the data collection method has been improved in its system and resources (number of staff and equipment) since Ethiopian Year 2010, it is expected that the capacity to secure the budget for road maintenance will be enhanced.</td></tr>
<tr><td>2. Road maintenance works based on PDCA cycle established by the Project are executed by AACRA.</td><td>Achieved
1) The PDCA is the one of key factor for the successful Road Maintenance Management Works (RMMW), JICA Team introduced the cycle in the 1st JCC held in Aug. 2016 and tried to activate the cycle in AACRA.
2) In order to activate the cycle in RMMW, the data sharing with all department concerned with RMMW are essential. However, at the early stage of the project, there was neither road condition survey data which covered most of principal roads (necessary for planning works), nor the data which identified the location to be repaired (necessary for repair works).
3) The following tools and systems were developed under the project and provided to collect required data;
• Visual Inspection System with GIS
• Database which can store the road data including inspection, inventory and repair
• Pavement Condition Survey System
• Road Maintenance Management System
4) The data which will be shared with all departments concerned became available, and the communication among the department has been improved, and PDCA Cycle became functional in RMMW.</td></tr>
<tr><td>3. The percentage of the implemented road maintenance works against all the maintenance works scheduled in AACRA Annual Road Maintenance Plan, exceeds 80% since the 3rd project year.</td><td>Achieved
1) The budget (requested and approved) and implemented amount for pavement maintenance of the 3rd Project Year, Ethiopian Year 2010 (2017/2018), are shown in the following table.
(Unit Mil. Bir)
<table><tr><th>Budget Requested</th><th>Budget Approved</th><th>Implemented Amount</th></tr><tr><td>520.9</td><td>195.9</td><td>254.5</td></tr></table>In AACRA, the budget planning procedures is (1) Set up plan and decide the amount of budget to request based on the plan (June), (2) Road Fund and City inform the approved budget to AACRA (July), (3) Based on the approved budget AACRA provide a practical plan (Sep.), and (4) AACRA starts the maintenance works. However, it is commonly happened that City allocates some additional budget (sometime reduction) to AACRA during the year. Therefore, the amount actually implemented sometime exceeds the amount of approved budget. In the case of the year 2010, AACRA carried out more than 100% of the planned maintenance work on the monetary basis.
2) With respect to the quantity implemented, following results of the Ethiopian year 2010 are obtained from Road Asset Management Directorate.
• Total quantity implemented for the pavement maintenance including asphalt paved, cobblestone paved and unpaved was 93% of the planned quantity.
• As for the asphalt pavement, actual quantity implemented was 103% of the planned quantity.
3) The result of the Ethiopian year 2011 (2018/2019) is yet to be obtained, however considering the strengthened resources (human, equipment and monetary), it is expected that the actual quantity implemented for the pavement maintenance will exceed 80% of the planned quantity in the practical plan.</td></tr>
</table>

2-3-3 Summary of Project Products

2-3-3-1 Sophisticated Visual Inspection Supporting System [Activity 2-2]

(1) Planning Stage of Development of Visual Inspection Supporting System (VISS)

A. Establishing Visual Inspection Methods

AACRA was carrying out Visual Inspection prior to the implementation of this project. JICA Team reviewed the contents of the Visual Inspection conducted up to this point and pointed out the problems as summarized below. The team established the scheme of visual inspection twice a year taking into the consideration the developmental process of yearly road damage. In addition to a Visual Inspection (Periodic Inspection) conducted during the dry season, the Emergency Patrol & Inspection was newly created to check unexpected damage caused by heavy rain. Information on potholes collected through the Emergency Patrol & Inspection will be used as an additional information for the Annual Maintenance Plan.

B. Problems with Visual Inspection thus so far

Up to this point, road damage and location were inspected by inspector at the site and the collected data were registered in the paper report paper. The location of damaged site was identified through the distance from road starting point by use of Distance Meter. Problems in this method were, 1) It took time (because inspector have to walk from the road starting point) 2) it was difficult to identify the location of damaged site, 3) It took time to compile the data collected written in the paper It was difficult to search the past data to provide report form. and 4) it was difficult to find past collected data to compare and to provide the data to be shared with departments concerned.

C. Methods of Streamlining Visual Inspection

To solve the aforementioned problems, IT technology was introduced to streamline and upgrade the Visual Inspection method. A smartphone app was developed to introduce an inspection method that efficiently and accurately collects information on Visual Inspection in the field. Information on the location of damage is automatically obtained through coordinate data gathered by GPS. As for the damage information, inspector repots it's condition precisely based on the standardized definition of each damage. Furthermore, photos of the damaged site are simultaneously collected to accurately understand the road damage. These 3 kinds of information of GPS location coordinates in GIS, information on damage, and photos are collected and registered in the field as a base data. These base data are registered in the database in the host PC.

(2) Problem Encountered During Development

A. AACRA's handling of the Actual State of Road Damage

Based on the results of the review of Visual Inspection that were conducted by AACRA, the first inspection support system was developed (Version 1). In order to cover all damage, a space titled "other damage" was provided in the report form in Smartphone. When Version 1 was released in June 2016, a lot of "Raveling" were found in the "other damage" space because Raveling was not shown in the list of standardized damage. After discussion among JICA Team and C/Ps, Raveling was added to the list of standardized damage. A workshop was held for the inspectors on those results, and the significance of raveling in Addis Ababa was confirmed. Consequently, "raveling" was added to VISS as a kind of general damage.

As this project targeted RR, PAS, and SAS roads in its scope of application, the inspection support system was first so developed as to apply only in the arterial roads. However, AACRA conducts visual inspection other than arterial roads, and requested to extend the cover area of Inspection Support system into the collector roads. According to the request of AACRA, JICA Team so amended the Visual Inspection Support System.

B. Difficulty Collecting Data on Repairs

In addition to inspection data, data on repairs is also important to provide the Road Maintenance Plan. Though AACRA recognized this, repair data collected were not enough because the role and

method of collecting data on repairs was not established. After the discussions through workshops, it was agreed to improve the capacity of Visual Inspection Support System and to enable to collect the repair data. By this improvement it was reasonably expected that the repair data could be collected from the routine work.

(3) Final Shape of System

A. Outline of the Visual Inspection Supporting System (VISS)

The VISS is comprised of a Mobile Inspection System and Visual Inspection Data Management System.

The Mobile Inspection System is a smartphone app for Visual Inspection in the field (Periodic Inspection, Emergency Patrol & Inspection) and Repair Information. The Visual Inspection Data Management System is a part of Road Maintenance Management System (RMMS) for efficiently and effectively recording the results gained through the Mobile Inspection System to a Road Maintenance Management Database.

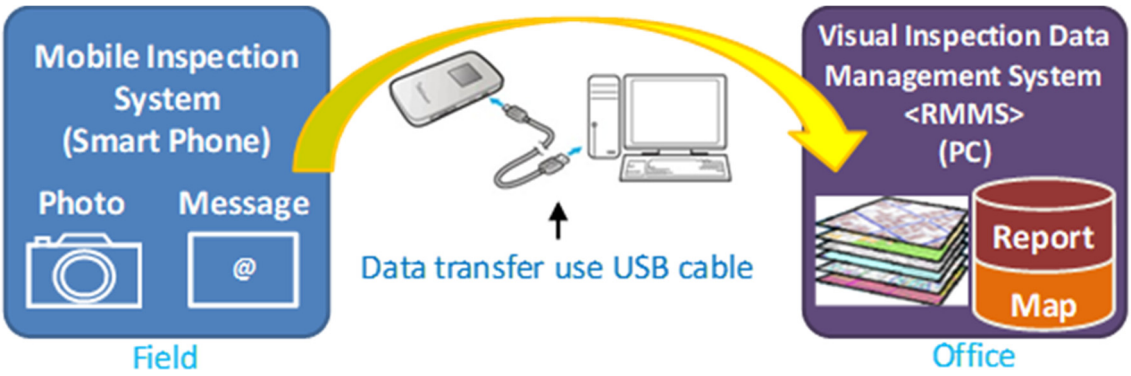


Figure 2-3-1 Visual Inspection Supporting System

- Mobile Inspection System (MIS)

In the Visual Inspection Support System, the Periodic Inspection targets damage of potholes, ruts, cracks, and raveling, but the Emergency Patrol & Inspection targets potholes newly developed in the season of heavy rain. In the repair information, data with respect to the work implementation are required. The design of each screen was standardized with simplified buttons to achieve a screen layout that is easily understood and easily used by anyone. Also, in addition to limiting the number of digits for input items, controls are in place that prevent inaccurate input or typos, such as displaying an error message when saving data if sections are left blank or if GPS has not been acquired.

Figure 2-3-2 Screen <Periodic Inspection (Left), Emergency Patrol & Inspection (Center), and Repair Information (Right)>

VISS is designed to assess the severity of damage and the priority order on repair based on measured values as much as possible, so that the severity of damage and priority order on repair do not depend on the feeling or judgment of the inspector individual.

Potholes are ranked as the damage that must be quickly repaired regardless of size, but priority level depends on the size of the damage. Ruts and cracks are assessed on a 4-level severity scale based on the size and depth of damage, which determines the necessity of repair and the priority level. The inspector assesses the severity of raveling as either none, light, or heavy, based on circumstances in the field, which determines the necessity of repair and the priority level.

Information obtained through a Visual Inspection is utilized as important data for creating a budget plan, estimating countermeasures, and calculating budget amounts.

Table 2-3-5 Ranking Definition of Damage

Severity	Rut	Crack	Raveling
0	R = 0	C = 0	None
1	0 < R < 20mm	0 < R < 6mm	-
2	20mm ≤ R < 40mm	6mm ≤ R < 15mm	Light※
3	40mm ≤ R	15mm ≤ R	Heavy※

For repair information, inspector uses a smartphone to record the segment in which repairs have been implemented, types of construction methods, width, and materials. The inspector selects the type of repair method that is applicable from patching, crack sealing, overlay, and rehabilitation.

In VISS, the data of the road section in which repair works has been implemented are to be amended. Through Repair information collected and imputed to VISS, data searching, and extraction can be conducted very easily.

- Road Maintenance Management System (RMMS)

Results of Visual Inspection collected in the field and repair information are registered into the Database in RMMS in the office. Work linked to the database is difficult if solely dependent on road names and road numbers, but utilization of RMMS which has a function of GIS makes it possible to carry out work while visualizing inspection results on a map. Furthermore, based on discussions with AACRA, this project introduced a function to link the data location with the road segment automatically by use of road numbers and GPS location coordinates.

Ultimately, RMMS was set up so that the icon changes when data recorded the Mobile Inspection System is registered in the Road Maintenance Management Database. Therefore, even if there are numerous inspection sites, anyone can easily check the progress of work that is linked to the database.

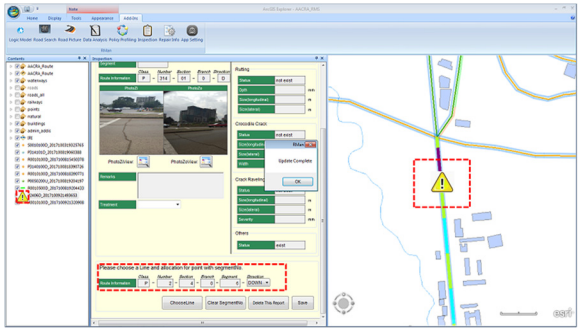


Figure 2-3-3 Icon after Registration Work

For VISS, the inspector uses MIS in the field and inputs the road number, section number, and lane direction, then takes photos of the field condition. At that time, location information is obtained with the smartphone's GPS function. At the office, the operator who registers the data from the field information, operates RMMS to compile all information sent from field such as location,

damage level and remarks. Thus, it is no longer necessary to identify the location of the damage by use of a distance meter to measure from the road's starting point to the damage site during inspection. This has made it possible to streamline field work.

B. Utilizing VISS at AACRA

The Visual Inspection Supporting System was introduced in Apr. 2016. Based on the series of discussion with AACRA, 4 (four) times of major upgrade have been conducted. Each time of the upgrade, training such as OJT was conducted. During training, an effort was made not only to teach how to use the Visual Inspection Supporting System, but also to conduct other activities including how to take photos of damage sites, safety management, daily reports, and work schedule management.

Operation of the Mobile Inspection System initially started with 5 smartphones, but 5 tablets were added in Feb. 2019 with the aim of further optimization and acceleration.

In 2017, as a result of management scope and management systems being reorganized at AACRA, the VISS was also changed to a specification based on management in 5 regions and Headquarters. Training for the operation of the VISS in each regional office was conducted by the staff in the headquarter.

Periodic Inspections are successively implemented on the roads where road surface screening surveys are carried out by Survey Vehicle and continue until Apr. when a review of the budget plan and maintenance management plan begins. Emergency Patrol & Inspections are implemented from Jul. to around Nov. with the aim of finding potholes newly developed in the season of heavy rains and identifying the locations that should be urgently repaired. More precise maintenance management plan and budget plan can be prepared through the reliable and proper implementation of the repair works identified by the emergency patrol.

C. Measures for Sustainable Utilization

In order to keep the sustainability of VISS, operational training and lessons how to establish the effective organization were conducted.

Skills for operating the VISS were continuously enhanced through OJTs aiming to improve IT literacy, capabilities and operational skills of inspectors and system operators. As the result of the training, the inspectors and system operators are now able to operate sufficiently the VISS by themselves.

The project also provided AACRA tools including a handbook, system operations manual, system control manual, system source, and system design specifications.

These tools work as a support for inspectors and system operators as well as for the newly assigned person in charge to guide them for operating system. Also these enable AACRA to continue personnel training on its own, and operational skills for the VISS to be in operation continuously.

With regards to the AACRA capacity to update the system in the event of a smartphone OS upgrade, system malfunction, or system bug, from the fact that the IT department of AACRA was able to use the MIS's system source to revise the language into Amharic, they possess the skills and technology to handle the system properly even in the event such as a system malfunction. In addition, the IT department was asked to fulfill the responsibilities as system manager for the VISS going forward to create an operational structure.

2-3-3-2 Pavement Condition Survey System (PCSS) with Vehicle [Activity 2-2]

(1) Planning Stage of Procure of Pavement Condition Survey System

A. Assessing Level of Service (LOS) of road using the International Roughness Index (IRI)

The International Roughness Index (IRI) has been adopted worldwide as an index that assesses road pavement condition. Up to this point, AACRA had not obtained IRI data nor implemented

efforts to quantitatively assess road pavement LOS. IRI was also established as the index for the overall goal of this project.

Measuring IRI requires introducing a vehicle-based automatic measurement system. Specifications appropriate to AACRA's road environment were utilized when introducing this vehicle-based measurement system. The IRI measuring system is roughly classified into the 2 method types of Class-2 and Class-3. While the latter enables measurement through a system that is easier to use and cheaper, uncertain reliability of measured IRI values when driving at low speeds is an issue. From this reason, the introduction of Class-3 was not suitable since it is highly likely that driving speed will be slow due to traffic jams when surveying roads in Addis Ababa. Therefore, the decision was made to introduce the Class-2 measurement system.

B. Optimizing Visual Inspection

In addition to IRI measurements, PCSS uses cameras mounted on a vehicle to obtain image data on roads. The data is entered into an office computer so that a simple overview of road damage can be understood on the computer. These road images are interpreted at the office to roughly evaluate the general state of road damage and the priority level for implementation routes for Visual Inspection (screening surveys) is determined. Interpreting road images allows to provide higher priority in visual inspection to the roads where damage is clearly visible, whereas lower priority to the roads where damage is not at all visible. This is anticipated to optimize the work of Visual Inspection.

(2) Problem encountered during procurement

A. Transferring the PCSS Operation Technology

PCSS is comprised of precision equipment, such as sensors and cameras, and a computer control system. A certain amount of skill is required to operate the system and improper operation can cause inaccurate data collection. PCSS was introduced in January 2017, and OJT was carried out while surveying a portion of the road network as a trial survey in the first fiscal year. The acquired data was reviewed by experts to confirm the validity of the survey data, and the calibration method was revised to suit AACRA's road environment. Technology transfer for the PCSS calibration method was also carried out through OJT.

B. Ensuring the Accuracy of Obtained Data

This project was the first attempt to experimentally gather IRI data at AACRA. Ensuring the accuracy of measured data was an issue since no previous data existed for reference to assess the reliability of the measured data. Thus, IRI data gathered through test measurements and IRI data assessed through actual surveys were compared to check the reliability of data measured by PCSS. According to the road condition, several locations were selected as the test measurement sites to implement test run using PCSS. Furthermore, a Dipstick was used to survey the longitudinal profile of the relevant locations to calculate IRI. This validation of accuracy was carried out in cooperation with AACRA technical staff to simultaneously conduct technology transfer for methods of validating accuracy.

(3) Final Shape of System

A. Overview of PCSS

The PCSS introduced by the project is composed of 1) a measurement system using a vehicle equipped with sensors, and 2) a data processing system that processes data obtained by the measurement system. This measurement system obtains data while an ordinary vehicle equipped with a laser displacement sensor (LDS) is driven to record the road surface profile through an accelerometer sensor (ACC) to record the vehicle's motion, front and side cameras to record the surrounding road condition, GPS/IMU to record location information, and a computer that controls this equipment. PCSS can acquire data up to the vehicle speed of a maximum 80 km/h. Installation of ACC to remove vehicle motion from the road surface profile enables the system to obtain high-precision data even at low speeds (20 km/h or less), which is a function used to be performed poorly with past automatic measuring equipment. This makes it possible to efficiently obtain highly

accurate data at approximately 30 km/day even when taking measurements in urban areas in the daytime when there are many traffic jams.

Figure 2-3-4 PCSV

The obtained data is processed in the office using the data processing system, and the IRI is calculated using Quarter Car (QC) simulation to create data to record in the database system. The data processing system displays the position of the vehicle on a map and can easily pick out measured segments while checking the surrounding condition from video taken by the front and side cameras. Pavement damage is also checked using video from the front and side to determine the priority level for the visual inspection segments. This allows the creation of data for efficiently implementing Visual Inspection work.

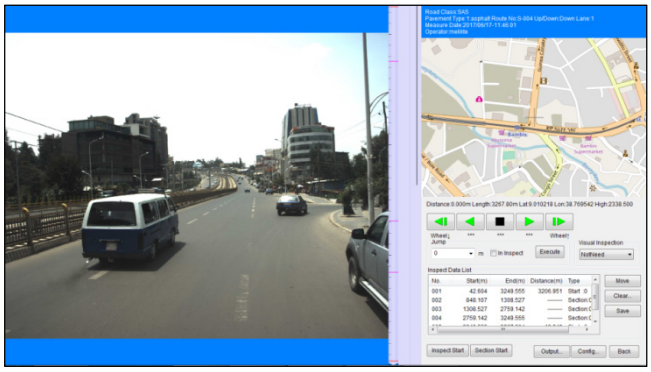


Figure 2-3-5 Data Processing System

Pavement inspection using PCSS cannot be conducted in rain since there is the possibility of equipment failure due to water leaking. Because of this, pavement inspections are concentrated in dry seasons in consideration of work efficiency.

B. Utilizing PCSS at AACRA

The project introduced PCSS in January 2017 and conducted OJT in February and August 2017. Following OJT in February, a trial inspection was conducted at AACRA and approximately 200 km of data was acquired and processed. Based on the review on the results of the trial inspection in September 2017, the supplementary OJT was held on topics from driving methods to data processing. By 2018, the OJT had yielded results and AACRA technicians were able to implement 600 km of data acquisition and processing on their own and assess road pavement using IRI.

It is recommended that PCSS sensors are calibrated once a year. Experts and AACRA technicians selected a site to carry out calibration. The initial calibration was conducted jointly with the experts and AACRA technicians. Calibration in the 2nd year was conducted only by AACRA technicians and a report on the results was verified by the experts. Currently AACRA technicians are carrying out calibration without problems.

In addition, since AACRA was not assessing road pavement with IRI, there was a need to evaluate

the reliability of measured data. Together with AACRA staff, the JICA team compared the IRI surveyed manually at test sites and the IRI calculated using PCSS for verification, which heightened understanding of OJT for accuracy validation methods and degree of IRI accuracy.

C. Measures for Sustainable Utilization

To enable sustainable utilization of PCSS, it is important to 1) avoid malfunctions, 2) ensure quality, and 3) cope with malfunctions.

- Avoiding malfunctions

  Not only do malfunctions in measurement equipment delay schedules for matters from inspections to the creation of repair plans, but the inspections themselves may not take place. PCSS equipment such as sensors are installed outside the vehicle and careful attention must be paid to damage caused by direct contact with impediments.

- Ensuring data quality

  The recommendation is for the PCSS sensors to be calibrated once a year. Calibration is conducted to correct distortion caused over time through a long-term use of PCSS. Also, before measuring is conducted equipment placement is checked for abnormalities, such as whether the LDS is placed horizontally.

- Coping with malfunctions

  Equipment installed in PCSS includes precision equipment, so separately contracting for service is recommended to receive support from the manufacturer or consultant.

  Details on these measures are written in the operation manual.

2-3-3-3 Database and GIS [Activity 2-3]

(1) Planning Stage of Development of Database and GIS

A. Coding Road Numbers

Route names and section names have been defined and used in AACRA's road maintenance management work, and those definitions have been shared among departments relevant to maintenance and management. However, when systematization of the maintenance management work was considered, it was noted that a database could not be constructed because the definitions of routes and sections were not coded.

Therefore, the project carried out coding to define routes. Specifically, among the roads managed by AACRA, arterial roads (RR, PAS, SAS) were assigned a road class, route number, and section number, and codes defined.

B. Introducing GIS

Coding route numbers required specifying the origin and end point of route and assigning consecutive numbers from the origin point to the end point. It was also necessary to apply GIS to the road network to share and manage location information, which is the basis of the VISS and RMMS. CAD data was used to manage the AACRA road network. It was developed as road network data based on the designs for roads at the time, they were newly constructed.

Based on the road network data developed as CAD data, information was converted to GIS data to create a foundation for the road network data. Moreover, for each targeted route the origin points and end points were confirmed, and route numbers and section numbers assigned. Furthermore, as minimum units for assessment in PCS and Visual Inspection, segments were created in 100-meter sections from the origin point and consecutive numbers starting from that point were assigned as segment numbers. This series of tasks was implemented using ArcGIS.

C. Constructing a Road Inventory Database

A Road Inventory Database was constructed based on the coded route information and road network data developed as GIS data. The basic concept for building the Road Inventory Database is shown in the figure below.

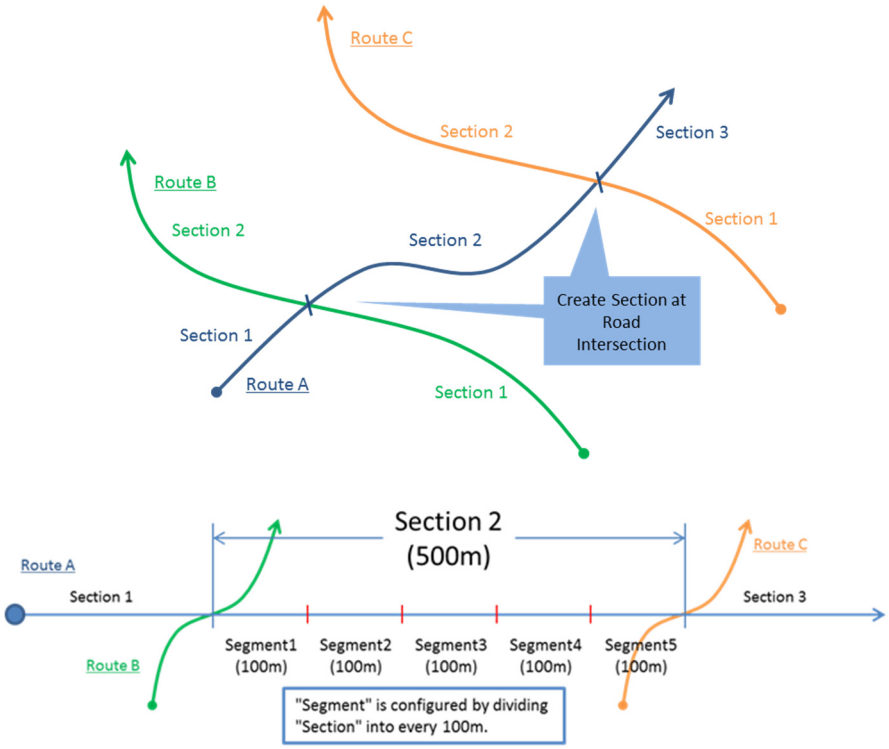


Figure 2-3-6 Basic Concept for Building the Road Inventory Database

(2) Problem Encountered During Development

A. Initial Development of the Road Inventory Database and Updates

RMMS was developed and road maintenance management work implemented based on information in the Road Inventory Database in its initial stage, which was developed based on CAD data. However, there was no guarantee that all the information in the Road Inventory Database at that point was accurate. For instance, the extension of a section calculated from the line shape of a route that was created based on CAD data could conceivably be different from the actual extension. It is also possible that data on road width is being managed that differs from reality. Differences in route extension and width data significantly impact the reliability of calculations for repair costs when drawing up a road maintenance management plan. Therefore, it is necessary to construct a Road inventory Database that is even more accurate.

However, realistically speaking it is impossible to conduct a field survey on all information to gather data. A process was introduced that revised and updated data as necessary while carrying out maintenance management work. PCS gauged the measured extension of sections to produce data. At that time, the Road Inventory Database was referenced to compare the length measured by PCS and Road Inventory Database data to identify locations where there were significant differences in length.

As a result, problematic locations were confirmed using PCS data and field checks to build a process for revising Road Inventory Database data. Intensive training was held, and technology transfer was conducted for appropriate revision processes and methods for the Road Inventory Database.

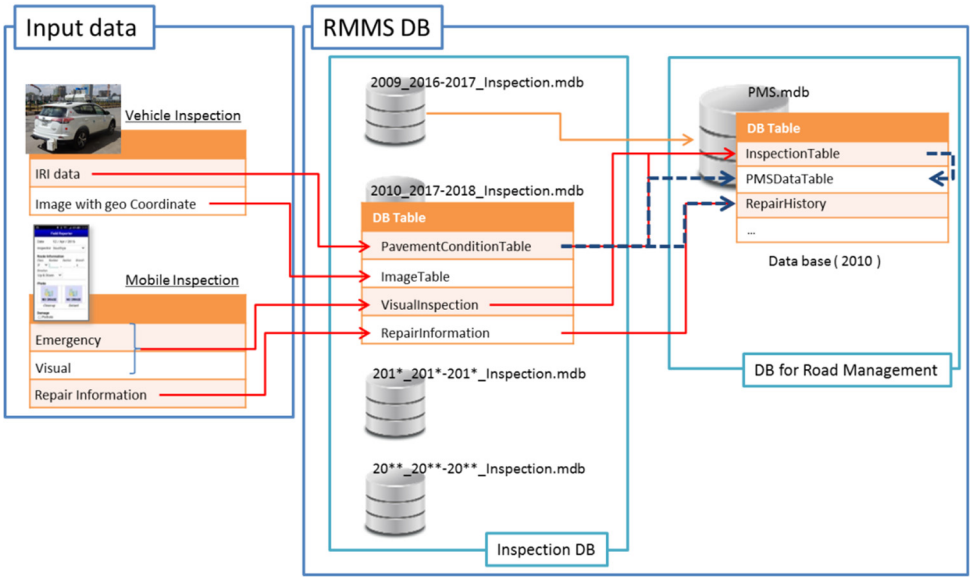
B. Joint Utilization of the Database

The Road Inventory Database is fundamental information that should be jointly utilized in all aspects of road maintenance management work. Common information must be referenced and shared among relevant departments and regional offices. In this project, because of the newly developed coding of roads, there were instances in which old definitions of roads and definitions created with new coding were confused. In response, definitions for coded roads were checked many times, shared recognition confirmed, and across-the-board understanding in relevant individuals promoted through repeated implementation of OJT for road inspections (PCS and Visual Inspection). In the end, the Road Inventory Database was developed as a platform to be jointly utilized according to a PDCA cycle for the road maintenance management work created in this project, and is used as fundamental information for RMMS, the Visual Inspection Supporting System, and PCS.

(3) Final Shape of Database and GIS

A. Database Overview

Definitions for the Road Inventory Database created in this project are shown below.



- Manage the inspection DB on a yearly basis
- The road management DB is created by combining the yearly inspection DB

Figure 2-3-7 Database Definitions

In addition, data that is comprehensively managed with RMMS, such as road inspections and repair data, was integrated based on the Road Inventory Database and constructed as a relational database. Below are definitions for inspection data.

Table 2-3-6 Data Definition of Inspection Data

How to obtain	Data	File format
Mobile Inspection	Periodic Inspection data	Xml
	Periodic Inspection (image)	Jpeg
	Emergency Inspection data	Xml
	Emergency Inspection (image)	Jpeg
	Repair Information data	Xml
	Repair Information (image)	Jpeg
Vehicle Inspection	IRI data	CSV
	Coordinate with image	CSV
	Front/Side view image	Jpeg

B. Utilizing the Database at AACRA

Of the road inspections, PCS inputs inspection data implemented at AACRA Headquarters into the database. On the other hand, Visual Inspection are carried out by inspectors from regional offices. To streamline the work of recording data from Visual Inspection, a database and system environment were built enabling the work of recording data from Visual Inspection to be conducted at each regional office. A function was developed that integrated inspection data recorded at regional offices into the database at Headquarters to consolidate inspection data from each region after inspections are conducted.

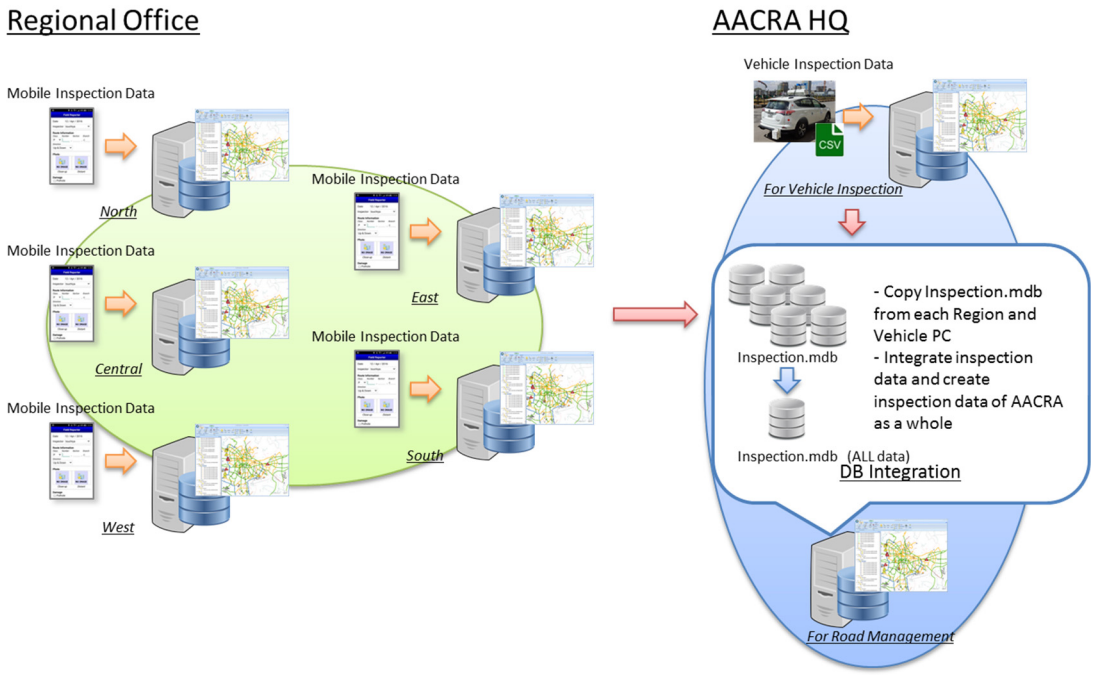


Figure 2-3-8 Database Integration

C. Measures for Sustainable Utilization

This project developed a Road Inventory Database that can be jointly used in various situations in road maintenance management work and defined its utilization and application methods. However, inventory information must be updated on roads managed by AACRA due to new construction and road improvements in the future. Intensive training was conducted on the procedure for updating the Road Inventory Database in association with new construction and road improvements, and technology transfer took place concerning update methods for GIS road network data and inventory information. Also, rules regarding updating data were clarified through OJT since updating the Road Inventory Database is an important action related to all system functions. Those procedure approaches and rules are written in the manual.

2-3-3-4 Road Maintenance Management System and Planning

(1) Planning Stage of Development of Procure of Road Maintenance Management System

A. Road Maintenance Management Planning Based on Objective Data

Road maintenance management work that was implemented at AACRA separated inspections and maintenance management planning, and creation of road maintenance management plans based on actual data and the execution of maintenance management work were problematic. The goal was set to make improvements toward a PDCA cycle of road maintenance management work that entails conducting inspections, choosing locations requiring repairs based on objective data on damage, then gathering and accumulating information on past repairs to identify problem sites and

make improvements.

A framework was constructed that uses the RMMS database to centrally manage the PCSS introduced to improve inspection work, and inspection data and repair data gathered through the Visual Inspection Supporting System. Based on objective information on road damage and repairs, a structure was put together that identifies locations requiring repair from inspection data and calculates necessary costs for repair work.

B. Deterioration Performance Evaluation and Risk Assessment

Solidly implementing road inspections and accumulating data make it possible to objectively grasp sites requiring repairs and their quantity. In addition, from the perspective of road asset management, an even greater challenge was rational maintenance management work through comprehensive decision making based on the lifecycle, rather than simply being based on the present condition.

In reality, locations of past repairs at AACRA tended to be concentrated in certain segments, and there were many cases when sufficient durability could not be ensured even after repeated repairs. Those types of locations require reconsideration of repair priority level and fundamental improvements, rather than stopgap measures.

To address these issues, this project created chronological data from accumulated inspection data and repair data, and using that chronological data introduced a system that assesses the speed of past road deterioration (deterioration performance evaluation). This deterioration performance evaluation assesses AACRA's overall average deterioration performance in regard to road damage morphology and the general evaluation index of severity. It is a system that can comparatively search for deterioration performance in segments subdivided into sections.

Based on the deterioration performance evaluation results, it is possible to review the priority level of measures for locations that have a high probability of deteriorating in the future. This links to implementation of maintenance management work based on risk assessment of roads. An approach was adopted in the system that extracts locations where the speed of deterioration in the past was remarkably fast as critical sections and establishes priority levels for repairs.

(2) Problem Encountered during Development

A. Recognizing the Importance of Inspection Data

Switching to a system geared toward decision making for road maintenance management based on objective data (data-driven decision making) necessitates the accumulation of solid data. The reliability of a database directly influences the reliability of road maintenance management planning. To gain understanding of maintenance management centering on this data, through OJT recognition was boosted regarding the fact that data accumulation is critical to creating maintenance management planning.

In data-centric maintenance management work, there cannot be planning without data accumulation. Therefore, the decision was made to have relevant individuals adjust the annual schedule with the aim of creating a maintenance management plan. PCS and a general Visual Inspection schedule were drawn up and the work process was thoroughly managed. In addition, functions were included that enable the progress of inspections to be managed using RMMS so that inspection progress can be monitored.

B. Streamlining Data Entry for Inspections

The understanding that implementation of road inspections leads to ensuring reliability of road maintenance management planning was encouraged. In addition, work field surveys and data entry for road inspections had become enormous tasks that required many AACRA resources. Moreover, regional offices are tasked with Visual Inspection, and further optimization of inspection data entry into the database was sought.

The Visual Inspection Supporting System, which is a smartphone app, is used to input field information into a smartphone for Visual Inspection data and repair data. Location information is

automatically obtained through GPS coordinates, and based on those coordinates the location point is shown in the GIS system. Next, the point data must be linked to road network data segments. An operator reconfirms the position using GIS and identifies segments that will be targeted. This takes a lot of time, and to boost efficiency a GIS function developed to enable automatic data entry was installed in RMMS. Information that is automatically recorded is later checked by an operator so that the function is semi-automatic. Including this function improved the efficiency of data entry.

C. Coping with the Process for Creating Plans and System Customization

Introducing RMMS makes it possible to offer outputs for supporting the creation of road maintenance management planning. Rather than use a system that is a commercial off-the-shelf (COTS) model, this project customized the system to enable system operation that conforms to the realities of AACRA.

At AACRA, a road maintenance management plan is created by June based on information from inspections conducted in the dry season and a budget request is made. Later, Emergency Patrol is carried out to discover unexpected road damage that occurs in the rainy season, and the first version of the road maintenance management plan is reassessed, making the creation of a second version necessary. The system was customized in this manner to adhere to the process of actual road maintenance management work and the budget request.

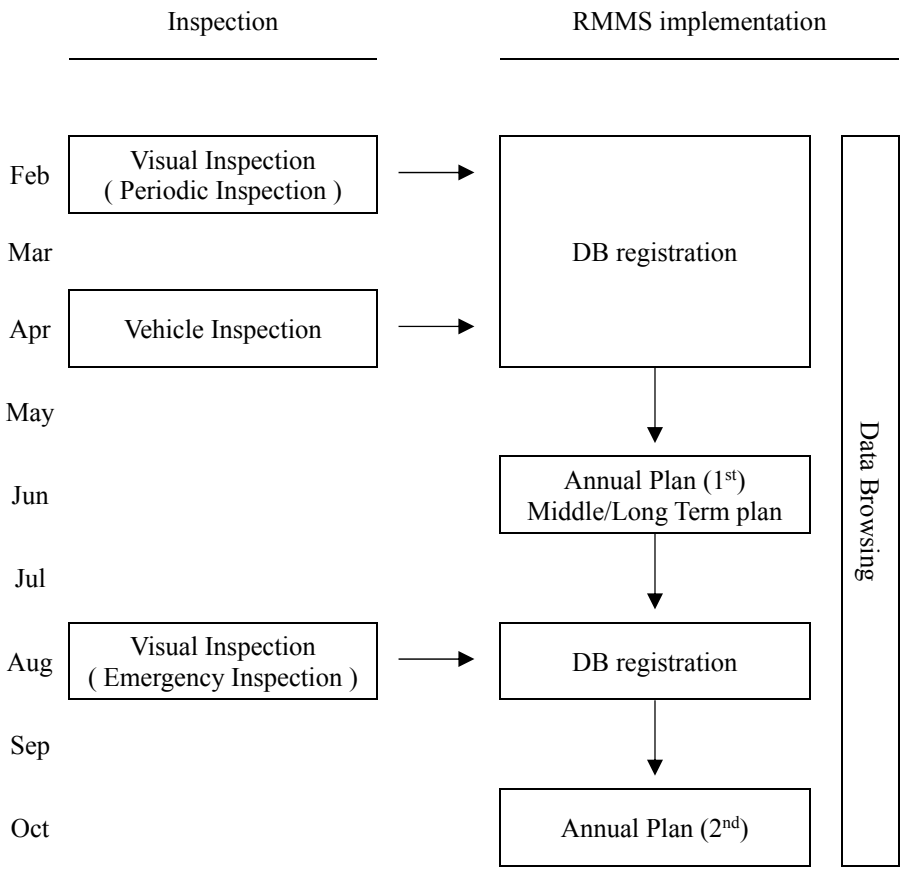


Figure 2-3-9 Annual Schedule of RMMS Implementation

(3) Final Shape of System and Planning

A. RMMS Overview

An overview of RMMS is shown in the figure below.

RMMS is comprised of a main system centering on data management and an analysis module that carries out a deterioration performance evaluation and budget simulation.

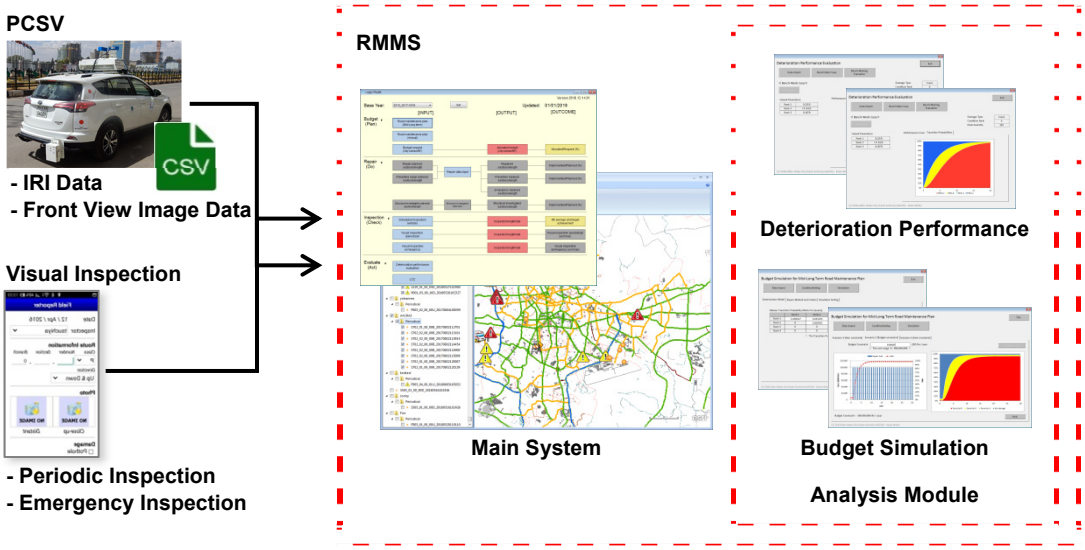


Figure 2-3-10 Structure of RMMS

The following table shows a list of RMMS functions.

Table 2-3-7 Work Items in RMMS

System	Works	Contents
Main System	Registration and browsing of the Visual Inspection results	- Data registration of the Visual Inspection data obtained by the Mobile application - Association of the registered data to Segment - Display of the registered data on GIS map - Registered data browsing
	Registration and browsing of PCS results	- Registration of PCS data to DB - Browsing of the registered PCS data - Data search - Display of the front view image data
	Registration and browsing of maintenance work information	- Registration of the maintenance work information obtained by the Mobile inspection to DB - Association of the registered data to Segment - Display of the registered data on GIS map - Registered data browsing
	Preparation of the Annual Maintenance Plan	- Preparation of the Annual Maintenance Plan - Setting of the unit prices for maintenance work - Setting of road profiling
	Deterioration performance evaluation (Database)	- Preparation of module dataset - Export of module dataset - Import of the evaluation results
	Preparation of the middle/long-term plan (Database)	- Preparation of module dataset - Export of module dataset - Import of the prepared plan
Analysis Module	Deterioration performance evaluation	- Preparation of the pavement deterioration performance evaluation
	Preparation of the middle/long-term plan	- Preparation of the middle/long-term plan for pavement

Next is a list of RMMS outputs. The main system supports the creation of an Annual Maintenance Plan based on database management and accumulated data. The analysis module reads the module dataset provided by the main system and executes a deterioration performance evaluation and a budget simulation for a middle/long-term plan.

Table 2-3-8 Outputs of RMMS

System	Functions	Outputs
Main System	Registration and browsing of the Visual Inspection results	
	Registration and browsing of PCS results	- Summary and list of the PCS results
	Registration and browsing of the maintenance work information	
	Preparation of the Annual Maintenance Plan	- Annual Maintenance Plan
	Deterioration performance evaluation (Database)	- Module dataset
	Preparation of the middle/long-term plan	- Module dataset
Analysis Module	Deterioration performance evaluation	- Deterioration Performance
	Preparation of the middle/long-term plan	- Middle/long-term plan

B. Measures for Sustainable Utilization

RMMS is an application customized to suit AACRA's road maintenance management work. However, road maintenance management is work that will continue even after this project, and it is anticipated that the system environment will need to be improved when required and functions updated. For that reason, the RMMS development environment, source code, and database definitions have been made public in consideration of its continuous utilization. Furthermore, AACRA's IT Department has been given the responsibility of managing RMMS so that a cooperative framework can be built as needed.

C. Annual Road Maintenance Plan

Based on the data of the Road Condition Survey and Visual Inspection conducted in 2011, the Repair Candidate Lists for the Annual Maintenance Plan in 2012 was prepared.

a) Evaluation of Level of Service (LOS)

The following table and figure are summary of the Pavement Condition Survey results targeting with the Strategic Road in 2011.

Table 2-3-9 Summary of LOS by Pavement Condition Survey in 2011 (2018/2019)

Road Class	IRI Average(mm/m)	IRI < 3.5	IRI < 6.0
Ring Road	3.78	59.0%	85.5%
PAS	4.20	49.3%	80.5%
SAS	5.63	26.8%	64.6%
Total	4.57	43.9%	76.5%

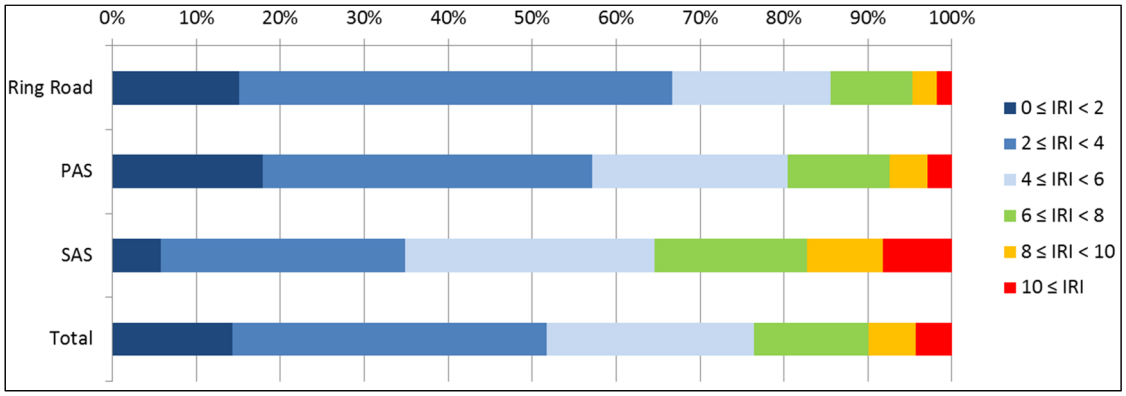


Figure 2-3-11 Summary of LOS by Pavement Condition Survey in 2011 (2018/2019)

The next table and figure are showing the comparison results of LOS between EY 2010 and EY 2011.

Table 2-3-10 Comparison of LOS between EY 2010 and EY 2011

Road Class	IRI Average(mm/m)		IRI < 3.5		IRI < 6.0	
	2010	2011	2010	2011	2010	2011
Ring Road	3.76	3.78	60.8%	59.0%	90.9%	85.5%
PAS	4.72	4.20	49.3%	49.3%	77.5%	80.5%
SAS	6.21	5.63	28.6%	26.8%	60.5%	64.6%
Total	5.00	4.57	45.1%	43.9%	74.5%	76.5%

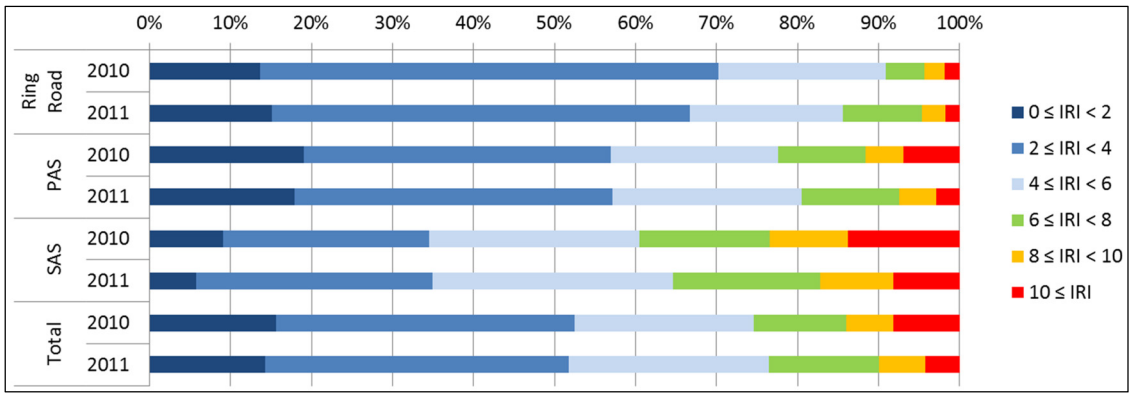


Figure 2-3-12 Comparison of LOS between EY 2010 and EY 2011

From the above results, we can see that there is no big difference of the LOS between 2010 and 2011 LOS. In order to achieve the Overall Goal, "60 % of Strategic Road (RR, PAS and SAS) is below targeted roughness of 3.5", it is necessary to improve the condition of PAS and SUS especially.

The following is a summary of damage of pavement from Visual Inspection for selecting repair segments in the Annual Maintenance Plan. We can see that many potholes are inspected on the whole.

Table 2-3-11 Summary of Visual Inspection in EY 2011

(Point)

Region	Damage Total	Pothole	Rut	Crack	Raveling
Central	309	177	17	67	48
North	148	67	29	5	47
East	313	150	19	83	61
South	168	92	22	39	15
West	176	85	15	14	62
Total	**1,114**	**571**	**102**	**208**	**233**

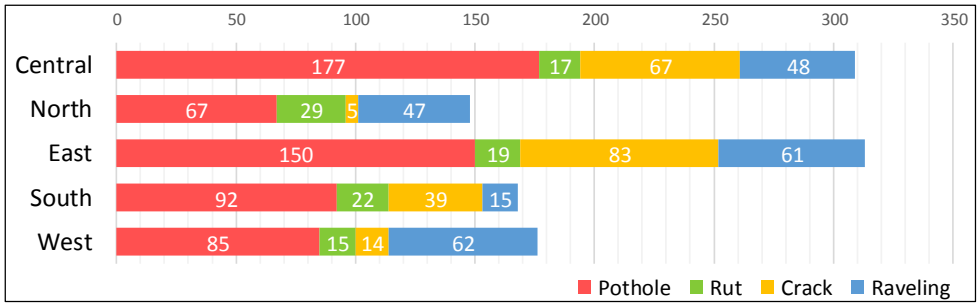


Figure 2-3-13 Summary of Visual Inspection in EY 2011 (Quantity of damages)

The next table shows the summary of damaged road length (sum of segment length) for each road class in 2011. Around 7 % of total road length was damaged in one year as the target of repair candidates.

Table 2-3-12 Summary of Damaged Road Length

	Damaged		Total length(m)
	length(m)	Ratio(%)	
RR	13,640	6.63%	205,800
PAS	39,135	5.95%	657,360
SAS	30,880	10.25%	301,360
Total	**83,655**	**7.18%**	**1,164,520**

The below tables show the summary of damaged road length for each type.

Table 2-3-13 Summary of Damaged Road Length for Each Damage Type

Rut	Damaged		Severity-1		Severity-2		Severity-3		Total
	(m)	(%)	(m)	(%)	(m)	(%)	(m)	(%)	
RR	2,375	1.15%	600	0.29%	300	0.15%	1,475	0.72%	205,800
PAS	4,390	0.67%	855	0.13%	910	0.14%	2,625	0.40%	657,360
SAS	3,145	1.04%	100	0.03%	400	0.13%	2,645	0.88%	301,360
Total	9,910	0.85%	1,555	0.13%	1,610	0.14%	6,745	0.58%	1,164,520

Crack	Damaged		Severity-1		Severity-2		Severity-3		Total
	(m)	(%)	(m)	(%)	(m)	(%)	(m)	(%)	
RR	4,000	1.94%	100	0.05%	340	0.17%	3,560	1.73%	205,800
PAS	7,730	1.18%	2,020	0.31%	820	0.12%	4,890	0.74%	657,360
SAS	5,085	1.69%	680	0.23%	565	0.19%	3,840	1.27%	301,360
Total	16,815	1.44%	2,800	0.24%	1,725	0.15%	12,290	1.06%	1,164,520

Raveling	Damaged		Light		Heavy		Total
	(m)	(%)	(m)	(%)	(m)	(%)	
RR	2,020	0.98%	1,245	0.60%	775	0.38%	205,800
PAS	13,000	1.98%	8,710	1.32%	4,290	0.65%	657,360
SAS	9,190	3.05%	5,535	1.84%	3,655	1.21%	301,360
Total	24,210	2.08%	15,490	1.33%	8,720	0.75%	1,164,520

Pothole	Damaged		Total
	(m)	(%)	
RR	7,985	3.88%	205,800
PAS	21,210	3.23%	657,360
SAS	19,740	6.55%	301,360
Total	48,935	4.20%	1,164,520

b) Setting of Repair Method and Unit Cost

The repair method and repair unit cost were set as follows. On the RMMS, two types of information for repair can be set, and in this plan, Unit Cost 1: City Admin & Transport Fund was applied.

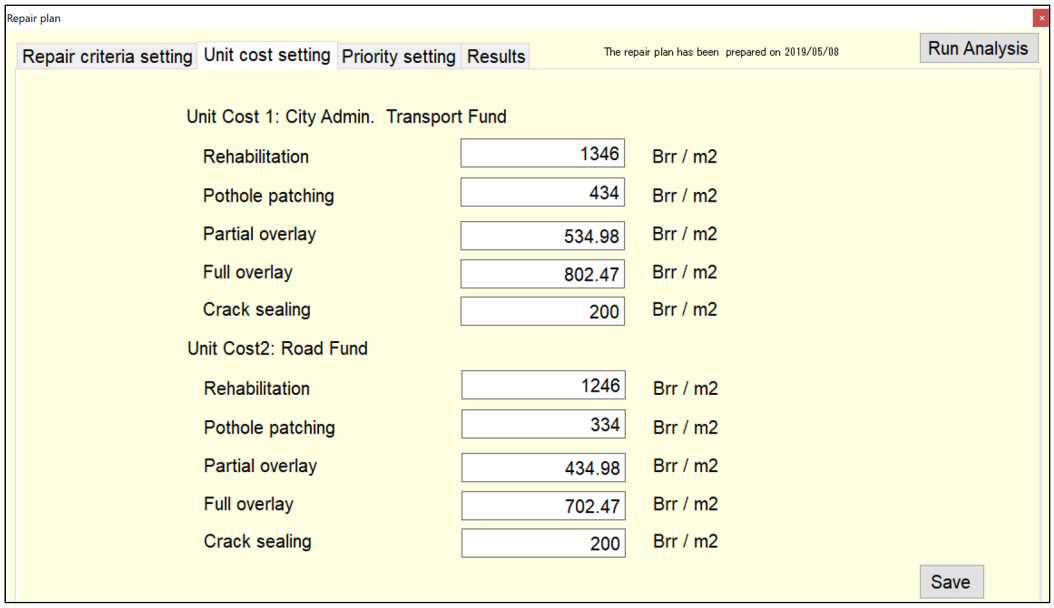


Figure 2-3-14 Repair Method and Unit Cost

c) Selection of Critical Sections

In order to set the priority of repair, Critical Segments were extracted based on the result of Bench-Marking evaluation of deterioration rate. Under the following conditions, 5.02% of the whole road network in Strategic roads and 8.45% of the damaged segments were extracted as Critical Segments.

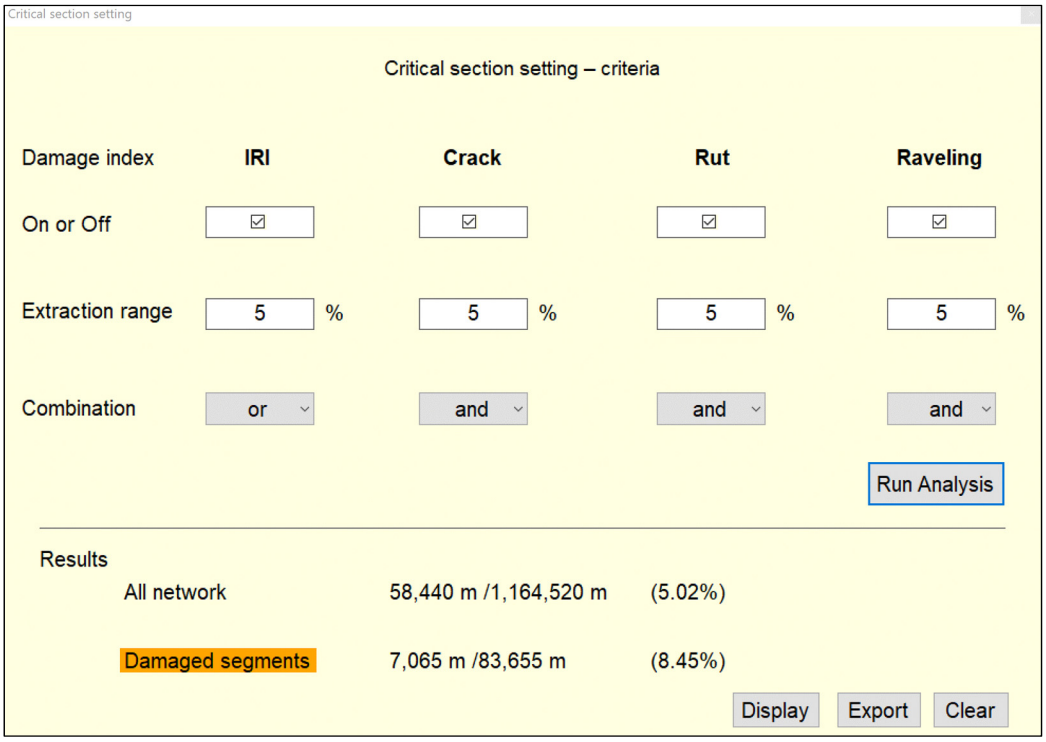


Figure 2-3-15 Setting of Condition to Select Critical Segments

d) Select Repair Candidate Segments

The long list of repair candidates section for annual maintenance plan have been prepared with three different repair criteria. In the below tables, the summary of repair volumes and repair cost are shown for each option.

- Option – 1 : targeting segments with severity ≥ 3 for overlay
- Option – 2 : targeting segments with severity ≥ 2 for overlay
- Option – 3 : targeting segments with severity ≥ 1 for overlay

* Pothole patching and Crack sealing are applied regardless of severity of segment
* Patching, crack sealing and partial OL are applied to only damaged area and Full OL is applied to segment area.

Table 2-3-14 Option – 1 (Repair Criteria: Severity ≥ 3)

	Patching			Crack Seal			Partial OL			Full OL		
	Repair Area(m2)	Segment Area(m2)	ratio(%)	Repair Area(m2)	Segment Area(m2)	ratio(%)	Repair Area(m2)	Segment Area(m2)	ratio(%)	Repair Area(m2)	Segment Area(m2)	ratio(%)
RR	1,233	101,100	1.2%	154	7,800	2.0%	4,730	77,600	6.1%	5,675	5,675	100.0%
PAS	8,759	104,355	8.4%	645	28,215	2.3%	8,912	101,030	8.8%	9,098	9,098	100.0%
SAS	34,803	44,300	78.6%	360	7,670	4.7%	4,983	44,895	11.1%	21,405	21,405	100.0%
Total	44,794	249,755	17.9%	1,159	43,685	2.7%	18,626	223,525	8.3%	36,178	36,178	100.0%

	Patching			Crack Seal			Partial OL			Full OL		
	Repair Area(m2)	Unit Cost	Repair Cost	Repair Area(m2)	Unit Cost	Repair Cost	Repair Area(m2)	Unit Cost	Repair Cost	Repair Area(m2)	Unit Cost	Repair Cost
RR	1,233	434	534,992	154	200	30,800	4,730	534.98	2,530,402	5,675	802.47	4,554,017
PAS	8,759		3,801,276	645		129,040	8,912		4,767,956	9,098		7,300,471
SAS	34,803		15,104,328	360		72,000	4,983		2,665,912	21,405		17,176,870
Total	44,794		19,440,596	1,159		231,840	18,626		9,964,270	36,178		29,031,358

Total **58,668,064**

Table 2-3-15 Option – 2 (Repair Criteria: Severity ≥ 2)

	Patching			Crack Seal			Partial OL			Full OL		
	Repair Area(m2)	Segment Area(m2)	ratio(%)	Repair Area(m2)	Segment Area(m2)	ratio(%)	Repair Area(m2)	Segment Area(m2)	ratio(%)	Repair Area(m2)	Segment Area(m2)	ratio(%)
RR	1,211	96,400	1.3%	2	2,000	0.1%	5,344	97,550	5.5%	10,775	10,775	100.0%
PAS	8,372	167,213	5.0%	230	19,065	1.2%	16,738	182,168	9.2%	18,898	18,898	100.0%
SAS	34,717	95,625	36.3%	243	2,520	9.6%	7,683	70,013	11.0%	33,075	33,075	100.0%
Total	44,300	359,238	12.3%	475	23,585	2.0%	29,765	349,730	8.5%	62,748	62,748	100.0%

	Patching			Crack Seal			Partial OL			Full OL		
	Repair Area(m2)	Unit Cost	Repair Cost	Repair Area(m2)	Unit Cost	Repair Cost	Repair Area(m2)	Unit Cost	Repair Cost	Repair Area(m2)	Unit Cost	Repair Cost
RR	1,211	434	525,444	2	200	400	5,344	534.98	2,858,880	10,775	802.47	8,646,614
PAS	8,372		3,633,622	230		45,940	16,738		8,954,495	18,898		15,164,677
SAS	34,717		15,067,265	243		48,600	7,683		4,110,091	33,075		26,541,695
Total	44,300		19,226,330	475		94,940	29,765		15,923,466	62,748		50,352,986

Total **85,597,722**

Table 2-3-16 Option – 3 (Repair Criteria: Severity ≥ 1)

	Patching			Crack Seal			Partial OL			Full OL		
	Repair Area(m2)	Segment Area(m2)	ratio(%)	Repair Area(m2)	Segment Area(m2)	ratio(%)	Repair Area(m2)	Segment Area(m2)	ratio(%)	Repair Area(m2)	Segment Area(m2)	ratio(%)
RR	1,182	92,400	1.3%	-	-	0.0%	5,707	105,950	5.4%	10,775	10,775	100.0%
PAS	8,341	158,563	5.3%	-	-	0.0%	17,584	209,943	8.4%	18,898	18,898	100.0%
SAS	34,484	93,605	36.8%	-	-	0.0%	7,943	72,213	11.0%	33,395	33,395	100.0%
Total	44,007	344,568	12.8%	-	-	0.0%	31,233	388,105	8.0%	63,068	63,068	100.0%

	Patching			Crack Seal			Partial OL			Full OL		
	Repair Area(m2)	Unit Cost	Repair Cost	Repair Area(m2)	Unit Cost	Repair Cost	Repair Area(m2)	Unit Cost	Repair Cost	Repair Area(m2)	Unit Cost	Repair Cost
RR	1,182	434	512,858	-	200	-	5,707	534.98	3,053,077	10,775	802.47	8,646,614
PAS	8,341		3,619,820	-		-	17,584		9,406,821	18,898		15,164,677
SAS	34,484		14,966,143	-		-	7,943		4,249,186	33,395		26,798,486
Total	44,007		19,098,821	-		-	31,233		16,709,084	63,068		50,609,777

Total	**86,417,682**

e) Summary of Annual Maintenance Plan

In all option cases, about 10% of the total segments were extracted for repair area, which is consistent with the visual inspection results. However, since the actual repair area is calculated by the damaged area, the ratio of the repair area to the total area is less than 10%. In patching, crack sealing, and partial OL, it is clear that the repair area is quite smaller than the segment area. This damage area is calculated based on the data measured by visual inspection.

Note that this plan does not include the rehabilitation sections.

D. Mid/Long Term Road Maintenance Plan

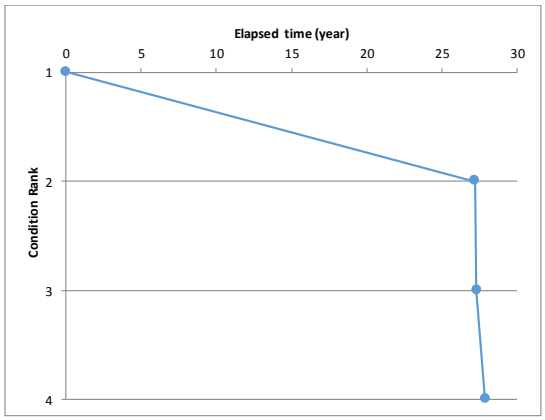
a) Deterioration Performance Evaluation

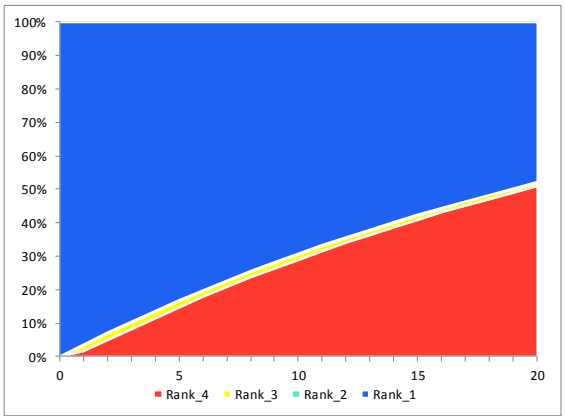
The deterioration performance of road surface damage was evaluated using time series data prepared based on the results of visual inspection for the past 3 years. The target index of this evaluation is representative value of the severity by the maximum value of the degree of damage among crack, rutting and raveling.

As shown in Figure 2-3-16, The average year from damage rank-1 (no damage) to initial damage rank-2 (Severity-1) is about 26 years on this performance curve. In other words, it takes about 26 years for 50% of all target roads to deteriorate as initial damage. On the other hand, it shows that about 20% of the whole are deteriorated after about 5 years in the probabilistic deterioration process.

The Markov transition probability matrix shows the probability of deterioration that progresses in one year. According to this result, 96% of the road segments aren't deteriorated in one year, and the damage is progressing in the remaining 4% of the segments.

This Markov transition probability matrix for the Severity is used as an input information of Budget Plan.



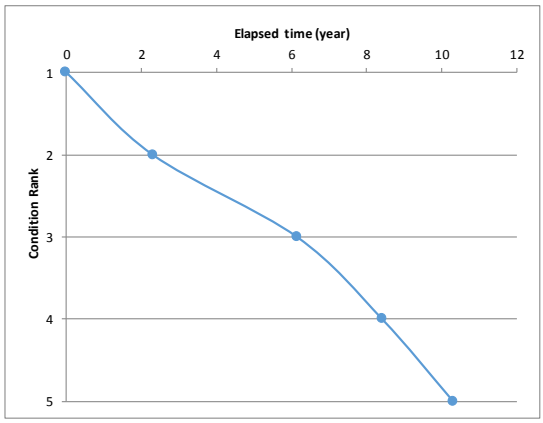


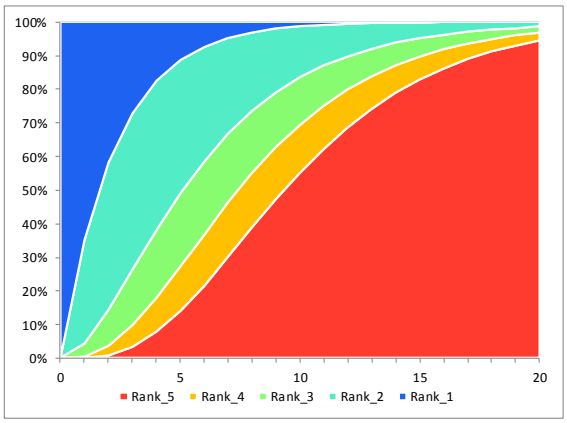
0.963907	0.003856	0.016264	0.015974
0	0.000098	0.217743	0.782159
0	0	0.176969	0.823031
0	0	0	1

Figure 2-3-16 Deterioration Evaluation for Severity

The following figure shows the evaluation results of deterioration performance for IRI. It takes about 10 years to reach damage rank-5 (IRI = 8.0). In addition, it shows that the process of the deterioration between the damage is constant.

The degradation performance evaluation of IRI is used to extract Critical Sections in the Annual Maintenance Plan. The results of benchmarking evaluation of IRI are shown in Appendix.





Markov Transition Probabilities

0.647449	0.30754	0.038745	0.005478	0.000788
0	0.771051	0.183434	0.038065	0.007451
0	0	0.643793	0.271355	0.084852
0	0	0	0.589382	0.410618
0	0	0	0	1

Figure 2-3-17 Deterioration Evaluation for IRI

b) Budget Simulation

Scenario-1: Non-Constraint

The simulation results without budget constraints is shown as below.

If there is no budget constraint, the transition of the cost necessary to repair all requiring segments is shown. According to this result, about 60 million Birr is required each year, and 80 million Birr is required for the first year to improve the existing damaged pavement.

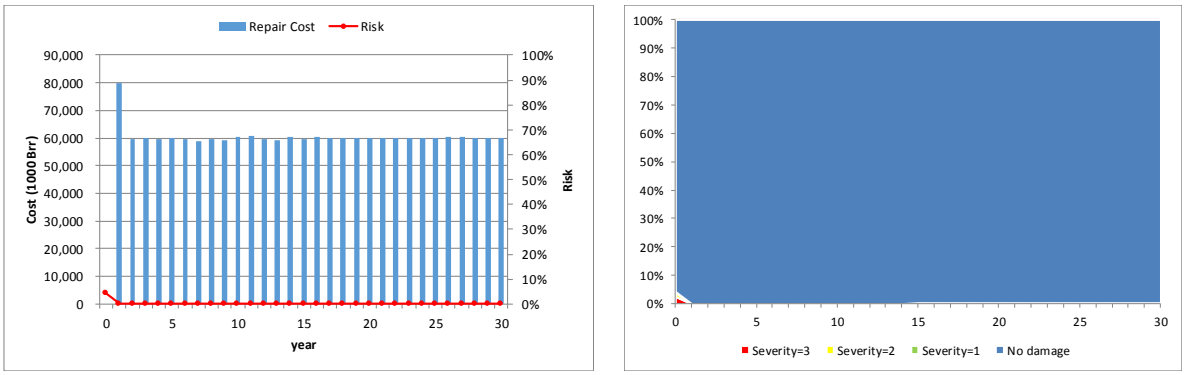


Figure 2-3-18 Budget Simulation (Non-Constraint)

Scenario-2: Budget Constraint

Next, the simulation results under budget constraints are shown.

If the annual constraint budget is 50 million Brr, the risk value will increase year by year, and it will be up to about 30% after 30 years.

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

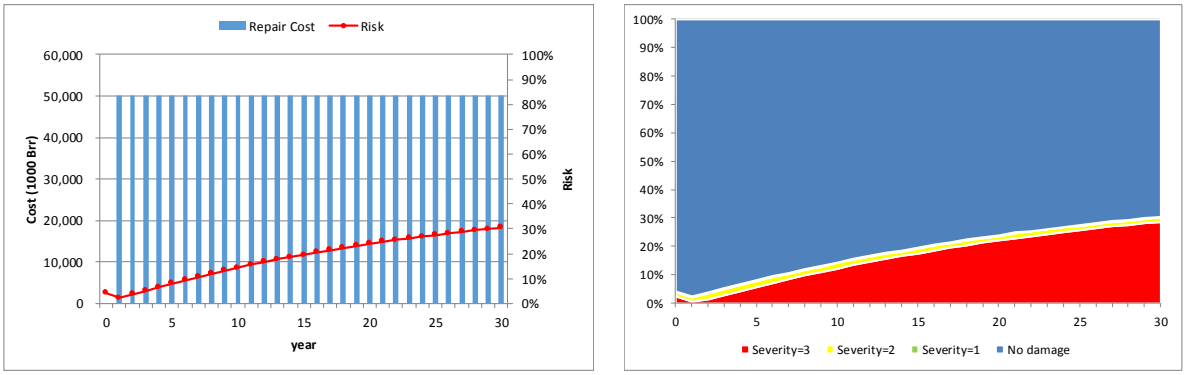


Figure 2-3-19 Budget Simulation (Budget Constraint 50 Million Birr)

In the case that budget constraint is 60 million Birr per year, the risk value gradually increases and rises to about 20% after 30 years, which indicates that it is difficult to maintain Strategic Roads LOS with the current budget level.

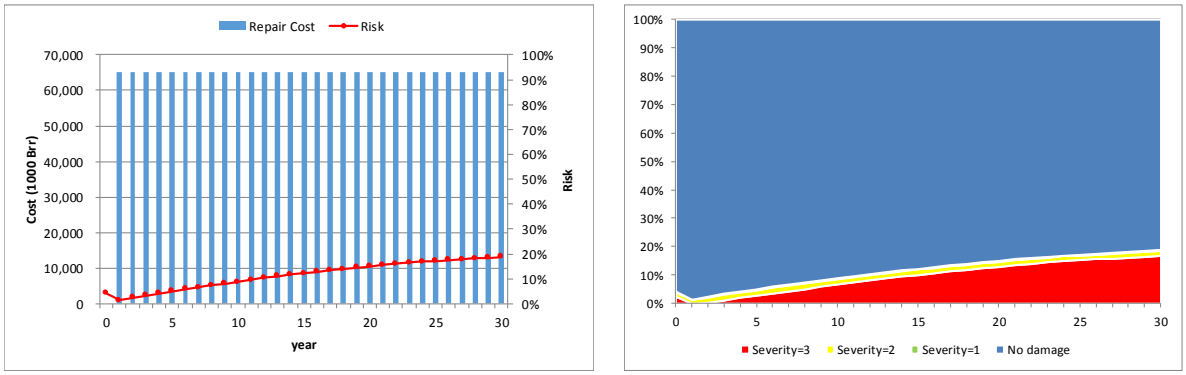


Figure 2-3-20 Budget Simulation (Budget Constraint 60 Million Birr)

Scenario-3: Risk Constraint

The results of simulation with the risk constraint are shown as below.

If the risk constraint value is 10%, it indicates that about 80 to 90 million Brr is required as the annual repair budget from 4th year, and around 75 million Birr is required as average for 30 years.

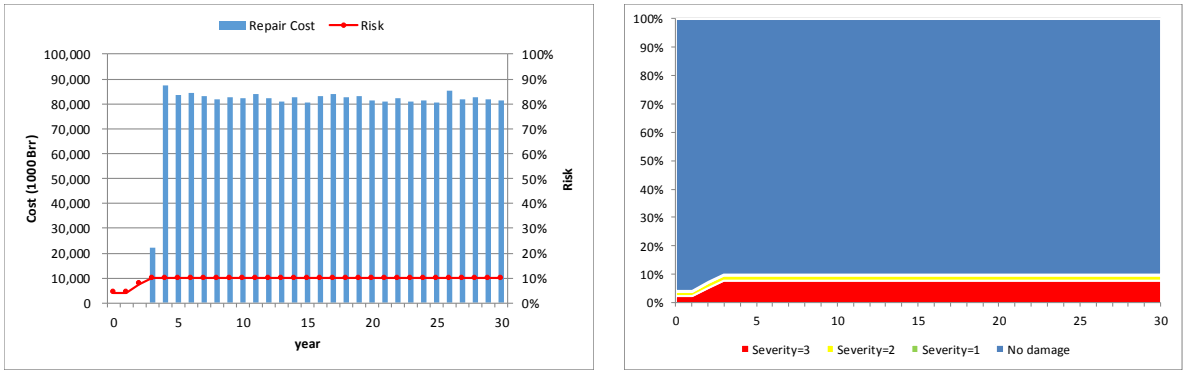


Figure 2-3-21 Budget Simulation (Risk Constraint 10%)

c) Strategic Plan for Mid/Long Term Budget

From the above simulation results, the optimal solution for the repair budget of pavement over the medium/long term can be estimated. The simulation results for the case of 75 million Brr as the annual repair budget are shown below. For the first two years, almost all of the budget will be spent. After that, the pavement condition can be maintained constantly by investing about 60 million Brr per year. The probability transition of Severity on the right of the figure also maintains good throughout the period with no damage (Severity = 0).

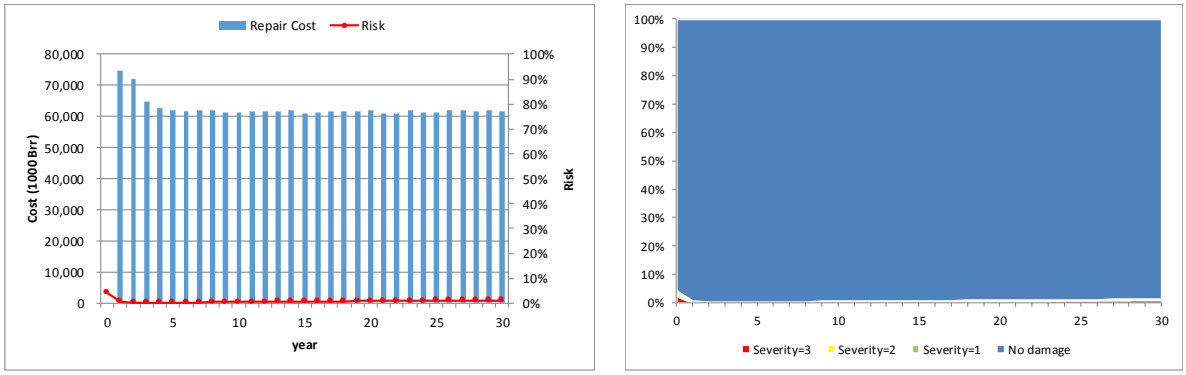


Figure 2-3-22 Budget Simulation (Budget Constraint 75 Million Birr)

d) Summary of Mid/Long Term Road Maintenance Plan

The results of analysis mentioned above can be summarized as follows.

In the Mid/Long Term Road Maintenance Plan, the deterioration and repair demand of pavement in the next 30 years are estimated and calculated the repair budget necessary to maintain the LOS. By combining several simulation results from Scenario from 1 to 3, an annual budget level (60 Million Birr with additional budget for the initial two year) that makes it possible to keep LOS constant are estimated. This budget level should be increased compared to the current investment amount. It is necessary to review the total budget required and/or the allocation of budgets between Strategic Roads and other roads.

On the other hand, the simulation results in this report are based on the accumulated data of inspection in this time up to 2011. From the next fiscal year, it is required to improve the accuracy of simulation by updating the deterioration forecasting model using the accumulated data every year.

2-3-3-5 Pilot Project and Structural Investigation Instrument

(1) Object of Pilot Project

The objectives of the pilot project are as follows, and through the pilot project the maintenance capacity of AACRA is improved.

- According to the annual maintenance plan of AACRA, detailed site investigation and repair work shall be carried out.
- Proper design and selection of maintenance methods shall be conducted.
- According to the damage of the subject road, proper repair method in addition to the pothole patching and overlay on the existing asphalt surface shall be adopted.
- A sustainable system in which data and results maintenance works are accumulated so as to be reused in future maintenance works shall be established.

(2) Selection of Implementation Methodology of the Pilot Projects

In order to achieve objectives above, two pilot projects were planned and discussed with JCC members. The first pilot project focused on preventive maintenance works such as crack sealing and small-sized maintenance work without pavement structural investigation. The second pilot project focused on maintenance works with detail pavement structural investigation such as spot replacement and cutting overlay.

Prior to the selection of methodology of the pilot projects, coordination with C/Ps, with respect to the objectives and implementation of pilot projects, were made and results were shared with all parties concerned. The selection of pilot projects was be carried out beginning of fiscal Ethiopian year in Ethiopia when annual maintenance plan was prepared and budget for pilot project was secured.

<u>First Pilot Project</u>

The first pilot project focuses on damages on pavement surface only. Therefore, crack sealing and pothole patching were adopted for the 1st pilot projects. It was noted that the crack sealing could be classified as a preventive maintenance method.

Crack sealing is used to fill cracks in asphalt pavement surfaces with sealing material in order to block rain water etc., thereby delaying the advance of pavement damage. In the pilot project, hot asphalt-based sealant (MC-30) was used because it is widely used and easy to purchase in Ethiopia.

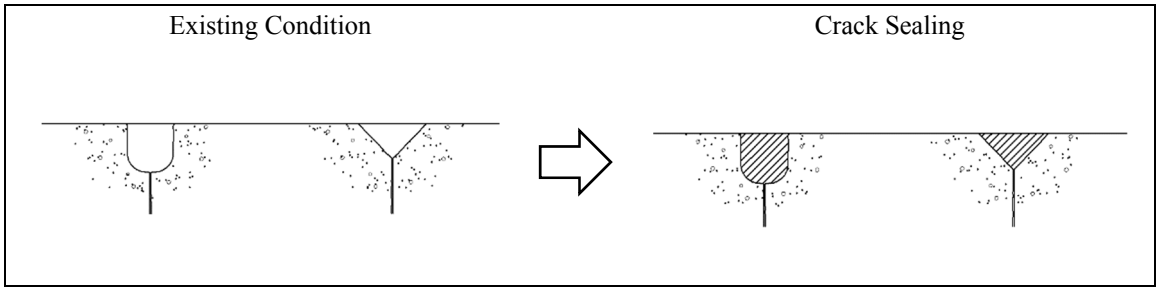


Figure 2-3-23 Cross Section of Crack Sealing

Patching is implemented as a provisional measure to recover trafficability for vehicles by filling potholes, faulting portions, local cracks and settlement with patching material. In the pilot project, hot mixed asphalt was utilized.

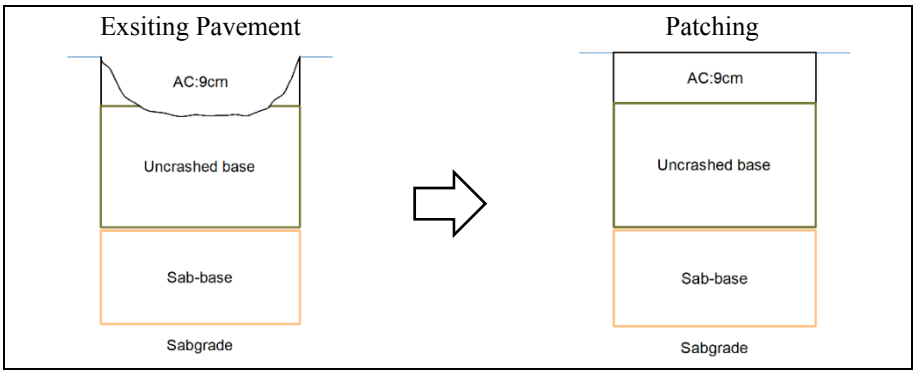


Figure 2-3-24 Cross Section of Patching

Second Pilot Project

The second pilot project focuses defaults of sub base and/or sub grade. Therefore, spot replacement was selected as the second pilot project.

The spot replacement is used to replace all asphalt mixture layers of existing pavement and part of sub base or to replace existing pavement in its entirely. In some cases, it is also used to replace sub grade or existing sub base. Through DCP test (further explanation with respect to DCP test is made later in this sub-section) black cotton soil layer was found under sub-base course layer in the 2nd pilot project. Therefore, the black cotton layer was replaced 50cm in depth by selected material from borrow pit, and new sub grade and base course layer consisting of course material were provided as shown in Figure 2-3-25.

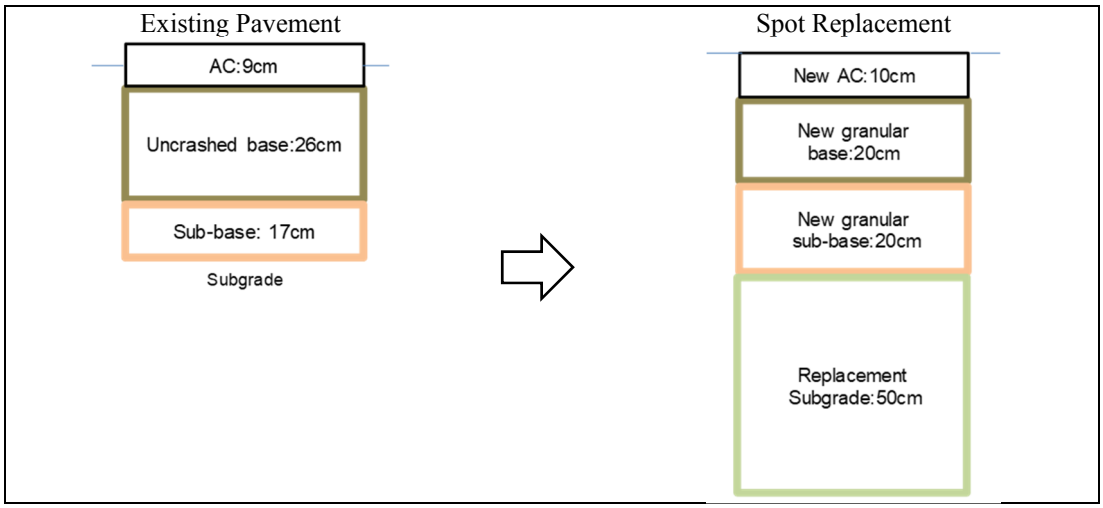


Figure 2-3-25 Cross Section of Spot Replacement

(3) Lecture and On-the-Job Training (OJT)

Lectures and OJTs were conducted for staff members related to AACRA's maintenance work. The content of lectures and OJTs are mainly classified into three areas: such as pavement failure mechanism, pavement repair design and method of pilot projects. The contents of lectures and OJTs of each field are summarized in the monitoring sheet attached.

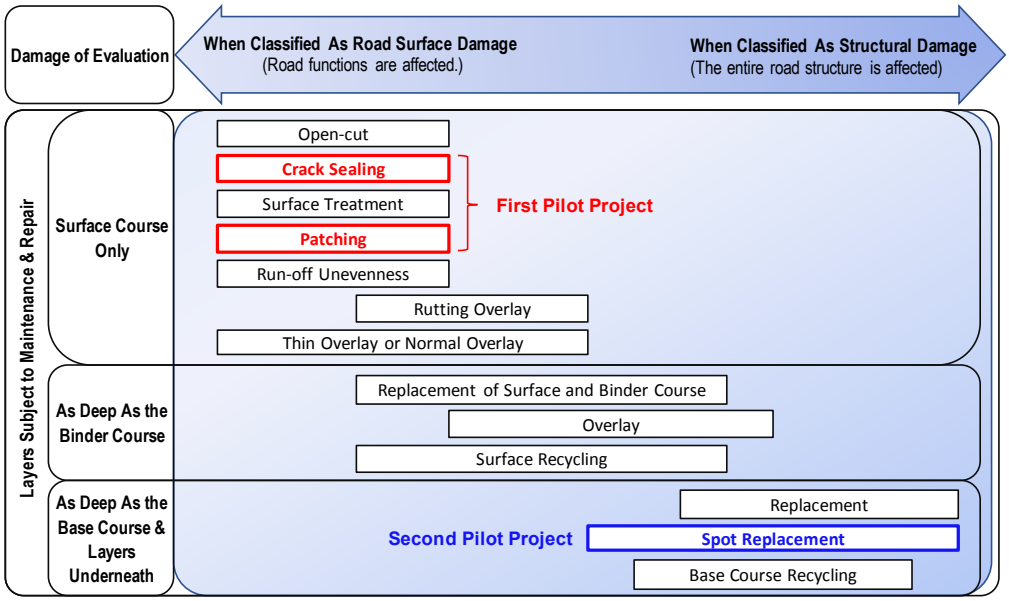


Figure 2-3-26 Application Example of Maintenance and Repair Method on Asphalt Pavement

Lecture

(4) Selection of Sites and Implementation of Pilot Projects

First Pilot Project

The prospected sites were selected from the annual maintenance plan in Ethiopian year 2009 (2016/2017) prepared by AACRA. Among the prospective sites, site locations for the pilot project were finalized in early October through joint inspections with C&M, RAM teams and JICA Project Team.

1) Road No.69 PAS4 (New No. P002, S-14, S-1)

- Selected reason: there are a lot of defects caused of asphalt layer
- Type of defect: Pothole, crocodile crack, delamination
- Repair method: Patching

2) Road No.4 PAS3 (New No. P002, S-4, S-3)

- Selected reason: There are typical potholes damaging base course and some longitudinal & traverse cracks, which is suitable to achieve the objectives of the first pilot project.
- Type of defect: Pothole, line crack
- Repair method: Pothole repair, sealing

3) Road No.4 PAS3 (New No. P002, S-1, S-3)

- Selected reason: There are typical potholes damaging base course and some longitudinal & traverse cracks, which is suitable to achieve the objectives of the first pilot project.

- Type of defect: Pothole, line crack
- Repair method: Pothole repair, sealing

4) Road No.76 PAS3 (New No. P001, S-12, S-3)

- Reason: A typical pothole damaged base course and edge of the road.
- Type of defect: Pothole, damaged edge
- Repair method: Pothole repair, patching

Second Pilot Project

The prospected sites were selected from the annual maintenance plan in Ethiopian year 2010 (2017/2018) prepared by AACRA. Selected prospective sites were investigated & analyzed by DCP respectively. Based on the result of analysis, sites suitable for the objectives of pilot project were picked up. During the joint site inspections, surveyed by RAM, C&M, Design teams and JICA Project Team, the defect of pavement was recognized, and the maintenance methods were discussed. The selection of second pilot project sites was finalized and listed below.

1) Road No.78 PAS4 (New No. P017, S-3)

- Selected reason: There is much kind of defects continuously on the stretch. The result of DCP test shows CBR value of sub-base is only 15%.
- Type of defect: Surface failure, subsided, crocodile crack, delamination
- Maintenance method: Replace weak layer
- Maintenance Area: 10.5m (W) x 150 m (L), lane to West direction only

2) Road No.7.2 PAS4 (New No. P307, S-2)

- Selected reason: The road was overlaid twice before. DCP test could not complete but the thickness & CBR value of sub-base were confirmed by the analysis of DCP data.
- Type of defect: Surface failure, waving, crocodile crack
- Maintenance method: Replace weak layer
- Maintenance Area: 14.0 m (W) x 100 m (L)

Number 2). Road No.7.2 was planned to be maintained by cutting overlay. However, a milling machine to be used to cut existing asphalt layer was not procured by the time of implementation, the prospective site was excluded from the second pilot project. It should be noted that two milling machines were procured and delivered to AACRA in December 2018. After an initial instructional operation given by a supplier, AACRA started to implement the cutting overlay by themselves.

Joint Inspection

(5) Records Implementation of the Pilot Project (Photos)

Before maintenance Work

Filling Sealing Material

Curing Sand

After maintenance Work

Figure 2-3-27 Photos of First Pilot Project (Crack Sealing)

Before maintenance Work

Asphalt Pavement Cutting

Asphalt Pavement Removal

Supplemental Material Spreading

Supplemental Material Compaction

Asphalt Emulsion (PK-3) Application

Asphalt Hot Mix Compaction

After Maintenance Work

Figure 2-3-28 Photos of First Pilot Project (Crack Sealing)

Before Maintenance Work

Excavation

Establishment of Sub Grade

Compaction of Sub Grade

Establishment of Sub Base

Establishment of Base Course

Establishment of Surface Course

After Maintenance Work

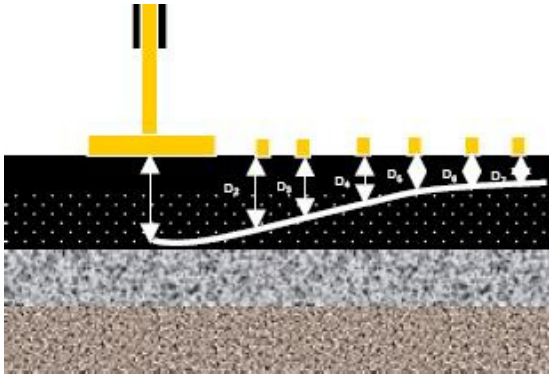
Figure 2-3-29 Photos of Second Pilot Project (Spot Replacement)

Due to the limitation of the budget fpr personnel and equipment of the pilot project, the JICA Project team together with C/Ps had to perform the OJT through daily maintenance work as well as the pilot projects. In these OJTs, safety management such as traffic control and third-party safety during construction was emphasized.

(6) Structural Investigation Instrument

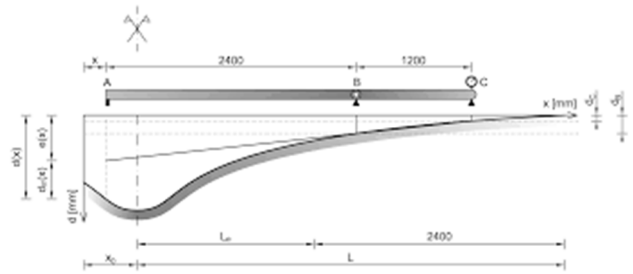
In this project it was requested to supply a structural investigation instrument in the TOR. The instrument can be categorized into two types such as destructive test (DT) and non-destructive test (NDT). Typical instrument for each DT and NDT is shown below.

1) Falling Weight Deflectometer (FWD) (NDT)



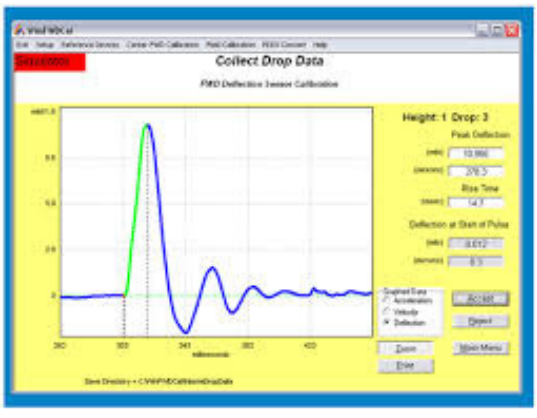
This is a very sophisticated equipment and can take all necessary data required but very expensive in its procurement and maintenance.

2) Benkelman Beam (NDT)



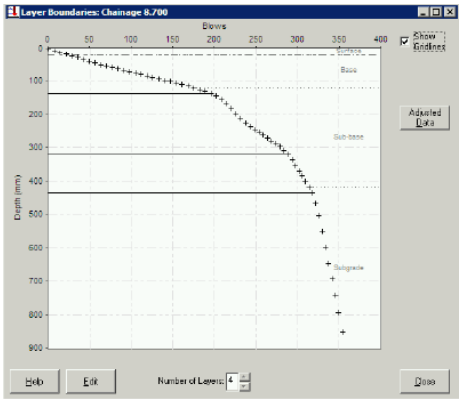
This is very popular equipment utilized in many countries, but very delicate operation is required. Data collected is limited.

3) Portable FWD (DT)



It is suitable to check the compaction of base course and sub base course but in order to check bearing capacity below asphalt layer from the pavement surface, core cutter is also needed.

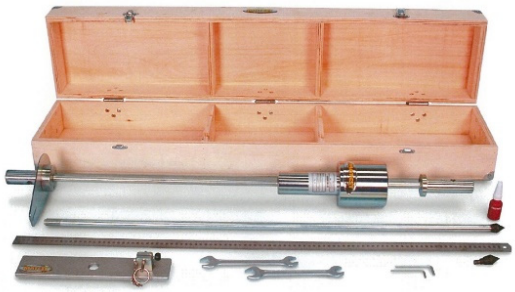
4) Dynamic Cone Penetrometer (DCP) (DT)



Operation is very simple and easy. As the instrument is very light & compact, it is very easy to shift the location to be invested. Procurement cost is very cheap.

5) Conclusion

Considering the price including maintenance cost, and the ease of operation and analysis, JICA Team recommended the DCP with core cutter to AACRA as the structural investigation instrument suitable for AACRA as of this moment, and AACRA accepted the recommendation.



DCP

Trial Operation of DCP (OJT)

2-4 History of PDM Modification

2-4-1 PO and PDM

(1) Version 1 (August 2015)

PDM was modified from that outlined in R/D (signed in April 2015) to better correspond the circumstances of the Project.

(2) Version 2 (February 2016)

PDM was updated for 1) verification indicator, 2) addition of activity “Development of Visual Inspection Supporting System” into Activity 2-2, 3) addition of activity “Develop Road Maintenance Management System” into Activity 2-4, 4) Experts of Japanese side, 5) extra item for provision of machinery and equipment in accordance with the contract amended in January 2016.

(3) Version 3 (September 2016)

After the review of "Objective verifiable indicator" under activity 0-2, modification was made on "Means of Verification".

(4) Version 4A (April 2017)

Through the discussion in TAC 5 and agreement made in TAC 6 (January 27 2017; detailed record of the 6th TAC was described in the next Monitoring Sheet Version 5). 80% was inserted into the target value of Objectively Variable Indicators for Project Purpose No. 3. With respect to other target values which were not inserted any figure, all attendances to TAC 6 agreed that these values should be decided after observation actual figure for a while.

(5) Version 5 (October 2017)

No modification was made.

(6) Version 6A (April 2018)

PO of Project term was extended in accordance to the JICA amended contract. Thus the schedule of project activities and monitoring activities were updated. Expert assignments were yet to be increased. Objectively Verifiable Indicator of PDM were updated.

(7) Version 7 (October 2018)

PDM means of verification on Overall Goal 1 and 2, and Outputs 1-3 were amended based on the discussion and agreement during the 7th JCC. Project Purposed 1 was amended by removing "interview to Addis Ababa City Administration "due to difficulty to have interview. JICA team justified that the interview with Road Funds Agency was sufficient to obtain the baseline data

2-4-2 Other Modifications on Detailed Implementation Plan

The key activities which caused the amendment of the contract between JICA and JICA Team are listed below.

- Introduce and develop of the visual inspection support system with GIS and smart phone by JICA team.
- Invite Dr. Kiyoshi KOBAYASHI professor of Kyoto University, Japan to the 1st seminar held in April 2017 as the special lecturer
- Due to the delay of PCSS, all work schedule of activities related to the data collection and the schedule of assignment period of Japanese experts were obliged to be changed and it became difficult to conduct full scale road data collection and reflect to the road management system and prepare mid and long-term road maintenance plan. This allowed to extended project period for 1-year, increased JICA expert assignments.

CHAPTER 3 RESULTS OF JOINT REVIEW

3-1 Results of Evaluation based on DAC Evaluation Criteria

3-1-1 Relevance

Under the Growth and Transformation Plan (GTP), which is a five-year national development plan from fiscal year 2010-2011 to 2014-2015, road development is identified as a key component of infrastructure development and prioritized it as a key driver for economic and social development. Moreover, the GTP calls for strengthening the organizational capacity of responsible road agencies, building the capacity of local contractors and consultants, and improving equipment maintenance services.

This is further emphasized under the GTP II (2015/2016 - 2019/2020), which highlights roads as important economic infrastructure to help accelerate economic growth and social development in the country. The major objectives include upgrading and improving the existing roads in the next five years. To this end, the GTP II provides a strategy to strengthen the road maintenance system taking the past experience into account.

The Road Sector Development Program Phase IV (RSDP IV) (2010/11-2014/15) , a development program in the transport sector, emphasizes the importance of developing and maintaining highways and district roads as well as improving access to rural areas. Following the RSDP IV, the RSDP V (2015/16-2019/20) recognizes maintenance as a priority program in the road sector and calls for increasing the monetary resources for road maintenance to overcome the shortage of funds for road maintenance. The RSDP V also highlights the role of road management agencies to maintain the existing roads and requires them to give priority not only to the construction of new roads but also to the maintenance of existing roads. Moreover, the RSDP V clearly emphasizes the importance of identifying all the roads that need to be rehabilitated in order to fill the gap between the maintenance needs and the funds available and provides strategies to develop human resources and further enhance the capacity of technical staff in the road sector.

In order to strengthen its road maintenance capacity in accordance with these abovementioned high-level plans, AACRA particularly committed to address managerial challenges, such as reviewing the organizational structure to improve interdepartmental communication and develop human resources, as well as technical challenges, such as 1) establishing a Road Management System, 2) collecting data for the maintenance system, and 3) promoting preventive maintenance for better performance. Among these challenges, it should be noted that a Road Management System was first introduced in 2003, but it did not take root in AACRA due to the complexity in the system operation, the need for burdensome data input, and the lack of relevant trainings.

Against this background, the project provided technical assistance to 1) develop and introduce a Road Maintenance Management System (RMMS) consistent with the operation flow of AACRA; 2) establish a database to manage the data collected for road maintenance; 3) develop and introduce a Pavement Condition Survey System (PCSS) and an inspection support system to enhance data collection; and 4) establish a structural examination (Dynamic Cone Penetration (DCP) testing) process to facilitate preventive maintenance. As a result, the project assisted to transform the maintenance process into a more systematic, evidence-based practice. Therefore, the project is considered to conform to the national strategies and the needs of AACRA. Moreover, while introducing the abovementioned systems, the project experts repeatedly discussed the specifications and customization of the systems with AACRA technical staff and deliberated how to ensure the system can establish in AACRA. This demonstrated that lessons were learned from AACRA's previous failure in development of RMMS to have an effective system in place. Therefore this project is also consistent with JICA's technical cooperation policy.

3-1-2 Efficiency

Experts of JICA Team were assigned as planned and completed their tasks. In order to minimize

the absent duration of experts in Ethiopia, experts' s assignment schedules were adjusted from the original schedule, by shortening the length of one stay but increasing the number of travel time of each expert and as the result number of months when expert stayed in AACRA was increased,-so that C/Ps can consult with JICA Team any time.

The project also provided the following equipment: 1) PCSS; 2) RMMS including PCs (4 sets); 3) Visual Inspection Support System (VISS) including smartphones (5 units), tablets (5 units) and PCs (2 sets), and 4) structural examination (DCP) equipment (2 sets). As for 1) PCSS, sufficient OJT was provided, because the project period was extended accordingly despite the delay in the delivery of the system equipment. 2) RMMS is the planning application developed by JICA team and installed to the Road Asset Management and Database Directorate (RAMDD), and the data registry application was installed on PCs at the regional offices, which enabled efficient data management. 3) VISS, smartphones, and Tablet PCs, were added at the 2nd contract amendment. The systems were developed by JICA team and currently applied to the ACCRA inspection since the task was transferred to the regional offices.

VISS and RMMS were developed and customized to meet the needs and requirements of AACRA. As a result, these systems were developed as open sources, and their source codes were made available to AACRA after the project completion so that the both system can be used sustainably.

In addition, a series of training were provided under the project to nurture trainers for the future trainings in the effective and efficient manner regularly.

AACRA assigned three inspection technicians and two engineers to the Project when it started, which expanded to 16. Moreover, after the AACRA restructuring in November 2016. Road Asset Management and Database Directorate staff were assigned to lead each project activity. As engineers with a degree in civil engineering from university, they had been equipped with the basic skills to implement the project and to communicate effectively with JICA Team.

AACRA provided the JICA Team with an office space and necessary equipment during the project period, which allow to communicate with C/Ps regularly as required. The road maintenance expenses and pilot project costs were also available by AACRA on time and allowed the project activities to be conducted as planned.

In light of the above, the efficiency of this project is rated as satisfactory.

3-1-3 Effectiveness

The project is designed to deliver the following three outputs to achieve the project purpose: 1) the implementation structure of AACRA for road maintenance is improved; 2) the process for formulating road maintenance plans is established; and 3) the maintenance skills and knowledge of AACRA technical staff are improved.

activities undertaken in the Project enhanced the implementation structure of AACRA for road maintenance. Five regional offices were established in November 2016 to collect data through visual inspection, and to supervise maintenance works. Moreover, the Road Asset Management and Database Directorate increased its technical staff to strengthen its asset management capabilities. Therefore, this project is considered highly effective in 1) improving the implementation structure of AACRA for road maintenance.

This project enhanced data collection capabilities by making it possible to conduct precise road inspections. The Project developed an inspection scheme and established an annual schedule including a mix of inspections by use of PCSS, visual inspections, and emergency patrol. The maintenance data collection process was also integrated into this scheme. In order to enhance data collection capabilities, the project developed a PCSS and a Visual Inspection Support System (VISS) as well as transferred the necessary skills and knowledge to AACRA technical staff. Moreover, the project established a process for using the data collected objectively to select the road sections to be rehabilitated and to develop maintenance plans. Thus, this project included all the actions necessary to complete the PDCA cycle for road maintenance improvement. Therefore,

the project is considered highly effective in 2) establishing the process for formulating road maintenance plans.

This project established a process for conducting structural examinations (DCP tests) when the road sections proposed for rehabilitation need detailed damage surveys as well as transferred the skills and knowledge required to apply the established process to AACRA. This enabled AACRA to conduct large scale rehabilitation works on structurally damaged sections. The project also transferred the skills and knowledge required for preventive maintenance through pilot projects, including safety management in construction sites, improvement of operational efficiency (e.g. asphalt temperature management), and ensuring data management. These technical transfer activities contributed to 3) improving the maintenance skills and knowledge of AACRA technical staff.

The components of the on-the-job training provided in this project were compiled as manuals and handbooks, which were distributed throughout AACRA. Moreover, an intensive training program was held from January to April 2019. Thus, this project established a hierarchical training system where Road Asset Management and Database Directorate (RAMDD) staff were first trained so that they could train the technical staff of the regional offices.

The PCSS was introduced in March 2017, around a year later than originally planned. Due to this delay, the project period was extended to June 2019. As a result, routine inspections using the PCSS were conducted over three dry seasons.

Since all the planned activities have been completed, the effectiveness of this project is rated as highly satisfactory.

3-1-4 Impact

The project first endeavored to strengthen the capacity of AACRA to collect and manage road maintenance data through developing road inspection systems and establishing its process to facilitate the systematic implementation of the PDCA cycle for road maintenance improvement. The PCSS was developed to enhance routine inspection, and the inspection support system to enhance visual inspection. The process to manage the collected data in the RMMS database and applying to develop transparent maintenance plans, and to conduct structural examinations to evaluate the structural durability of pavements and select the most efficient rehabilitation methods. The PDCA cycle established through the project allowed AACRA to provide reliable maintenance services and gave it credibility in requesting budgets from the Addis Ababa City and the Road Fund. Thus, this project laid the foundation for sustainable road maintenance.

Measuring the IRI on a regular basis was introduced thorough the PCSS, which was also adopted as an indicator for the overall goal, and a long-term service level target set for pavement maintenance. By using this international standard indicator for target setting and applying it to actual maintenance services, the project made it easier for relevant organizations in Ethiopia and neighboring countries to understand AACRA's road maintenance service level. This environment will facilitate to deploy AACRA's road maintenance system widely in the future.

In addition, promotional videos were created on AACRA's road maintenance services and the project aiming to promote understanding of the general public on the importance of road maintenance, the long-term vision of AACRA, and the effects of the technologies introduced under the project. The video is also expected to improve the accountability of AACRA.

In light of the above, the impact of this project is rated as highly satisfactory.

3-1-5 Sustainability

The sustainability of this project is evaluated from the following three perspectives and rated as satisfactory.

(1) Technical Aspect

Continuous OJTs and lectures were provided to transfer technologies introduced in the Project. In general, many of those concerned including staff from the regional offices and other relevant organizations, participated trainings.

Moreover, an intensive training program was held for RAMDD staff from January to April 2019. This training mainly focused on the RMMS, inspection and data management practices, and system operations to address potential needs might arise after the project completion (e.g. expansion of systems to new roads). Trainings manuals and handbooks were also distributed throughout AACRA, This established a training system where the RAMDD's technical staff who participated in training can take in charge of one or more disciplines covered and provide continuous trainings to newly assigned staff at RAMDD and regional offices.

RAMDD staff were sufficiently trained on the PCSS including regular calibration procedures. The pavement condition survey was conducted on the target road section with a length of 500 km (a round trip length of 1,000 km) for over three dry seasons, and the collected data were verified. Given the high-level expertise required to maintain the PCSS, a hotline was set up to allow constant contact with the PCSS supplier in case questions arise about system errors and operations after the project completion.

The RMMS and the VISS were developed and delivered to AACRA, and all program source codes were made available to the IT Department of AACRA so that the systems can be improved and customized after the project completion as required to meet the needs of the rapid progress of technology. In addition, all the relevant documents such as system design specifications and database framework specification, were also provided as attachments to the manuals. A system engineers of AACRA's IT department, have a enough capacity to understand the systems developed in this project.

(2) Financial Aspect

AACRA receives road maintenance funds from two sources: 1) the Addis Ababa City, and 2) the Road Fund.

Among them, the budget from the Road Fund were constantly allocated in recent years. The budget estimate submitted to the Road Fund Office is made based on the construction unit prices set by the Road Fund Office in the past, which were far from current market prices. This problem was pointed out in the project, and the Road Fund Office advised to continue reviewing the repair unit prices.

The budget allocation for road has been increasing in recent years, reaching a enough level to perform a certain level of road maintenance.

Table 3-1-1 Budget Allocations for Road Maintenance

Summary (Pavement)

(unit: Birr)

Ethiopian Year	Plan/ Requested	Approved			Implemented		
		Road Fund	City	Total	Road Fund	City	Total **
2007	**N/A**	18,759,000	24,094,000	***42,853,000***	*not confirmed **	*not confirmed **	***58,467,900***
2008	**N/A**	22,447,000	7,472,000	***29,919,000***	*not confirmed **	*not confirmed **	***41,891,000***
2009	**N/A**	41,770,000	267,069,000	***308,839,000***	46,689,000	197,394,000	***244,083,000***
2010	**520,900,000**	39,728,000	156,133,000	***195,861,000***	*57,790,000*	*196,760,000*	***254,550,000***
2011	**599,348,319**	49,300,000	300,000,000	***349,300,000***	*not yet*	*not yet*	***not yet***

*"not confirmed *"* --- The implemented amount is not confirmed separately (City or Road Fund), but the total implemented amount by City and Road Fund is avail
"Total **" --- Including additional budgets.

STEP = 1. Plan/Requested → 2. Approved → 3. Implemented

Source: JICA Team

(3) Institutional Aspect

As mentioned in "1-1. Relevance" above, the Government of Ethiopia, in the GTPs and RSDPs, explicitly emphasize the importance of road maintenance and commitment to increase the road maintenance budget.

AACRA was restructured in November 2016 including to create new positions of Deputy Director General in charge of Road Asset Management and Database Directorate under the Director General and creating five regional offices to provide road maintenance services. This reform established a clear reporting line for the PDCA cycle of road maintenance and enabled smooth communication throughout the organization from the top management-level decision makers to the frontline staff.

At TAC meeting held in February 2019, the needs of establishing a common understanding on actions required to enhance the sustainability of project activities introduced after the project completion was discussed and it was confirmed that AACRA's top leaders will take the initiative in road maintenance.

3-2 Key Factors Affecting Implementation and Outputs

3-2-1 Contributing Factors

(1) Consistency with the Project and Ethiopian Development Needs

As described in 3-1, this Project is well aligned with the development policy of the Government of Ethiopia as well as Addis Ababa City. Thus C/Ps participated the project activities enthusiastically with sense of ownership, and project outputs were produced as planned with clear intension to utilize those in order to improve the road maintenance capacity in Addis Ababa City. These facts increase the prospect of achievement Overall Goal and sustainability of the Project.

(2) Improved Communication among C/Ps

At the early stage of the Project, the communication among departments related road maintenance was not sufficient and they acted as their please. Through the introduction of outputs (new technology) and restructuring of AACRA in November 2016 (five regional offices were newly set), the communication among C/Ps has improved gradually and regular internal meetings are held between Directorate of Asset Management and Directorate of Engineering Operation. This improvement in communication among C/Ps, the PDCA Cycle has started functioning.

(3) Close Communication between JICA Team and C/Ps

During the project period, more than 100 times of training including workshops, lectures and OJTs were conducted and a series of discussions were held between JICA team and C/Ps. Through trainings and discussions, close communication between JICA Team and C/Ps were maintained.

(4) Stable and Fixed Assignment of C/Ps

Staff of AACRA normally moves to other department periodically, however, AACRA senior management kept most of C/Ps unchanged during the Project period. It helped smooth continuation of activities and accumulation of knowledge and experience in organization. It is also expected that C/Ps will act as trainer/lecturer to teach knowledge and technology transferred under the Project to the newly assigned staff in order to keep the sustainability and to achieve the Overall Goal of the Project.

(5) Security Condition

During the project period, Addis Ababa was stable and JICA Team were able to assign experts as planned. This also helped to implement the project activities.

3-2-2 Inhibitory Factors

(1) Delay of Equipment Supply for the Pavement Condition Survey System

PCSS is composed of survey equipment and a vehicle on which the survey equipment is installed.

As previously described, the procurement of the survey equipment was delayed 1 year from the original plan because of the change in the bidding procedure. Due to this delay, schedules for activities related to the data collection using PCSS and assignment schedule of the JICA Team had to be revised accordingly. In order to produce all outputs as planned, JICA Team proposed the revised overall schedule (1-year extension of the Project period) and revised assignment plan to JICA. AACRA recognized the importance of this delay and requested JICA to admit the proposal of JICA Team. After series of discussion between JICA and JICA Team, JICA approved the proposal as requested and the Contract was amended in May 2018.

(2) Lack of the Equipment for the Road Repair Works

As described in the Section 2-3-1 in this report, pilot projects were planned and implemented in Ethiopia Year 2009 (2016/2017) and 2010 (2017/2018) respectively. Due to the lack of equipment required for the pothole repair work such as asphalt cutter, breaker, compact air compressor and asphalt layer, the repair work were not able to be carried out in the 1 pilot project. The cutting asphalt overlay also could not be carried out due to the lack of asphalt milling machine, however, by using DCP, unsuitable material was found in the area where repair works was planned and a full scale surface replacements including replacement of base course material (refer to the photos in Table 2.3-1) was conducted. It should be noted that from Ethiopian Year 2010 (2018/2019) AACRA has been proactively procuring equipment for road works, and currently owns two number of Milling Machine.

3-3 Evaluation on the Results of the Project Risk Management

3-3-1 Ownership

At the early stage of the Project, JICA Team anticipated that the key risk lead the project unsuccessful would be the lack of the sense of ownership among C/Ps and listed following counter measures to keep or nourish the sense of ownership in C/Ps.

(1) Product a Visible and Tangible Output Rapidly

At the early stage of the Project, C/Ps carried out the inspection of road condition without any apparatus which could specify the location of the damaged area. This caused significant difficulty for other staff to identify the damaged area earlier defined during the inspection due to absent of information and data shared among inspectors such as the location coordinates. In order to resolve this issue, JICA Team proposed to develop the visual inspection support system composing smart-phones and GIS as the first output which was approved under the 1st amendment of the Contract. The system was completed in late January 2016 and deployed after the handover of smart-phones to AACRA at 2 JCC held in February 2016. This system enabled AACRA' staff to implement the road inspection more efficiently, more precisely and more sophisticatedly than before. These beneficial outcomes nourished the sense of ownership in C/Ps.

(2) Create an Environment Where Experts of JICA Team were Available for Consultation at Any Time

In order to keep the sense of ownership in C/Ps, it was important to minimize the absence duration of expert(s) of JICA Team and to create an environment where JICA Team were available for consultation at any time. For this purpose, the assignment schedule was adjusted shortening the length of one stay of each member but by increasing the number of travel time of member, which allowed experts could assign alternately to cover the project period. This rescheduled assignment plan was approved by JICA.

3-3-2 Delay of Equipment Supply for PCSS

Due to the significant delay in procumbent of the PCSS equipment, a risk was anticipated that some of outputs required would not be provided within the project period. By the extension of project period approved by JICA and rearrangement of assignment schedule of JICA Team, all outputs planned were procured and are efficiently utilized by AACRA staff.

3-4 Lessons Learnt

(1) Producing an Output Rapidly to Strengthen the Sense of Ownership in C/Ps

At early stage of the project, we carried out the data collection of road condition using the Visual Inspection Support System (VISS) which have been developed by JICA Team and as the result, visual road condition survey data could be obtained in the early stage, then we started discussions on collected data utilization for road maintenance plan and evaluation of road condition. By sharing visible results among C/Ps at early stage of the project, the motivation to participate in the project has been improved and the sense of ownership of C/Ps has been strengthened.

(2) Introduction of Structural Investigation Instrument

In this project the Dynamic Cone Penetration (DCP) have been provided as a structural examination equipment.

The applicability of the equipment was discussed based on the comparison of DCP and FWD. The FWD is an equipment that enables non-destructive examination of pavement structures. However, the FWD requires very much high cost for both procurement and maintenance. In addition, the usage of FWD in urban district like Addis Ababa City will become restricted. Considering all the aspects, it is concluded that the DCP was more suitable for AACRA at this moment and was selected.

When JICA Team made decision of the DCP, we worried whether AACRA staff would utilize the DCP actively or not because the DCP was not sophisticated equipment nor had any cutting-edge technology. Two DCPs were handed over to AACRA, and through the training, the C/Ps acquired the technique in both operation and evaluation of the data obtained. Then, the opportunities for the use of DCP for the investigation of below surface was much increased.

High spec and expensive technologies are not always needed depending on the circumstances and the degree of maturity in the technology of the targeted organization. It was learned that the introduction of appropriate technology leads to the success of technology transfer.

(3) Procedure of System Development and Customization

At early stage of the project, the version-1 systems, such as VISS and RMMS with basic functions, have been developed and the OJT was started using these systems. As the OJT had been held several times, the points and functions which should be revised, updated and added in the systems became apparent. According to the requirement for these points and functions, the systems have been modified, updated and customized several times during the project period and the systems became user friendly systems.

Thus, these facts such as to spare sufficient time for OJT and discussion, and to build up user friendly systems through updating and customization contributed to nourish the sense of ownership in the C/Ps.

(4) Open Source System for Continuous Operation and Updating

In order to manage the road maintenance work properly for long term, it is required that road maintenance data of each year are accumulated continuously. Computer system technology is advancing rapidly and, therefore, it can be expected that the systems developed in the project will become obsolete within several years and system replacement will become necessary. Even if it is the case, accumulated data such as inspection and maintenance data can be reused in the new system if the interface between database and new system is harmonized with both systems.

From the above viewpoints, we learned that all source codes of the systems should be released so that system update and customization would be possible after the project completion by C/Ps. Moreover, the methodologies for updating and upgrading system was discussed with IT experts in AACRA as a part of technology transfer. As a result, it can be concluded that the environment which can make it possible to utilize the systems continuously after project completion was constructed.

CHAPTER 4 FOR THE ACHIEVEMENT OF OVERALL GOALS AFTER THE PROJECT COMPLETION

4-1 Prospects to Achieve Overall Goal

In the original PDM, the overall goal of the Project was "Three years after the completion of the Project, 1. XX % of roads under AACRA is below the targeted roughness of YY. 2.The length(km) of road under AACRA inspected by the standardized method is increased by XX % compared to 3 months before the project completion".

(1) Overall Goal No. 1

Due to the absent of data of IRI in AACRA prior to the Project, the target values of the overall goal 1 was not able to set at the start of the Project. The value could be set only after the IRI results of for each strategic road (RR, PAS and SAS) were obtained by PCSS at the end of the April 2018 (Ethiopian Year 2010).

The results of IRI surveyed for each strategic road are shown in Table 4-1-1.

Table 4-1-1 Results of IRI in 2017-2018

Road Class	IRI Average(mm/m)	IRI < 3.5	IRI < 6.0
Ring Road	3.76	60.8%	90.9%
PAS	4.72	49.3%	77.5%
SAS	6.21	28.6%	60.5%
Total	5.00	45.1%	74.5%

Base on the results shown above, the overall goal 1 was amend to "Three years after the completion of the Project, 1. 60% of Strategic Roads (RR, PAS and SAS) is below the targeted roughness of 3.5", agreed by C/P and approved in the 7th JCC held on October 4, 2018. In other words, in the 3 years after the project completion, AACRA has to maintain the road condition of the strategic road as the same to the existing RR through the future maintenance works.

(2) Overall Goal No. 2

As for the overall goal no.2, JICA Team recommended to insert 90% as the target value of the asphalt paved road length such as RR, PAS, SAS and Collector Road that will be inspected by the standardized method based on the following reasons.

- In the Ethiopian year 2010 (2017/2018) AACRA inspected, by use of the standardized method (PCSS or VISS), more than 90% of the strategic roads (RR, PAS and SAS) which are the targeted roads in this project.
- In addition to above, AACRA started to inspect collector roads by VISS in their own discretion and expressed their intention to expand further the application of VISS method for the inspection of collector roads.
- Considering the positive attitude of AACRA staff, JICA team concluded that it would be possible to inspect 90% of road managed by AACRA by use of the standardized method (VISS) three years after the completion of the project.

This recommendation was discussed in the 7th JCC and approved as the target value of the overall goal no. 2.

Through AACRA properly keep utilizing all products introduced under the Project and applying the PDCA Cycle, AACRA will achieve the overall goals in the road maintenance of Addis Ababa City.

4-2 Recommendation for the Japan and Ethiopian Side

4-2-1 Japan Side

Even though the project period was extended one year from the original plan, the duration of the Project is fairly limited. It was very much challenging to complete all procedures including technology development, technology transfer and institutional arrangement to realize project outputs within 4 years of the project period. In particular, it was very difficult for JICA Team to present recommendations for the institutional arrangement because (1) a large-scale organizational reform was made in November 2016, and (2) further restructuring is still under consideration as of March 2019. The final form of the AACRA's organization very much depends on the restructuring of the Addis Ababa City which is in progress. Therefore, AACRA could not prepare any action plan nor roadmap. For this reason, it is recommended that JICA keep monitor the progress of institutional arrangement and conduct a follow-up study upon the request by AACRA.

4-2-2 Ethiopian Side

(1) Hierarchy of PDCA Cycle

In this Project AACRA learned how to operate and manage the road maintenance work in accordance with the PDCA cycle. JICA Team sincerely hopes that AACRA will extend the application of process of PDCA cycle into other activities as well. PDCA cycle management can be applied in the implementation of each activity of the PDCA cycle for the umbrella works. As illustrated in Figure 4-2-1, the relationship between the implementation of works based on the mid and long-term plan (umbrella works) and annual implementation works is an activity of "Do" of the PDCA cycle.

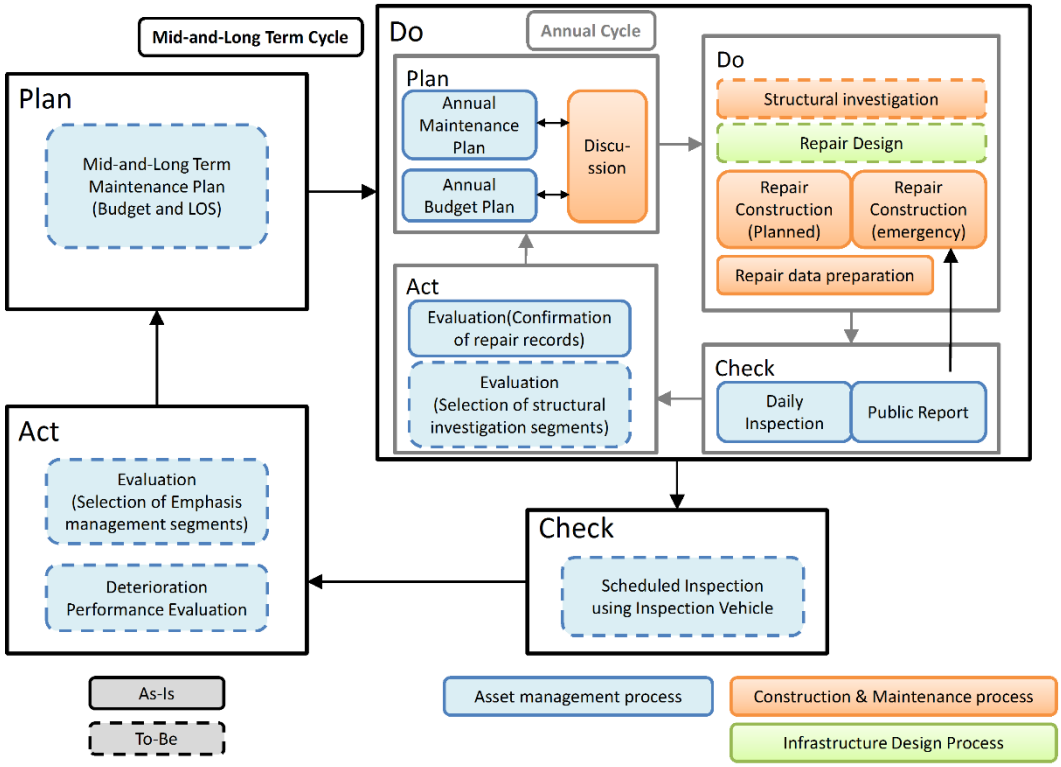


Figure 4-2-1 Hierarchical PDCA Management Cycle

(2) Conduct Continuous Data Collection

It is important to accumulate data continuously and evaluate the performance of the road for the implementation of reliable road maintenance.

Deterioration Performance Evaluation assess the deterioration rate of the road using the latest inspection data. By accumulating data continuously and performing Deterioration Performance Evaluation every year, it is possible to monitor the changes in average performance. Furthermore, with Bench-Marking Evaluation, it is possible to extract locations where deterioration is rapid. This evaluation method can also periodically evaluate and monitor the change of the deterioration rate.

(3) Authorization of Duties and Rights to System Engineers in IT Department

Management of the systems (RMMS and VISS) shall be done under initiative of the IT experts in IT Department in AACRA. JICA Team handed over all program sources to AACRA and asked IT Department to control the source and deal with the required customization.

In the customization of systems, it requires to harmonize with other systems and, therefore, AACRA senior management, we sincerely request, should authorize the following duties and rights to system engineers in IT Department.

- Management of the program source of the systems
- Update and customization of systems and database
- Minor refurbishment, independent from database (ex. System interface)
- Training of system operation
- Others (related the system technology)

4-3 Monitoring Plan from the End of the Project to Ex-Post Evaluation

JICA conducts Ex-post evaluations of the ODA projects to assess the relevance, effectiveness, efficiency, impacts and sustainability of each project on the basis of international evaluation criteria (DAC Evaluation Criteria). DAC evaluation indices, mentioned in the Chapter 3 of this report, will be re-assessed again during ex-post evaluation. Ex-post evaluations are carried out for the projects two years[3] after completion in principle so as to ensure full accountability and to enhance effectiveness and efficiency of ODA operations.

As for this Project also, JICA may carry out ex-post evaluation as per JICA's standard practices. Moreover, JICA also regularly monitor the project output developed under the Project from end of the Project until the ex-post evaluation as suggested tentatively in below.

- JICA Ethiopia Office will regularly monitor the project outputs whether they are practically and continuously applied by AACRA to achieve the overall goal of the Project.
- JICA may inquire about the progress achieving of the overall goals based on AACRA's roadmap which will be announced soon.
- If JICA find the necessity of dispatching expert(s) to confirm the progress achieving the overall goal, the dispatched expert(s) will conduct follow up study to assess the progress and/or to support AACRA effectively utilizing the project output.
- If any technical difficulties are occurred in using the project output especially PCSS and/or RMMS, JICA and AACRA may discuss to overcome the difficulties jointly. It should be noted that the manufacturer of PCSS will keep the communication window open in case their help is required.

[3] https://www.jica.go.jp/english/our_work/evaluation/oda_loan/post/index.html

APPENDICES

APPENDIX-1: RESULTS OF THE PROJECT

(1) List of Experts

Table A-1.1 List of JICA Experts

SN	Position/Responsibility	Name	Remarks
1.	Team Leader Chief Advisor/Road Maintenance	Mr. Hiroshi HONDA	KEI
2.	Deputy Chief Advisor/ Road Maintenance/ Maintenance Management System	Dr. Kazuya AOKI	PASCO
3.	Road Maintenance Plan	Mr. Seiji KADOOKA/ Mr. Hidemasa NOBUTANI/ Ms. Yayoi NISHIHAMA	PADECO
4.	Inspection System Development	Mr. Katsuya HOMMA	PASCO
5.	Road Inspection (Site Survey)	Mr. Yoshiyasu TSUCHIYA/ Mr. Ryousuke KANEKO	PASCO
6.	Road Inspection (Database)	Mr. Kohei SAKAI	PASCO
7.	Road Maintenance Design	Mr. Keiichi MURAKAMI	KEI
8.	Construction Supervisor	Mr. Kiyoshi MUKAI	KEI
9.	Training Plan	Ms. Chiaki YAMADA	PADECO
10.	Monitoring	Ms. Naomi ICHIMIYA/ Ms. Akiko MIYAKAWA	KEI
11.	Theory of Pavement Deterioration	Dr. Kiyoshi KOBAYASHI	KEI

(2) List of Counterparts

The following Ethiopian counterparts were assigned by AACRA.

Table A-1.2 List of Ethiopian Counterparts

SN	Name	Position in AACRA	Role/Responsibility in Project
1	Mr. Demelash G/Marian	Deputy Director General	Project Director
2	Mr. Asnake Adraro	Director of RAM and Database Directorate, ICT Group	Project Manager
3	Ms. Mesert Abera	Team Leader RAM and Database, Road Network Management	Counterpart Engineer
4	Mr. Abel Wube	Civil Engineer, RAM and Database	Mid/Long Term planning
5	Mr. Tesfaye Abdissa	Civil Engineer, RAM and Database	O&M of PCSV data collection and processing
6	Mr. Yehenaw Getachew	Senior GIS Expert, RAM and Database	O&M of Visual inspection and RMMS database
7	Mr. Abiy Shiferaw	Surveyor, RAM and Database	O&M of PCSV data collection and processing, support
8	Mr. Dawit Melkamu	Junior Civil Engineer, RAM and Database	O&M of PCSV data collection and processing, support
9	Ms. Hirut Tektel	Senior Civil Engineer, RAM and Database	Project Progress follow up
10	Ms. Hiwot Samuel	Director, South Regional RAM	Regional counterparts
11	Ms. Bethlhem Hailu	Director, West Regional RAM	Regional counterparts
12	Mr. Ismael Seid	Director, North Regional RAM	Regional counterparts
13	Mr. Belay W/Aregay	Director, Central Regional RAM	Regional counterparts
14	Mr. Lijalem Yalew	Director, East Regional RAM	Regional counterparts
15	Mr. Mekonen Tibebu	Director, Own Force Road Maintenance Directorate	Road Maintenance
16	Mr. Solomon Tesfaye	Project Manager Lot 1, Own Force Road Maintenance Directorate	Road Maintenance

Note: Some C/P members were replaced by new members.

(3) List of Trainings

- **Training in Ethiopia**

Table A-1.3 shows the implementation summary of Lecture, Workshop and OJT.

Table A-1.3 Summary of Lecture, Workshop and OJT

Training Courses		Style	Date	Participants No.
A Training for Activity 2-2: Conduct Road Inspections in the City				
A1 Visual Inspection (Emergency Patrolling)	A1-1: Concept of Emergency Patrolling	Lecture	11 Sep. 2015	11 RAM members
	A1-2: How to Carry Out Emergency Patrolling	Lecture	14 Sep. 2015	RAM members
		Lecture	9 Oct. 2015	11 RAM members
		OJT	15-22 Sep. 2015	11 RAM members
	A1-3: How to Process Geo-tagged Photographs	Lecture	15 Sep. 2015	11 RAM members
		OJT	16-22 Sep. 2015	11 RAM members
A2 Visual Inspection (Periodic Inspection)	A2-1: Revision of Visual Inspection	Lecture	15, Jun. 2016	13 RAM members
		Lecture	20 Jun. 2016	13 RAM members
		Lecture	22 Jun. 2016	13 RAM members
	A2-2: Visual Inspection Using Mobile System	Lecture	17 Feb. 2016	11 RAM members
		Lecture	23 Feb. 2016	RAM members
		Lecture	8 Mar. 2016	RAM members
		Lecture	18 Apr. 2016	RAM members
		Lecture	24 Oct. 2016	RAM members
		Lecture	25 Jul. 2017	RAM members
		OJT	3 Feb. 2016	11 RAM members
		OJT	20 Apr. 2016	11 RAM members
		OJT	22 Jan. 2019	14 RAM members
		OJT	28 Jan. 2019	9 RAM members
	A2-3: Data Input to RMMS	OJT	01 Oct. 2019	8 RAM members
		OJT	29 Jan. 2019	8 RAM members
A3 Scheduled Inspection	A3-1: Introduction of Inspection Vehicle	Lecture	20 Aug. 2015	11 RAM members
		Lecture	1 Feb. 2017	RAM members
	A3-2: Revision of Visual Inspection	Lecture	15 Oct. 2016	12 RAM members
		OJT	22 Jan. 2019	14 RAM members
	A3-3: Training for Operation of PCSV and Analysis of the Data.	Lecture	1– 13 Feb. 2017 (9 days)	20-25 RAMDD members (Morning)
	A3-4: Training for Operation of PCSV and Analysis of the Data (Field Work).	OJT	1– 13 Feb. 2017 (9 days)	20-25 RAMDD members (Afternoon)
		OJT	28 Jan. 2019	9 RAM members
	A3-5: PCSV System Maintenance	Lecture	22 Sep. 2017	RAMDD members
	A3-6: Mobile Data Registration Method	OJT	11 Oct. 2017	RAM member
	A3-7: Vehicle Inspection Review	Lecture	26 Jan. 2018	8 RAM members
		OJT	24 Jan. 2019	12 RAM members
	A3-8: Follow up Mobile Inspection System and Data Registration 2	Lecture	29 Jan. 2018 30 Apr. 2018	7 RAM members 5 RAM members
	A3-9: Mobile Inspection and Data Registration	OJT	30 Jan. 2018 30 Apr. 2018 1 Oct. 2018	5 RAM members 5 RAM members 6 RAM members

Training Courses		Style	Date	Participants No.
B Training for Activity 2-3: Develop and Update the Road Inventory (Database) of AACRA				
B1 Restructuring of Road Network	B1-1: Concept of Revised Road Network System (Road Numbering)			
	B1-2: Setup of Road Network Inventory	Lecture	29 Oct. 2015	10 RAM members
		Lecture	16 Dec. 2015	10 RAM members
		OJT	16-27 Dec. 2015	10 RAM members
B2 GIS	B2-1: GIS Database Preparation for CS Roads	Lecture	26 Jan. 2018	7 RAM members
B3 Database Maintenance	B3-1: Items to be Updated and Frequency (Intensive Training)	OJT	22 Jan.-1 Feb. 2019	8 RAM members
		OJT	20 May-24 May 2019	10 RAM members
C Training for Activity 2-4 and 2-5: Prepare and Revise Short/Medium/Long Term Road Maintenance Plan				
C1 Road Priority and Service Level	C1-1: Road Priority and Service Level for AACRA	Lecture	19 May. 2016	11 RAM members
C2 Road Management System– Kyoto Model	C2-1: Introduction of Kyoto Model	Lecture	11 Aug. 2016	11 RAM members
		Lecture	20 Aug. 2015	11 RAM members
		Lecture	26 Jul. 2017	RAM members
C3 Mid/long-term Maintenance Planning	C3-1: Difference between Kyoto Model Result and Mid/long-Term Plan		Conducted as the seminar in Apr.	
	C3-2: Mid/long-term Maintenance Planning	Lecture	26 Jul. 2017	RAM members
		OJT	22 Feb. 2019	12 RAM members
C4 Annual Maintenance Planning	C4-1: Annual Maintenance Planning	Lecture	11 Sep. 2015	3 RAM members
		Lecture	19 May 2016	RAM members
		OJT	6 May 2016	6 RAM members
		OJT	18 & 22 Apr. 2019	12 RAM members
D Training for Activity 3-3: Conduct Detailed Investigation and Design Technical Specification				
D1 Type of Deterioration of Pavement	D1-1: Type of Damage Maintenance	Lecture	2 Aug 2016	5 Member of RAM, 1 RTD, 1 Laboratory Member
		Lecture	9 Aug. 2016	5 Member of RAM, 1 RTD, 1 Laboratory Member
	D1-2: Repair Method of Damage (Construction Method)	Lecture	19 Aug 2016	5 Member of RAM, 1 RTD, 1 C&M Member
D2 Repair Method	D2-1: Selection of Repair Method	Lecture	15 Sep. 2016	at the 3rd JCC
D3 Structural Instrument	D3-1: Selection of Inspection Instrument	Lecture	15 Sep. 2016	Member of Laboratory (Research and Technology Adaptation technology)
	D3-2: Introduction Dynamic Cone Penetrometer	Lecture	28 Jul. 2017	Member of Laboratory
	D3-3: Introduction UK DCP 3.1	Lecture	2 Aug. 2017	Member of Laboratory
	D3-4: Method and Procedure of Maintenance Design	OJT	7 Nov. 2017	Construction and Design
E Training for Activity 3-4 and 3-5: Assist AACRA to execute pilot projects & feedback achievement & experience				
E1 Preparation of Pilot	E1-0: Joint Site Investigation	OJT	28 Oct. 2016	2 from Construction, 2 from RAM

Training Courses		Style	Date	Participants No.
Project	E1-1: Selection of Construction Method	Lecture	11 Nov. 2016	10 members of C&M
	E1-2: List up of Material, Equipment, Signboard, Manpower	Lecture	14. Nov. 2016	2 members of C&M
	E1-3: Joint Site Inspection	OJT	16 Oct. 2017	5 C&M
E2 Preparation & Confirmation of Asphalt Mix	E2-1: Check Asphalt Mix Design	Lecture	29-30 Oct. 2016	5 members
	E2-2: Trial Mix and Test the Contents of Each Material	Lecture	22 Nov. 2016	3 members of C & M
	E2-3: Temperature Management of Hot Mix	OJT	29 Nov. 2016	2 members of C&M
E3 Improper Work	E3-1: Procedure of Work & Temperature Management	Lecture	11 Nov. 2016	10 members of C&M
	E3-2: Typical Mistake during the Work	Lecture	18 Nov. 2016	6 members of C&M
E4 Repair Method	E4-1: Crack sealing and Safety Measures	OJT	23 Nov. 2016	Engineers and Site Supervisors
	E4-2: Patching and Pothole patching and Safety Measures	OJT	24 Nov. 2016	
		OJT	25 Nov. 2016	
		OJT	28 Nov. 2016	
		OJT	29 Nov. 2016	
		OJT	2 Dec. 2016	
		OJT	3 Dec. 2016	
		OJT	30 Nov. 2016	
		OJT	1 Dec. 2016	
	E4-3: Implementation Methodology	OJT	14 Jan. 2018	

In addition to the above mentioned trainings, 2 seminars were held as follows.

Table A-1.4 Record of Seminar

Seminar	Held on	Venue	Attendance
1st Seminar	April 18, 2017	Friendship hotel	94 people
2nd Seminar	May 10, 2019	Raddison Blu hotel	72 people

First Seminar (Dr. Kobayashi)

Second Seminar (Dr. Kinoshita)

- **Training in Japan**

In this Project the training in Japan was conducted in 2016 and 2017 respectively.

Table A-1.5 Record of Training in Japan

Training in Japan	Duration	Key Places Visit	Participator
1st Training	Aug. 23 ~ Sep. 7, 2016	MLIT, MECL, Kyoto Univ. and Kyoto City	5 people
2nd Training	Aug. 23 ~ Sep. 7, 2017	Koshigaya City, Nagaoka Univ., NERI and Yokohama City	5 people

APPENDIX-2: LIST OF PRODUCTS

Table A-2.1 shows the Project outputs by Project measures.

Table A-2.1 List of Project Outputs

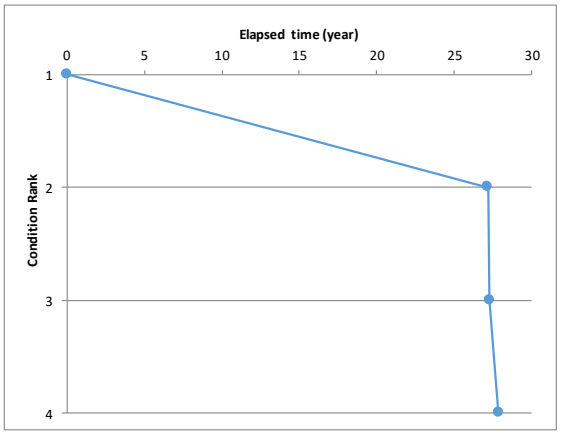
Category	Output
System & Database	Visual Inspection Support System (Mobile Application) with Source Code Road Maintenance and Management System (RMMS) with Source Code Road Inventory Database Road Inspection Database Maintenance Information Database
Equipment	Pavement Condition Survey System with Vehicle Structural Investigation Instrument (DCP) (2 sets)
Plan	Annual Maintenance Plan Mid-Long-term Maintenance Plan
Manual & Handbook	Road Maintenance Handbook Road Inspection Implementation Manual Mobile Inspection System Operation Manual Pavement Condition Survey Implementation Manual Manual for Pavement Investigation Using Dynamic Cone Penetrometer Road Maintenance Plan Guideline Road Maintenance and Management System (RMMS) Implementation Manual Road Maintenance and Management System (RMMS) Operation Manual Road Maintenance and Management System (RMMS) Analysis Module Operation Manual
Guideline	Report on Calibration and Check the Survey System The Specification of the Pavement Condition Survey System The Specification of the Installed Equipment Information about System Support Service Mobile Inspection Support System Design Document Database Definition Document Document of RMMS System Design
PR	Promotion Video – Road Asset Management in AACRA
Training	1st Seminar hand out (April 2017) 2nd Seminar hand out (May 2019) Report of 1st Training in Japan (Sep. 2016) Report of 2nd Training in Japan (Sep. 2017)

APPENDIX-3: RESULS OF DETERIORATION EVALUATION

Estimation Results
01_deterioration **Damage type** Severity
001_Average

Hazard rate	t-value	Rank	Expected life length(year)
0.037	20.9742	1	0
9.226	6.3816	2	27.17
1.732	12.5799	3	27.28
-	-	4	27.86

Deterioration Curve



Deterioration Transition Probabilities

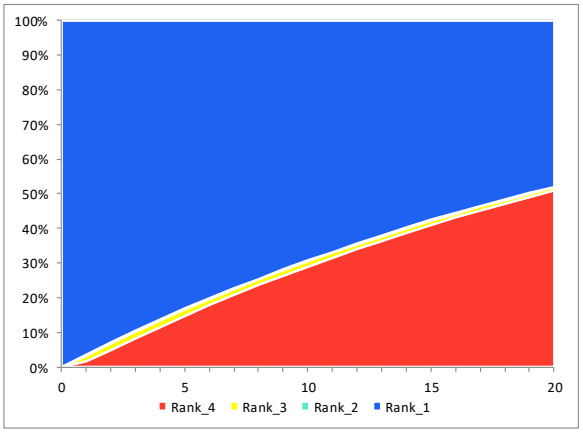
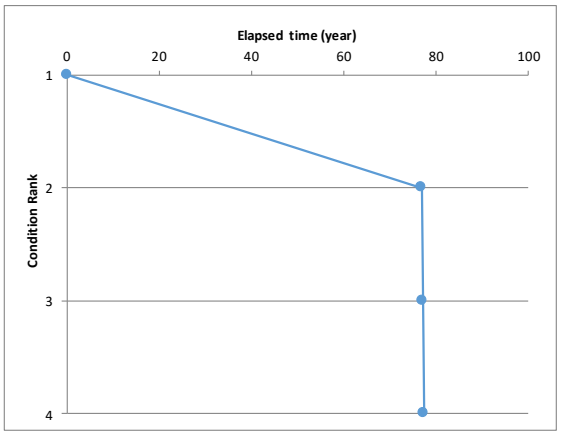


Figure A-3.1 Results of Deterioration Performance Evaluation for Severity

Estimation Results
01_deterioration **Damage type** Crack
001_Average

Hazard rate	t-value	Rank	Expected life length(year)
0.013	12.4898	1	0
4.303	5.6955	2	76.92
5.375	5.5088	3	77.16
-	-	4	77.34

Deterioration Curve



Deterioration Transition Probabilities

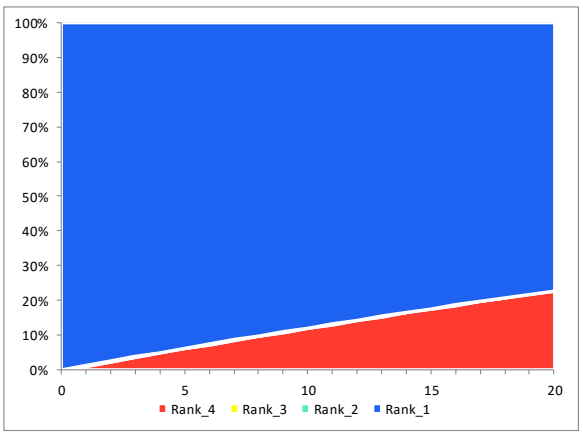
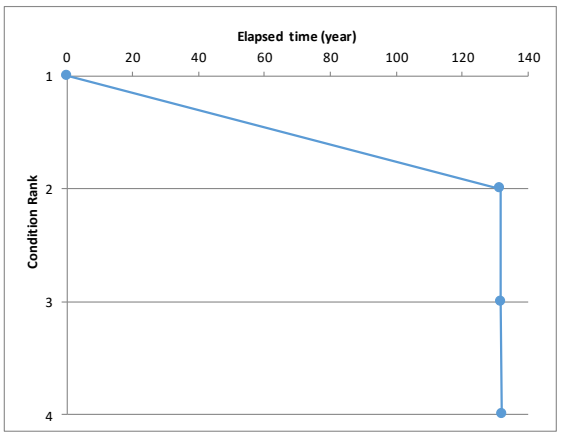


Figure A-3.2 Results of Deterioration Performance Evaluation for Crack

Estimation Results
01_deterioration **Damage type** Rut
001_Average

Hazard rate	t-value	Rank	Expected life length(year)
0.008	9.5916	1	0
5.500	3.8405	2	131.58
4.398	4.1797	3	131.76
-	-	4	131.99

Deterioration Curve



Deterioration Transition Probabilities

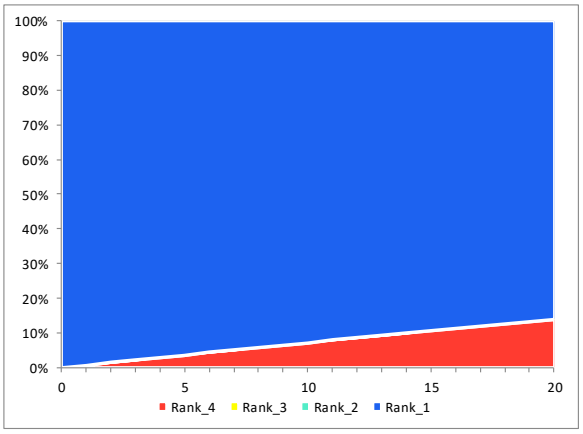
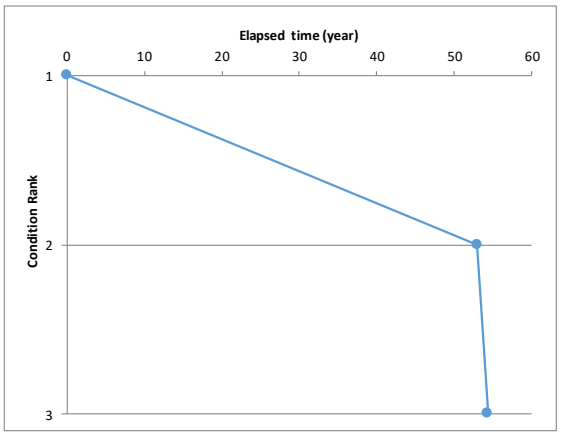


Figure A-3.3 Results of Deterioration Performance Evaluation for Rut

Estimation Results
01_deterioration **Damage type** Raveling
001_Average

Hazard rate	t-value	Rank	Expected life length(year)
0.019	15.0329	1	0
0.715	8.5131	2	52.91
-	-	3	54.31

Deterioration Curve



Deterioration Transition Probabilities

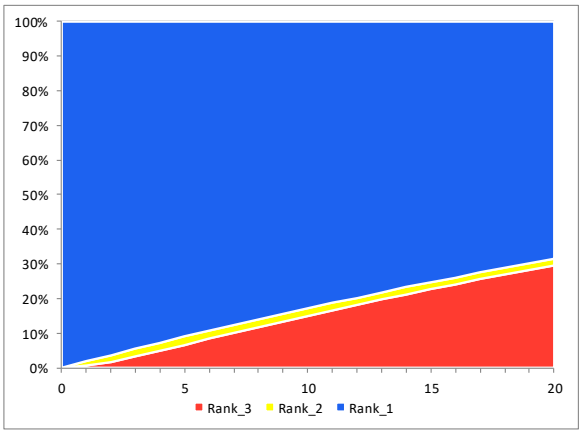


Figure A-3.4 Results of Deterioration Performance Evaluation for Raveling

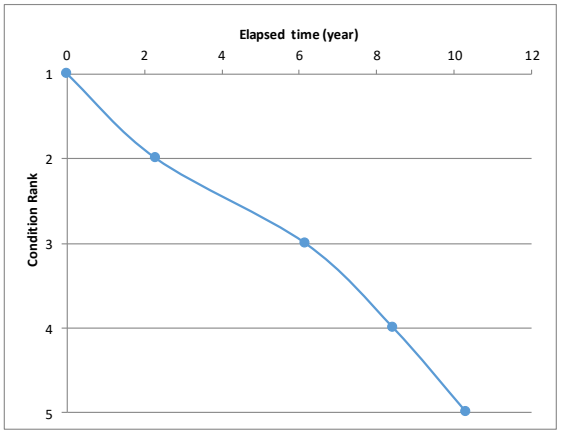
Estimation Results

01_deterioration **Damage type** IRI

001_Average

Hazard rate	t-value	Rank	Expected life length(year)
0.435	17.3806	1	0
0.260	23.3349	2	2.30
0.440	22.1959	3	6.15
0.529	17.6403	4	8.42
-	-	5	10.31

Deterioration Curve



Deterioration Transition Probabilities

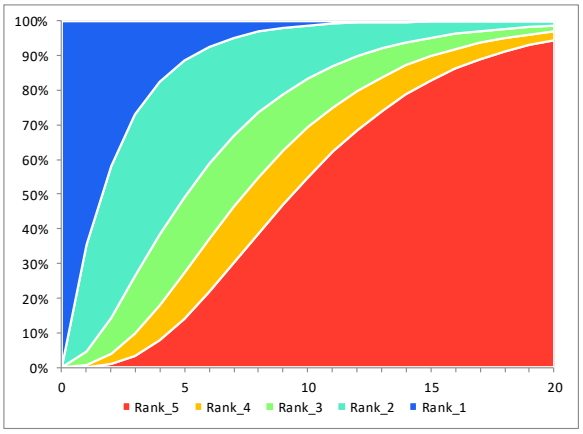
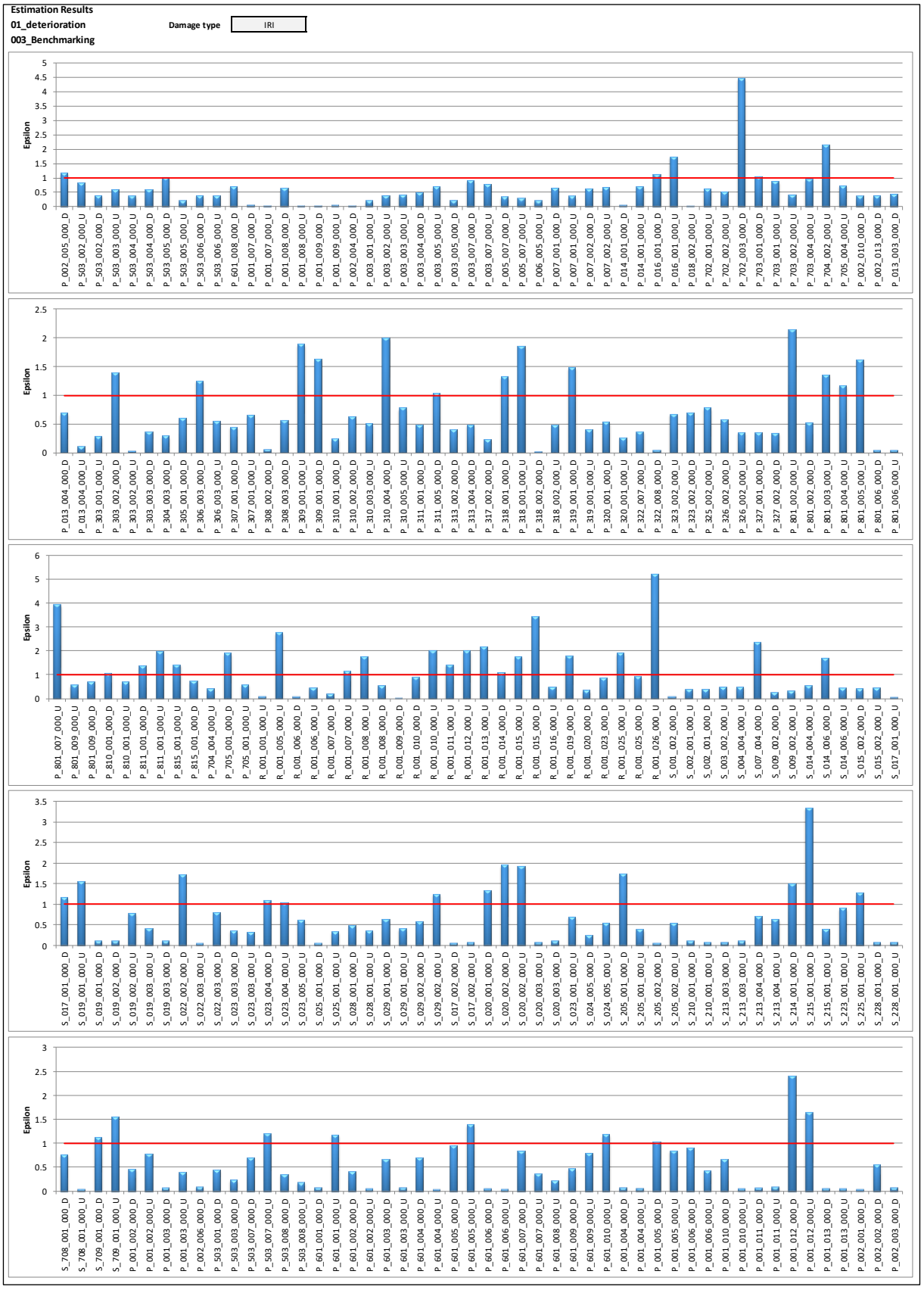


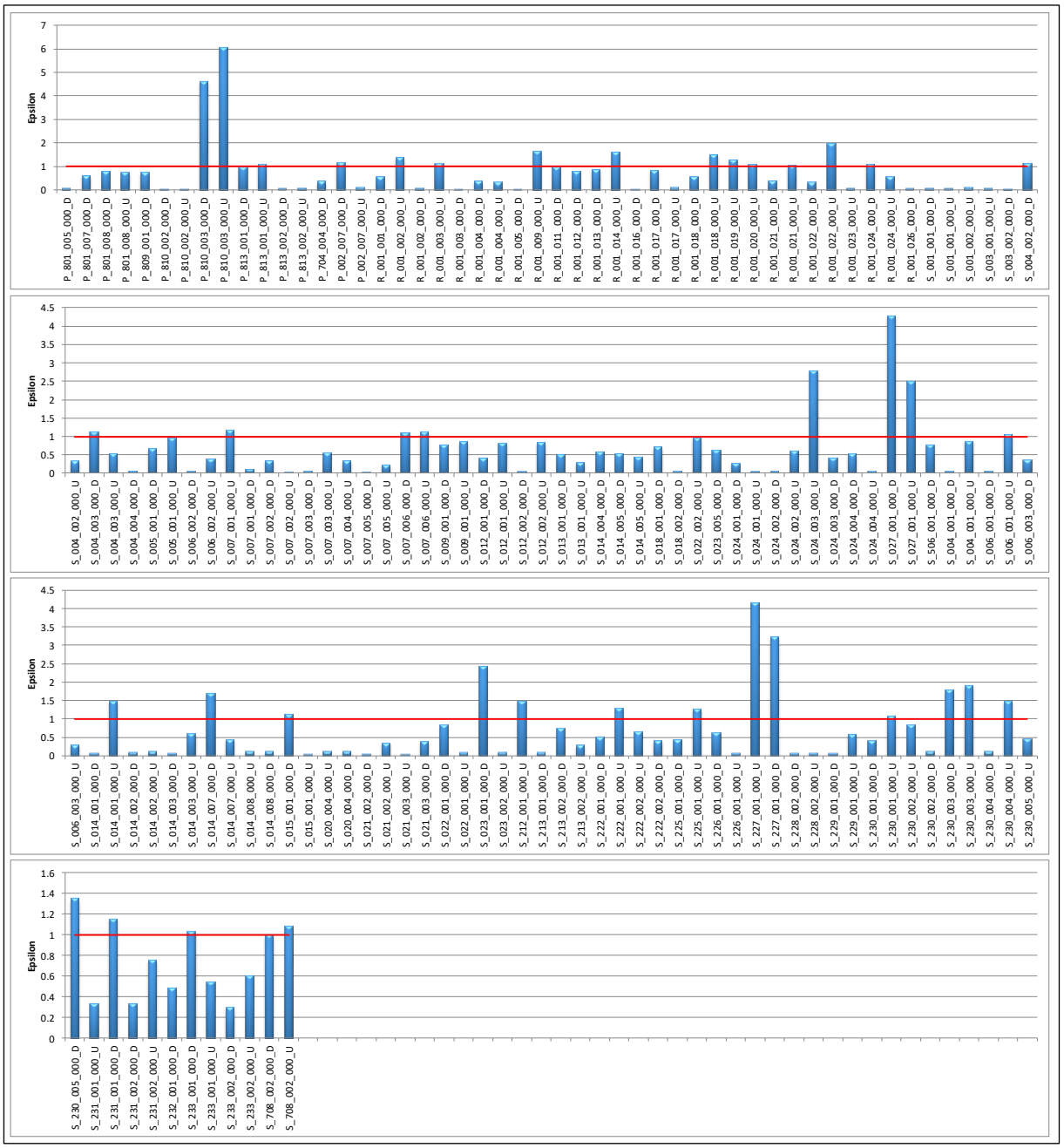
Figure A-3.5 Results of Deterioration Performance Evaluation for IRI

Results of Bench-Marking Evaluation for IRI (1/3)



Results of Bench-Marking Evaluation for IRI (2/3)

Results of Bench-Marking Evaluation for IRI (3/3)



The Federal Democratic Republic of Ethiopia
Addis Ababa City Roads Authority

Project for Development of Road Maintenance Capacity of Addis Ababa City

Project Completion Report

Appendix 4: PDM (All Versions)

June 2019

Japan International Cooperation Agency

KATAHIRA & Engineers International
PADECO Co., Ltd.
PASCO CORPORATION

Project Design Matrix

Project Title: Project for Development of Road Maintenance Capacity of Addis Ababa City
Implementing Agency: Addis Ababa City Roads Authority (AACRA)
Target Group: Staff of Addis Ababa City Roads Authority (AACRA)
Period of Project: 10/Jul/2015 - 9/Jul/2018
Project Site: Addis Ababa City **Model Site: Pilot project sites are to be determined**

Version 1
Revision Dated 8/Aug/2015

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal	Three years after the completion of the Project,				
The roads in Addis Ababa City are maintained in a sustainable way.	1. XX % of roads under AACRA is below the targeted roughness of YY%.	1. Road inventory in Addis Ababa City			
	2.The length(km) of road under AACRA inspected by the standardised method is increased by XX % compared to 3 months before the project completion.	2. Road inventory in Addis Ababa City			
Project Purpose	By 3 months before the completion of the Project,		1.Human resources necessary for the road maintenance are continuously assigned by AACRA. 2.Financial resources are allocated by the City Administration and Road Funds Agency in a sustainable manner.		
The management capacity of AACRA for road maintenance is enhanced.	1. The self-rating of AACRA staff on their management capacity for road maintenance exceeds XX % on the average.	1. Interview to AACRA management staff: Baseline and Annual interviews			
	2. Road maintenance works based on PDCA*1 cycle established by the Project are executed by AACRA.	2. The PDCA Checklist			
	3. The assessment of AACRA's capacity to secure the budget for road maintenance exceeds XX% on the average.	3. Questionnaire survey/Interview to Addis Ababa City Administration and Road Funds Agency: Baseline and			
Outputs					
1. The implementation structure of AACRA for road maintenance is improved.	1-1. Suggestions for improving the implementation structure of AACRA for road maintenance is compiled and presented to the 2nd JCC February 2016.	1-1. The complied suggestions, the Project meeting record	The AACRA staff capacitated by the Project continue to work for their respective positions.		
	1-2. Road map to act on the suggestions is prepared by April 2016, to be incorporated into the budget FY Jul/2016 - Jun/2017 if necessarily.	1-2. The Road Map, Minutes of JCC			
	1-3. More than XX% of the requested budget on the basis of the annual road maintenance plan are allocated since the 3rd project year.	1-2.The baseline Data, AACRA annual report			
2. The process for formulating road maintenance plans is established.	2-1. PDCA Checklist is developed by January 2016.	2-1. The developed PDCA checklist, JCC minutes			
	2-2. AACRA Annual road maintenance plan contains necessary items based on the PDCA checklist since the beginning of the 3rd project year.	2-2 The PDCA Checklist, ACCRA annual road maintenance plan			
	2-3 The percentage of the implemented road maintenance works to all the maintenance works in the AACRA annual road maintenance plan exceeds XX% since the 3rd project year.	2-3 The baseline data, AACRA annual road maintenance plan, AACRA annual report,			
3. The maintenance skills and knowledge of AACRA technical staff are improved.	3-1.The self-rating of AACRA technical staff on their maintenance skills and knowledge exceeds XX% on the average at 3 months before the project completion.	3-1. Test and questionnaire survey to AACRA technical staff: Baseline and Endline			
	3-2.The ratio of preventive maintenance works to all the maintenance works is increased by XX % in the City compared to before the commencement of the Project at the beginning of the 3rd project year.	3-2. The baseline data, AACRA annual report, AACRA annual road maintenance plan			

Activities	Inputs		Important Assumption
	The Japanese Side	**The Ethiopian Side**	
1-1 Review Implementation Structure of AACRA, and compile suggestions for the structure improvement	1. Experts ・Chief Advisor/Road Maintenance ・Road Maintenance Planning ・Road Inspection ・Maintenance Management System ・Maintenance Design ・Construction Supervision ・Training Planning ・Others as necessary 2. Training of counterpart personnel, including Project Director and Project Manager, in Japan and/or the Third Countries 3. Provision of machinery and equipment ・Inspection Equipment ・Maintenance Management System ・Structural Investigation Equipment ・Others 4. Local expenses for the project activities as necessary	1. Personnel ・Project Director ・Project Manager ・Counterpart personnel 2. Provision of the project office and facilities necessary for the project implementation 3. Traffic survey and pilot projects in Addis Ababa City 4. Administrative and operational expenses necessary for the project implementation ・Electricity, water, communication, etc. ・Local traveling costs and daily subsistence allowance (DSA) for counterpart personnel 5. Others as necessary	1. The turnover of AACRA staff does not profoundly affect the project activities. 2. Natural disasters, such as floods, do not profoundly affect the project activities.
1-2 Convene Technical Advisory Committee (TAC)			**Pre-Conditions**
1-3 Prepare a training plan for AACRA Staff			Understanding and cooperation on road maintenance in the City are obtained from the project stakeholders such as the City Administration, Addis Ababa City Road and Transport Bureau, Road Funds Agency, etc.
1-4 Conduct training of AACRA staff for road maintenance: road inspection, maintenance planning, maintenance management system, etc.			
1-5 Share Information of road conditions in the City with Road Funds Agency and the City Administration to request the budget for road maintenance			
1-6 Promote public relations (PR) activities on road maintenance in the City			
2-1 Review the road maintenance cycle of AACRA, compile the PDCA checklist, and revise the checklist if needed			
2-2 Conduct road inspections in the City			
2-3 Develop and update the road inventory (database) of AACRA, including road condition, traffic volume, unit costs, etc.			
2-4 Prepare and revise a medium-long-term road maintenance plan based on the above inventory data			
2-5 Prepare the annual road maintenance plan			<Issues and countermeasures>
3-1 Select pilot projects for maintenance works from the annual road maintenance plan			
3-2 Share the information of pilot projects between/within Road Asset Management Process and Construction and Maintenance Process			
3-3 Conduct the detailed investigations and design specifications of the pilot projects			
3-4 Assist AACRA to execute pilot projects			
3-5 Feedback the achievements and experiences of pilot projects into the next annual road maintenance plan			
3-6 Organize a workshop/seminar of the pilot projects for Ethiopian Roads Authority (ERA) and road agencies at regional and municipal level			

Project Monitoring Sheet I(Revision of the Project Design Matrix)

Project Title: Project for Development of Road Maintenance Capacity of Addis Ababa City

Version 2
Dated 18th Feb,2016

Implementing Agency: Addis Ababa City Roads Authority (AACRA)
Target Group: Staff of Addis Ababa City Roads Authority (AACRA)
Period of Project: 10/Jul/2015 - 9/Jul/2018 Project Site: Addis Ababa City Model Site: Pilot project sites are to be determined

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal	Three years after the completion of the Project,				
The roads in Addis Ababa City are maintained in a sustainable way.	1. XX % of roads under AACRA is below the targeted roughness of YY%.	1. Road inventory in Addis Ababa City			
	2.The length(km) of road under AACRA inspected by the standardized method is increased by XX % compared to 3 months before the project completion.	2. Road inventory in Addis Ababa City			
Project Purpose	By 3 months before the completion of the Project,		1.Human resources necessary for the road maintenance are continuously assigned by AACRA.		
The management capacity of AACRA for road maintenance is enhanced.	1. AACRA's capacity to secure the budget for road maintenance is enhanced.	1. Interview to Addis Ababa City Administration and Road Funds Agency: Baseline and Endline data			
	2. Road maintenance works based on PDCA*1 cycle established by the Project are executed by AACRA.	2. The PDCA Checklist	2.Financial resources are allocated by the City Administration and Road Funds Agency in a sustainable manner.		
	3 The percentage of the implemented road maintenance works against all the maintenance works scheduled in AACRA Annual Road Maintenance Plan, exceeds XX% since the 3rd project year.	3 The baseline data, AACRA Annual Road Maintenance Plan, AACRA annual report,			
Outputs					
1. The implementation structure of AACRA for road maintenance is improved.	1-1. Suggestions for improving the implementation structure of AACRA for road maintenance is compiled and presented at the 5th JCC August 2017.	1-1. The complied suggestions, the Project meeting record	The AACRA staff capacitated by the Project continue to work for their respective positions.	In progress	
	1-2. Road map on institutional strengthening to act on the suggestions is prepared by AACRA, by August 2017 to be incorporated into the budget FY Jul/2017 - Jun/2018 if necessarily.	1-2. The Road Map, Minutes of JCC			
	1-3. More than XX% of the requested budget on the basis of Annual Road Maintenance Plan are allocated since the 3rd project year.	1-3.The baseline Data, AACRA annual report			
	1-4 Trainings on road maintenance is conducted targeting AACRA staff	1-4. Training Record		In progress	
	1-5 Public understanding and cooperation on road maintenance is enhanced.	1-5. PR outputs			
2. The process for formulating road maintenance plans is established.	2-1. PDCA Checklist is developed by January 2016.	2-1. The developed PDCA checklist, JCC minutes		In progress	
	2-2. AACRA Annual and Mid/Long term Road Maintenance Plan contains necessary items based on the PDCA checklist are formulated using Road Maintenance Management System developed under the Project, from the beginning of the 3rd project year.	2-2 The PDCA Checklist, ACCRA Annual and Mid/Long term road maintenance plan, Road Maintenance Management System			
	2-3.AACRA Annual and Mid/Long term road maintenance plan are formulated in consideration of Life Cycle Cost on Road	2-3 AACRA annual report, Maintenance Historical Record			
3. The maintenance skills and knowledge of AACRA technical staff are improved.	3-1.Training road maintenance skills and knowledge targeting AACRA technical staff are conducted.	3-1 Training Record			
	3-2. Number of preventive maintenance works executed are increased through the implementation of the project.	3-2.The baseline data, AACRA annual report, AACRA Annual Road Maintenance Plan			

Activities	Inputs		Important Assumption
	The Japanese Side	The Ethiopian Side	
1-1 Review Implementation Structure of AACRA, and compile suggestions for the structure improvement	1. Experts ・Chief Advisor/Road Maintenance ・Road Maintenance Planning ・Road Inspection (Site Survey) ・Road Inspection (Database) ・Maintenance Management System ・Maintenance Design ・Construction Supervision ・Training Planning ・Monitoring ・System Development ・Others as necessary 2. Training of counterpart personnel, including Project Director and Project Manager, in Japan and/or the Third Countries 3. Provision of machinery and equipment ・Inspection Equipment(Pavement Condition Survey Vehicle) ・Maintenance Management System ・Visual Inspection Supporting System ・Structural Investigation Equipment ・Others 4. Local expenses for the project activities as necessary	1. Personnel ・Project Director ・Project Manager ・Counterpart personnel 2. Provision of the project office and facilities necessary for the project implementation 3. Traffic survey and pilot projects in Addis Ababa City 4. Administrative and operational expenses necessary for the project implementation ・Electricity, water, communication, etc. ・Local traveling costs and daily subsistence allowance (DSA) for counterpart personnel 5. Others as necessary	1. The turnover of AACRA staff does not profoundly affect the project activities. 2. Natural disasters, such as floods, do not profoundly affect the project activities. **Pre-Conditions** Understanding and cooperation on road maintenance in the City are obtained from the project stakeholders such as the City Administration, Addis Ababa City Road and Transport Bureau, Road Funds Agency, etc. <Issues and countermeasures>
1-2 Convene Technical Advisory Committee (TAC)			
1-3 Prepare a training plan for AACRA Staff			
1-4 Conduct training of AACRA staff for road maintenance: road inspection, maintenance planning, maintenance management system, etc.			
1-5 Share Information of road conditions in the City with Road Funds Agency and the City Administration to request the budget for road maintenance			
1-6 Promote public relations (PR) activities on road maintenance in the City			
2-1 Review the road maintenance cycle of AACRA, compile the PDCA checklist, and revise the checklist if needed			
2-2 Conduct road inspections in the City			
2-3 Develop and update the road inventory (database) of AACRA, including road condition, traffic volume, unit costs, etc.			
2-4 Prepare and revise Medium/Long term Road Maintenance Plan using Road Maintenance Management System developed under the project.			
2-5 Prepare Annual Road Maintenance Plan using Road Maintenance Management System developed under the Project.			
3-1 Select pilot projects for maintenance works based on the Annual Road Maintenance Plan formulated under the Project			
3-2 Share the information of pilot projects between/within Road Asset Management Process and Construction and Maintenance Process			
3-3 Conduct the detailed investigations and design specifications of the pilot projects			
3-4 Assist AACRA to execute pilot projects			
3-5 Feedback achievements and experiences of pilot projects into the next Annual Road Maintenance Plan			
3-6 Organize a workshop/seminar of the pilot projects for Ethiopian Roads Authority (ERA) and road agencies at regional and municipal level			

Project Monitoring Sheet I（Revision of the Project Design Matrix）

Project Title: Project for Development of Road Maintenance Capacity of Addis Ababa City

Version 3
Dated 15th Sep.2016

Implementing Agency: Addis Ababa City Roads Authority (AACRA)
Target Group: Staff of Addis Ababa City Roads Authority (AACRA)
Period of Project: 10/Jul/2015 - 9/Jul/2018　　Project Site: Addis Ababa City　　Model Site: Pilot project sites are to be determined

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal	Three years after the completion of the Project,				
The roads in Addis Ababa City are maintained in a sustainable way.	1. XX % of roads under AACRA is below the targeted roughness of YY.	1. Road inventory and Inspection Data in Addis Ababa City			
	2.The length(km) of road under AACRA inspected by the standardized method is increased by XX % compared to 3 months before the project	2. Road inventory and Inspection Data in Addis Ababa City			
Project Purpose	By 3 months before the completion of the Project,		1.Human resources necessary for the road maintenance are continuously assigned by AACRA.		
The management capacity of AACRA for road maintenance is enhanced.	1. AACRA's capacity to secure the budget for road maintenance is enhanced.	1. Interview to Addis Ababa City Administration and Road Funds Agency on Baseline and Endline data		**In Progress:** Baseline data from Addis Ababa City Administration and Road Funds agency is yet to be obtain.	
	2. Road maintenance works based on PDCA*1 cycle established by the Project are executed by AACRA.	2. Evaluation Result by PDCA Checklist	2.Financial resources are allocated by the City Administration and Road Funds Agency in a sustainable manner.	**In Progress:** PDCA Checklist (ver.1) is developed. Currently operation method in consideration to inspection equipment and maintenance management system is under discussion.	
	3 The percentage of the implemented road maintenance works against all the maintenance works scheduled in AACRA Annual Road Maintenance Plan, exceeds XX% since the 3rd project year.	3 Baseline data (Maintenance record 2015-2016 and Road Maintenance Plan), AACRA Annual Road Maintenance Plan, AACRA Maintenance Historical Record		**In Progress:** Baseline data shows maintenance work have been conducted more than 100 % of scheduled work. Appropriateness of Indicator needs to be discussed.	
Outputs					
1. The implementation structure of AACRA for road maintenance is improved.	1-1. Suggestions for improving the implementation structure of AACRA for road maintenance is compiled and presented at the 5th JCC August	1-1. Complied suggestions, Project meeting record	The AACRA staff capacitated by the Project continue to work for their respective positions.	**In Progress:** JICA Team has proposed suggestions at TACs. Further review and discussion are required.	
	1-2. Road map on institutional strengthening to act on the suggestions is prepared by AACRA, by August 2017 to be incorporated into the budget FY Jul/2017 - Jun/2018 if necessarily.	1-2. The Road Map, Minutes of JCC		**In Progress:** Proposed improvement on internal communication institution has been proposed by JICA Team. Further discussions are required for external communication and further strengthening of institution.	
	1-3. More than XX% of the requested budget on the basis of Annual Road Maintenance Plan are allocated since the 3rd project year.	1-3.Baseline data(Requested and allocated budget on annual road maintenance plan 2015-2016), AACRA annual report (Budget Plan), AACRA Annual Road Maintenance Plan		**In Progress:** Baseline data is yet to be obtained	
	1-4 Trainings on road maintenance is conducted targeting AACRA staff	1-4. Training Record		**In Progress:** At of September 2016, 22 lectures and 6 OJTs,. 1st training in Japan was conducted	
	1-5 Public understanding and cooperation on road maintenance is enhanced.	1-5. PR outputs		**In Progress:** Leaflet on Activity 2 was prepared and distributed.	
2. The process for formulating road maintenance plans is established.	2-1. PDCA Checklist is developed by January 2016.	2-1. PDCA checklist, Minutes of JCC		**In Progress:** Checklist version 1 is developed. Version will be updates as necessary through the operation.	
	2-2. AACRA Annual and Mid/Long term Road Maintenance Plan contains necessary items based on the PDCA checklist are formulated using Road Maintenance Management System developed under the Project, from the beginning of the 3rd project year.	2-2 PDCA Checklist, ACCRA Annual and Mid/Long term road maintenance plan, Road Maintenance Management System		**In Progress:** Framework for Road Maintenance Management System and planning procedure were agreed. PDCA Checklist(ver.1) is developed.	
	2-3.AACRA Annual and Mid/Long term road maintenance plan are formulated in consideration of Life Cycle Cost on Road	2-3 ACCRA Annual and Mid/Long term road maintenance plan, AACRA Maintenance Historical Record		**In Progress:** Approach and formulation process for road maintenance planning have been agreed.	
3. The maintenance skills and knowledge of AACRA technical staff are improved.	3-1. Technical Transfer on Road maintenance skills and knowledge targeting AACRA technical staff are conducted .	3-1 Training Record, Report on Pilot Project		**In Progress:** 3 trainings relevant to maintenance skill and knowledge were provided.	
	3-2. Number of preventive maintenance works executed are increased through the implementation of the project.	3-2.Baseline data(Maintenance record 2015-2016), AACRA Maintenance History Record, AACRA Annual Road Maintenance Plan			

Activities	Inputs		Important Assumption
	The Japanese Side	The Ethiopian Side	
1-1 Review Implementation Structure of AACRA, and compile suggestions for the structure improvement	1. Experts ・Chief Advisor/Road Maintenance ・Road Maintenance Planning ・Road Inspection (Site Survey) ・Road Inspection (Database) ・Maintenance Management System ・Maintenance Design ・Construction Supervision ・Training Planning ・Monitoring ・System Development ・Others as necessary 2. Training of counterpart personnel, including Project Director and Project Manager, in Japan and/or the Third Countries 3. Provision of machinery and equipment ・Inspection Equipment(Pavement Condition Survey Vehicle) ・Maintenance Management System ・Visual Inspection Supporting System ・Structural Investigation Equipment ・Others 4. Local expenses for the project activities as necessary	1. Personnel ・Project Director ・Project Manager ・Counterpart personnel 2. Provision of the project office and facilities necessary for the project implementation 3. Traffic survey and pilot projects in Addis Ababa City 4. Administrative and operational expenses necessary for the project implementation ・Electricity, water, communication, etc. ・Local traveling costs and daily subsistence allowance (DSA) for counterpart personnel 5. Others as necessary	1. The turnover of AACRA staff does not profoundly affect the project activities. 2. Natural disasters, such as floods, do not profoundly affect the project activities.
1-2 Convene Technical Advisory Committee (TAC)			
1-3 Prepare a training plan for AACRA Staff			
1-4 Conduct training of AACRA staff for road maintenance: road inspection, maintenance planning, maintenance management system, etc.			
1-5 Share Information of road conditions in the City with Road Funds Agency and the City Administration to request the budget for road maintenance			**Pre-Conditions** Understanding and cooperation on road maintenance in the City are obtained from the project stakeholders such as the City Administration, Addis Ababa City Road and Transport Bureau, Road Funds Agency, etc.
1-6 Promote public relations (PR) activities on road maintenance in the City			
2-1 Review the road maintenance cycle of AACRA, compile the PDCA checklist, and revise the checklist if needed			
2-2 Conduct road inspections in the City			
2-3 Develop and update the road inventory (database) of AACRA, including road condition, traffic volume, unit costs, etc.			
2-4 Prepare and revise Medium/Long term Road Maintenance Plan using Road Maintenance Management System developed under the project.			⇩
2-5 Prepare Annual Road Maintenance Plan using Road Maintenance Management System developed under the Project.			<Issues and countermeasures>
3-1 Select pilot projects for maintenance works based on the Annual Road Maintenance Plan formulated under the Project			
3-2 Share the information of pilot projects between/within Road Asset Management Process and Construction and Maintenance Process			
3-3 Conduct the detailed investigations and design specifications of the pilot projects			
3-4 Assist AACRA to execute pilot projects			
3-5 Feedback achievements and experiences of pilot projects into the next Annual Road Maintenance Plan			
3-6 Organize a workshop/seminar of the pilot projects for Ethiopian Roads Authority (ERA) and road agencies at regional and municipal level			

Project Monitoring Sheet I（Revision of the Project Design Matrix）

Project Title: Project for Development of Road Maintenance Capacity of Addis Ababa City

Version 4a
Dated Apr.5th, 2017

Implementing Agency: Addis Ababa City Roads Authority (AACRA)
Target Group: Staff of Addis Ababa City Roads Authority (AACRA)
Period of Project: 10/Jul/2015 - 9/Jul/2018　　Project Site: Addis Ababa City　　Model Site: Pilot project sites are to be determined

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal	Three years after the completion of the Project,				
The roads in Addis Ababa City are maintained in a sustainable way.	1. XX % of roads under AACRA is below the targeted roughness of YY.	1. Road inventory and Inspection Data in Addis Ababa City			
	2.The length(km) of road under AACRA inspected by the standardized method is increased by XX % compared to 3 months before the project	2. Road inventory and Inspection Data in Addis Ababa City			
Project Purpose	By 3 months before the completion of the Project,		1.Human resources necessary for the road maintenance are continuously assigned by AACRA.		
The management capacity of AACRA for road maintenance is enhanced.	1. AACRA's capacity to secure the budget for road maintenance is enhanced.	1. Interview to Addis Ababa City Administration and Road Funds Agency on Baseline and Endline data		**In Progress:** Baseline data from Addis Ababa City Administration and Road Funds agency is yet to be obtain.	
	2. Road maintenance works based on PDCA*[1] cycle established by the Project are executed by AACRA.	2. Evaluation Result by PDCA Checklist	2.Financial resources are allocated by the City Administration and Road Funds Agency in a sustainable manner.	**In Progress:** PDCA Checklist (ver.1) is developed. Currently operation method in consideration to inspection equipment and maintenance management system is under discussion.	
	3 The percentage of the implemented road maintenance works against all the maintenance works scheduled in AACRA Annual Road Maintenance Plan, exceeds 80% since the 3rd project year.	3 Baseline data (Maintenance record 2015-2016 and Road Maintenance Plan), AACRA Annual Road Maintenance Plan, AACRA Maintenance Historical Record		**In Progress:** Baseline data shows maintenance work have been conducted more than 100 % of scheduled work. Appropriateness of Indicator needs to be discussed.	
Outputs					
1. The implementation structure of AACRA for road maintenance is improved.	1-1. Suggestions for improving the implementation structure of AACRA for road maintenance is compiled and presented at the 5th JCC August	1-1. Complied suggestions, Project meeting record	The AACRA staff capacitated by the Project continue to work for their respective positions.	**In Progress:** JICA Team has proposed suggestions at TACs. Further review and discussion are required.	
	1-2. Road map on institutional strengthening to act on the suggestions is prepared by AACRA, by August 2017 to be incorporated into the budget FY Jul/2017 - Jun/2018 if necessarily.	1-2. The Road Map, Minutes of JCC		**In Progress:** Proposed improvement on internal communication institution has been proposed by JICA Team. Further discussions are required for external communication and further strengthening of institution.	
	1-3. More than XX% of the requested budget on the basis of Annual Road Maintenance Plan are allocated since the 3rd project year.	1-3.Baseline data(Requested and allocated budget on annual road maintenance plan 2015-2016), AACRA annual report (Budget Plan), AACRA Annual Road Maintenance Plan		**In Progress:** Baseline data is yet to be obtained	
	1-4 Trainings on road maintenance is conducted targeting AACRA staff	1-4. Training Record		**In Progress:** At of September 2016, 22 lectures and 6 OJTs,. 1st training in Japan was conducted	
	1-5 Public understanding and cooperation on road maintenance is enhanced.	1-5. PR outputs		**In Progress:** Leaflet on Activity 2 was prepared and distributed.	
2. The process for formulating road maintenance plans is established.	2-1. PDCA Checklist is developed by January 2016.	2-1. PDCA checklist, Minutes of JCC		**In Progress:** Checklist version 1 is developed. Version will be updates as necessary through the operation.	
	2-2. AACRA Annual and Mid/Long term Road Maintenance Plan contains necessary items based on the PDCA checklist are formulated using Road Maintenance Management System developed under the Project, from the beginning of the 3rd project year.	2-2 PDCA Checklist, ACCRA Annual and Mid/Long term road maintenance plan, Road Maintenance Management System		**In Progress:** Framework for Road Maintenance Management System and planning procedure were agreed. PDCA Checklist(ver.1) is developed.	
	2-3.AACRA Annual and Mid/Long term road maintenance plan are formulated in consideration of Life Cycle Cost on Road	2-3 ACCRA Annual and Mid/Long term road maintenance plan, AACRA Maintenance Historical Record		**In Progress:** Approach and formulation process for road maintenance planning have been agreed.	
3. The maintenance skills and knowledge of AACRA technical staff are improved.	3-1. Technical Transfer on Road maintenance skills and knowledge targeting AACRA technical staff are conducted .	3-1 Training Record, Report on Pilot Project		**In Progress:** 3 trainings relevant to maintenance skill and knowledge were provided.	
	3-2. Number of preventive maintenance works executed are increased through the implementation of the project.	3-2.Baseline data(Maintenance record 2015-2016), AACRA Maintenance History Record, AACRA Annual Road Maintenance Plan			

Activities	Inputs		Important Assumption
	The Japanese Side	The Ethiopian Side	
1-1 Review Implementation Structure of AACRA, and compile suggestions for the structure improvement	1. Experts ・Chief Advisor/Road Maintenance ・Road Maintenance Planning ・Road Inspection (Site Survey) ・Road Inspection (Database) ・Maintenance Management System ・Maintenance Design ・Construction Supervision ・Training Planning ・Monitoring ・System Development ・Others as necessary 2. Training of counterpart personnel, including Project Director and Project Manager, in Japan and/or the Third Countries 3. Provision of machinery and equipment ・Inspection Equipment(Pavement Condition Survey Vehicle) ・Maintenance Management System ・Visual Inspection Supporting System ・Structural Investigation Equipment ・Others 4. Local expenses for the project activities as necessary	1. Personnel ・Project Director ・Project Manager ・Counterpart personnel 2. Provision of the project office and facilities necessary for the project implementation 3. Traffic survey and pilot projects in Addis Ababa City 4. Administrative and operational expenses necessary for the project implementation ・Electricity, water, communication, etc. ・Local traveling costs and daily subsistence allowance (DSA) for counterpart personnel 5. Others as necessary	1. The turnover of AACRA staff does not profoundly affect the project activities. 2. Natural disasters, such as floods, do not profoundly affect the project activities.
1-2 Convene Technical Advisory Committee (TAC)			
1-3 Prepare a training plan for AACRA Staff			
1-4 Conduct training of AACRA staff for road maintenance: road inspection, maintenance planning, maintenance management system, etc.			
1-5 Share Information of road conditions in the City with Road Funds Agency and the City Administration to request the budget for road maintenance			**Pre-Conditions** Understanding and cooperation on road maintenance in the City are obtained from the project stakeholders such as the City Administration, Addis Ababa City Road and Transport Bureau, Road Funds Agency, etc.
1-6 Promote public relations (PR) activities on road maintenance in the City			
2-1 Review the road maintenance cycle of AACRA, compile the PDCA checklist, and revise the checklist if needed			
2-2 Conduct road inspections in the City			
2-3 Develop and update the road inventory (database) of AACRA, including road condition, traffic volume, unit costs, etc.			
2-4 Prepare and revise Medium/Long term Road Maintenance Plan using Road Maintenance Management System developed under the project.			⇩
2-5 Prepare Annual Road Maintenance Plan using Road Maintenance Management System developed under the Project.			<Issues and countermeasures>
3-1 Select pilot projects for maintenance works based on the Annual Road Maintenance Plan formulated under the Project			
3-2 Share the information of pilot projects between/within Road Asset Management Process and Construction and Maintenance Process			
3-3 Conduct the detailed investigations and design specifications of the pilot projects			
3-4 Assist AACRA to execute pilot projects			
3-5 Feedback achievements and experiences of pilot projects into the next Annual Road Maintenance Plan			
3-6 Organize a workshop/seminar of the pilot projects for Ethiopian Roads Authority (ERA) and road agencies at regional and municipal level			

Project Monitoring Sheet I(Revision of the Project Design Matrix)

Project Title: Project for Development of Road Maintenance Capacity of Addis Ababa City

Version 5
Dated 4th Oct, 2017

Implementing Agency: Addis Ababa City Roads Authority (AACRA)
Target Group: Staff of Addis Ababa City Roads Authority (AACRA)
Period of Project: 10/Jul/2015 - 9/Jul/2018 Project Site: Addis Ababa City Model Site: Pilot project sites are to be determined

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important	Achievement	%
Overall Goal The roads in Addis Ababa City are maintained in a sustainable way.	Three years after the completion of the Project, 1. XX % of roads under AACRA is below the targeted roughness of YY.	1. Road inventory and Inspection Data in Addis Ababa City			N/A
	2.The length(km) of road under AACRA inspected by the standardized method is increased by XX % compared to 3 months before the project completion.	2. Road inventory and Inspection Data in Addis Ababa City			
Project Purpose The management capacity of AACRA for road maintenance is enhanced.	By 3 months before the completion of the Project, 1. AACRA's capacity to secure the budget for road maintenance is enhanced.	1. Interview to Addis Ababa City Administration and Road Funds Agency on Baseline and Endline data	1.Human resources necessary for the road maintenance are continuously assigned by AACRA. 2.Financial resources are allocated by the City Administration and Road Funds Agency in a sustainable manner.	**In Progress:** Baseline data from Addis Ababa City Administration is yet to be obtain.	N/A
	2. Road maintenance works based on PDCA*[1] cycle established by the Project are executed by AACRA.	2. Evaluation Result by PDCA Checklist		**In Progress:** PDCA Checklist (ver.1) is developed. Currently operation method in consideration to inspection equipment and road management system is under development.	N/A
	3 The percentage of the implemented road maintenance works against all the maintenance works scheduled in AACRA Annual Road Maintenance Plan, exceeds 80% since the 3rd project year.	3 Baseline data (Maintenance record 2015-2016 and Road Maintenance Plan), AACRA Annual Road Maintenance Plan, AACRA Maintenance Historical Record		**In Progress:** Baseline data shows maintenance work have been conducted more than 100 % of scheduled work. Appropriateness of Indicator needs to be discussed.	N/A
Outputs 1. The implementation structure of AACRA for road maintenance is improved.	1-1. Suggestions for improving the implementation structure of AACRA for road maintenance is compiled and presented at the 5th JCC August 2017.	1-1. Complied suggestions, Project meeting record	The AACRA staff capacitated by the Project continue to work for their respective positions.	**In Progress:** JICA Team has proposed suggestions at TACs. Further review and discussions are required after role and responsibility of each section under new AACRA structure is clarified.	50%
	1-2. Road map on institutional strengthening to act on the suggestions is prepared by AACRA, by August 2017 to be incorporated into the budget FY Jul/2017 - Jun/2018 if necessarily.	1-2. The Road Map, Minutes of JCC		**In Progress:** AACRA re structured in November 2016. Proposed improvement on internal communication institution has been proposed by JICA Team. Further discussions are required for external communication and further strengthening of institution.	50%
	1-3. More than XX% of the requested budget on the basis of Annual Road Maintenance Plan are allocated since the 3rd project year.	1-3.Baseline data(Requested and allocated budget on annual road maintenance plan 2015-2016), AACRA annual report (Budget Plan), AACRA Annual Road Maintenance Plan		**In Progress:** Baseline data is yet to be obtained	0%
	1-4 Trainings on road maintenance is conducted targeting AACRA staff	1-4. Training Record		**In Progress:** As of September 2017, 38 lectures and 18 OJTs, and two trainings in Japan were conducted.	75%
	1-5 Public understanding and cooperation on road maintenance is enhanced.	1-5. PR outputs		**In Progress:** Leaflet on Activity 2 was prepared and distributed. One seminar was held in April 2017.	20%
2. The process for formulating road maintenance plans is established.	2-1. PDCA Checklist is developed by January 2016.	2-1. PDCA checklist, Minutes of JCC		**In Progress:** Checklist version 1 was developed. Version will be updates as necessary through the operation.	100%
	2-2. AACRA Annual and Mid/Long term Road Maintenance Plan contains necessary items based on the PDCA checklist are formulated using Road Maintenance Management System developed under the Project, from the beginning of the 3rd project year.	2-2 PDCA Checklist, ACCRA Annual and Mid/Long term road maintenance plan, Road Maintenance Management System		**In Progress:** Framework for RMMS and planning procedure were agreed. Currently RMMS is currently under development. Due to the delayed supply of the Pavement Condition Survey Vehicle, both of the development of RMMS and Mid/Long Term Maintenance Plan are delayed accordingly.	50%
	2-3.AACRA Annual and Mid/Long term road maintenance plan are formulated in consideration of Life Cycle Cost on Road	2-3 ACCRA Annual and Mid/Long term road maintenance plan, AACRA Maintenance Historical Record		**In Progress:** Approach and formulation process for road maintenance planning have been agreed. Annual	50%
3. The maintenance skills and knowledge of AACRA technical staff are improved.	3-1. Technical Transfer on Road maintenance skills and knowledge targeting AACRA technical staff are conducted .	3-1 Training Record, Report on Pilot Project		**In Progress:** 11 lectures and 11 OJT relevant to maintenance skill and knowledge were conducted.	70%
	3-2. Number of preventive maintenance works executed are increased through the implementation of the project.	3-2.Baseline data(Maintenance record 2015-2016), AACRA Maintenance History Record, AACRA Annual Road Maintenance Plan		**In Progress:** Concept and importance of Preventive Maintenance should be shared first among all stake holders.	30%

Activities	Inputs		Important Assumption
	The Japanese Side	The Ethiopian Side	
1-1 Review implementation structure of AACRA, and compile suggestions for the structure improvement	1. Experts ・Chief Advisor/Road Maintenance ・Road Maintenance Planning ・Road Inspection (Site Survey) ・Road Inspection (Database) ・Maintenance Management System ・Maintenance Design ・Construction Supervision ・Training Planning ・Monitoring ・System Development ・Others as necessary 2. Training of counterpart personnel, including Project Director and Project Manager, in Japan and/or the Third Countries 3. Provision of machinery and equipment ・Inspection Equipment(Pavement Condition Survey Vehicle) ・Maintenance Management System ・Visual Inspection Supporting System ・Structural Investigation Equipment ・Others 4. Local expenses for the project activities as necessary	1. Personnel ・Project Director ・Project Manager ・Counterpart personnel 2. Provision of the project office and facilities necessary for the project implementation 3. Traffic survey and pilot projects in Addis Ababa City 4. Administrative and operational expenses necessary for the project implementation ・Electricity, water, communication, etc. ・Local traveling costs and daily subsistence allowance (DSA) for counterpart personnel 5. Others as necessary	1. The turnover of AACRA staff does not profoundly affect the project activities. 2. Natural disasters, such as floods, do not profoundly affect the project activities.
1-2 Convene Technical Advisory Committee (TAC)			**Pre-Conditions** Understanding and cooperation on road maintenance in the City are obtained from the project stakeholders such as the City Administration, Addis Ababa City Road and Transport Bureau, Road Funds Agency, etc.
1-3 Prepare a training plan for AACRA Staff			
1-4 Conduct training of AACRA staff for road maintenance: road inspection, maintenance planning, maintenance management system, etc.			
1-5 Share Information of road conditions in the City with Road Funds Agency and the City Administration to request the budget for road maintenance			
1-6 Promote public relations (PR) activities on road maintenance in the City			
2-1 Review the road maintenance cycle of AACRA, compile the PDCA checklist, and revise the checklist if needed			
2-2 Conduct road inspections in the City			
2-3 Develop and update the road inventory (database) of AACRA, including road condition, traffic volume, unit costs, etc.			
2-4 Prepare and revise Medium/Long term Road Maintenance Plan using Road Maintenance Management System developed under the project.			<Issues and countermeasures>
2-5 Prepare Annual Road Maintenance Plan using Road Maintenance Management System developed under the Project.			
3-1 Select pilot projects for maintenance works based on the Annual Road Maintenance Plan formulated under the Project			
3-2 Share the information of pilot projects between/within Road Asset Management Process and Construction and Maintenance Process			
3-3 Conduct the detailed investigations and design specifications of the pilot projects			
3-4 Assist AACRA to execute pilot projects			
3-5 Feedback achievements and experiences of pilot projects into the next Annual Road Maintenance Plan			
3-6 Organize a workshop/seminar of the pilot projects for Ethiopian Roads Authority (ERA) and road agencies at regional and municipal level			

Project Monitoring Sheet I(Revision of the Project Design Matrix)

Project Title: Project for Development of Road Maintenance Capacity of Addis Ababa City

Version 6A
Dated 3rd Apr., 2018

Implementing Agency: Addis Ababa City Roads Authority (AACRA)
Target Group: Staff of Addis Ababa City Roads Authority (AACRA)
Period of Project: 10/Jul/2015 - 9/Jul/2019 Project Site: Addis Ababa City Model Site: Pilot project sites in Addis Ababa City

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important	Achievement	%
Overall Goal The roads in Addis Ababa City are maintained in a sustainable way.	Three years after the completion of the Project, 1. XX % of roads under AACRA is below the targeted roughness of YY.	1. Road inventory and Inspection Data in Addis Ababa City		JICA team will propose the verifiable indicator based on the survey results.	N/A
	2.The length(km) of road under AACRA inspected by the standardized method is increased by XX % compared to 3 months before the project completion.	2. Road inventory and Inspection Data in Addis Ababa City		JICA team will propose the verifiable indicator based on the survey results.	
Project Purpose The management capacity of AACRA for road maintenance is enhanced.	By 3 months before the completion of the Project, 1. AACRA's capacity to secure the budget for road maintenance is enhanced.	1. Interview to Addis Ababa City Administration and Road Funds Agency on Baseline and Endline data	1.Human resources necessary for the road maintenance are continuously assigned by AACRA. 2.Financial resources are allocated by the City Administration and Road Funds Agency in a sustainable manner.	**In Progress:** Baseline data from Addis Ababa City Administration is yet to be obtain.	N/A
	2. Road maintenance works based on PDCA*1 cycle established by the Project are executed by AACRA.	2. Evaluation Result by PDCA Checklist		**In Progress:** PDCA Checklist (ver.1) is developed. Currently operation method in consideration to inspection equipment and road management system is under development.	N/A
	3 The percentage of the implemented road maintenance works against all the maintenance works scheduled in AACRA Annual Road Maintenance Plan, exceeds 80% since the 3rd project year.	3 Baseline data (Maintenance record 2015-2016 and Road Maintenance Plan), AACRA Annual Road Maintenance Plan, AACRA Maintenance Historical Record		**In Progress:** Baseline data shows maintenance work have been conducted more than 100 % of scheduled work. Appropriateness of Indicator needs to be discussed.	N/A
Outputs 1. The implementation structure of AACRA for road maintenance is improved.	1-1. Suggestions for improving the implementation structure of AACRA for road maintenance is compiled and presented at the 7th JCC (September 2018).	1-1. Complied suggestions, Project meeting record	The AACRA staff capacitated by the Project continue to work for their respective positions.	**In Progress:** JICA Team has proposed suggestions at TACs. Further review and discussions are required after role and responsibility of each section under new AACRA structure is clarified.	50%
	1-2. Road map on institutional strengthening to act on the suggestions is prepared by AACRA, by March 2019 to be incorporated into the budget FY Jul/2019 - Jun/2020 if necessarily.	1-2. The Road Map, Minutes of JCC		**In Progress:** AACRA has re-structured in November 2016. Proposed improvement on internal communication institution has been proposed by JICA Team. Further discussions are required for the needs of external communication and further strengthening of institution. The verifiable indicator is updated.	50%
	1-3. More than 100% of the requested budget on the basis of Annual Road Maintenance Plan are allocated since the 3rd project year.	1-3.Baseline data(Requested and allocated budget on annual road maintenance plan 2015-2016), AACRA annual report (Budget Plan), AACRA Annual Road Maintenance Plan .		**In Progress:** JICA team proposed to set verifiable indicator as 100% at the 6th JCC. The verifiable indicator is updated.	0%
	1-4 Trainings on road maintenance is conducted targeting AACRA staff	1-4. Training Record		**In Progress:** As of end of March 2018, 41 lectures and 23 OJTs, and two trainings in Japan were conducted	80%
	1-5 Public understanding and cooperation on road maintenance is enhanced.	1-5. PR outputs		**In Progress:** Leaflet on Activity 2 was prepared and distributed. One seminar was held in April 2017. Other PR activities are currently under discussion.	20%
2. The process for formulating road maintenance plans is established.	2-1. PDCA Checklist is developed by January 2016.	2-1. PDCA checklist, Minutes of JCC		**In Progress:** Checklist version 1 was developed. Version will be updates as necessary through the operation.	100%
	2-2. AACRA Annual and Mid/Long term Road Maintenance Plan contains necessary items based on the PDCA checklist are formulated using Road Maintenance Management System developed under the Project, from the beginning of the 4th project year.	2-2 PDCA Checklist, ACCRA Annual and Mid/Long term road maintenance plan, Road Maintenance Management System		**In Progress:** Framework for RMMS and planning procedure were agreed. RMMS ver. 1 was issued July 2017 and ver. 2 in January 2018. Ver. 3 is currently developed to issue in July 2018. The verifiable indicator is updated.	60%
	2-3.AACRA Annual and Mid/Long term road maintenance plan are formulated in consideration of Life Cycle Cost on Road	2-3 ACCRA Annual and Mid/Long term road maintenance plan, AACRA Maintenance Historical Record		**In Progress:** Approach and formulation process for road maintenance planning have been agreed. Annual Road Maintenance Plan for August 2017- July 2018 was prepared in July 2017. Annual Road Maintenance Plan for August 2018-July 2019 will be prepared in July 2017.	50%
3. The maintenance skills and knowledge of AACRA technical staff are improved.	3-1. Technical Transfer on Road maintenance skills and knowledge targeting AACRA technical staff are conducted .	3-1 Training Record, Report on Pilot Project		**In Progress:** 11 lectures and 14 OJT relevant to maintenance skill and knowledge were conducted.	90%
	3-2. Number of preventive maintenance works executed are increased through the implementation of the project.	3-2.Baseline data(Maintenance record 2015-2016), AACRA Maintenance History Record, AACRA Annual Road Maintenance Plan		**In Progress:** Concept and importance of Preventive Maintenance have been shared through pilot projects.	30%

Activities	Inputs		Important Assumption
	The Japanese Side	The Ethiopian Side	
1-1 Review Implementation Structure of AACRA, and compile suggestions for the structure improvement	1. Experts ・Chief Advisor/Road Maintenance ・Road Maintenance Planning ・Road Inspection (Site Survey) ・Road Inspection (Database) ・Maintenance Management System ・Maintenance Design ・Construction Supervision ・Training Planning ・Monitoring ・System Development ・Others as necessary 2. Training of counterpart personnel, including Project Director and Project Manager, in Japan and/or the Third Countries 3. Provision of machinery and equipment ・Inspection Equipment(Pavement Condition Survey Vehicle) ・Maintenance Management System ・Visual Inspection Supporting System ・Structural Investigation Equipment ・Others 4. Local expenses for the project activities as necessary	1. Personnel ・Project Director ・Project Manager ・Counterpart personnel 2. Provision of the project office and facilities necessary for the project implementation 3. Traffic survey and pilot projects in Addis Ababa City 4. Administrative and operational expenses necessary for the project implementation ・Electricity, water, communication, etc. ・Local traveling costs and daily subsistence allowance (DSA) for counterpart personnel 5. Others as necessary	1. The turnover of AACRA staff does not profoundly affect the project activities. 2. Natural disasters, such as floods, do not profoundly affect the project activities. **Pre-Conditions** Understanding and cooperation on road maintenance in the City are obtained from the project stakeholders such as the City Administration, Addis Ababa City Road and Transport Bureau, Road Funds Agency, etc. <Issues and countermeasures>
1-2 Convene Technical Advisory Committee (TAC)			
1-3 Prepare a training plan for AACRA Staff			
1-4 Conduct training of AACRA staff for road maintenance: road inspection, maintenance planning, maintenance management system, etc.			
1-5 Share Information of road conditions in the City with Road Funds Agency and the City Administration to request the budget for road maintenance			
1-6 Promote public relations (PR) activities on road maintenance in the City			
2-1 Review the road maintenance cycle of AACRA, compile the PDCA checklist, and revise the checklist if needed			
2-2 Conduct road inspections in the City			
2-3 Develop and update the road inventory (database) of AACRA, including road condition, traffic volume, unit costs, etc.			
2-4 Prepare and revise Medium/Long term Road Maintenance Plan using Road Maintenance Management System developed under the project.			
2-5 Prepare Annual Road Maintenance Plan using Road Maintenance Management System developed under the Project.			
3-1 Select pilot projects for maintenance works based on the Annual Road Maintenance Plan formulated under the Project			
3-2 Share the information of pilot projects between/within Road Asset Management Process and Construction and Maintenance Process			
3-3 Conduct the detailed investigations and design specifications of the pilot projects			
3-4 Assist AACRA to execute pilot projects			
3-5 Feedback achievements and experiences of pilot projects into the next Annual Road Maintenance Plan			
3-6 Organize a workshop/seminar of the pilot projects for Ethiopian Roads Authority (ERA) and road agencies at regional and municipal level			

Project Monitoring Sheet I(Revision of the Project Design Matrix)

Project Title: Project for Development of Road Maintenance Capacity of Addis Ababa City

Version 7
Dated 4th Oct. 2018

Implementing Agency: Addis Ababa City Roads Authority (AACRA)
Target Group: Staff of Addis Ababa City Roads Authority (AACRA)
Period of Project: 10/Jul/2015 - 9/Jul/2019 Project Site: Addis Ababa City Model Site: Pilot project sites in Addis Ababa City

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption	Achievement	%
Overall Goal The roads in Addis Ababa City are maintained in a sustainable way.	Three years after the completion of the Project, **1. 60 % of Strategic roads (PR, PAS and SAS) is below the targeted roughness of 3.5.**	1. Road inventory and Inspection Data in Addis Ababa City		JICA team has proposed the verifiable indicator based on the survey results in April 2018. During the 7th JCC, the verifiable indicator proposed by JICA team was agreed.	N/A
	2. The 90% of length(km) of planned road under AACRA is inspected by the standardized method.	2. Road inventory and Inspection Data in Addis Ababa City		During the 7th JCC, the verifiable indicator proposed by JICA team was agreed.	
Project Purpose The management capacity of AACRA for road maintenance is enhanced.	By 3 months before the completion of the Project, 1. AACRA's capacity to secure the budget for road maintenance is enhanced.	**1. Interview Road Funds Agency on Baseline and Endline data**	1.Human resources necessary for the road maintenance are continuously assigned by AACRA. 2. Financial resources are allocated by the City Administration and Road Funds Agency in a sustainable manner.	**In Progress:** JICA team will propose the means of verification is to be revised by removing "Interview to Addis Ababa City Administration ".	N/A
	2. Road maintenance works based on PDCA*[1] cycle established by the Project are executed by AACRA.	2. Evaluation Result by PDCA Checklist		**In Progress:** PDCA Checklist (ver.1) is developed. Currently operation method in consideration to inspection equipment and road management system is under development.	N/A
	3 The percentage of the implemented road maintenance works against all the maintenance works scheduled in AACRA Annual Road Maintenance Plan, exceeds 80% since the 3rd project year.	3 Baseline data (Maintenance record 2015-2016 and Road Maintenance Plan), AACRA Annual Road Maintenance Plan, AACRA Maintenance Historical Record		**In Progress:** Baseline data shows that there were some years that maintenance work have been conducted more than 100 % of scheduled work.	N/A
Outputs 1. The implementation structure of AACRA for road maintenance is improved.	1-1. Suggestions for improving the implementation structure of AACRA for road maintenance is compiled and presented at the 7th JCC (September 2018).	1-1. Complied suggestions, Project meeting record	The AACRA staff capacitated by the Project continue to work for their respective positions.	**In Progress:** Implementation structure has been improved dramatically since restructuring of AACRA, which is confirmed from the results of questionnaire. Recommendation for sustainable implementation structure for road management will be presented a the 7th JCC.	80%
	1-2. Road map on institutional strengthening to act on the suggestions is prepared by AACRA, by March 2019 to be incorporated into the budget FY Jul/2019 - Jun/2020 if necessarily.	1-2. The Road Map, Minutes of JCC		**In Progress:** Internal Communication has been improved dramatically since restructuring of AACRA, which is confirmed from the results of questionnaire. Further discussion will be made for the needs of further strengthening of institution and communication at the 7th JCC.	80%
	1-3. More than 100% of the **approved** budget on the basis of Annual Road Maintenance Plan are allocated since the 3rd project year.	1-3.Baseline data(Requested and allocated budget on annual road maintenance plan 2015-2016), AACRA annual report (Budget Plan), AACRA Annual Road Maintenance Plan .		**In Progress:** JICA team proposed to set verifiable indicator as 100% at the 6th JCC. Based on the discussion during the 7th JCC, the proposed verifiable indicator was agreed.	50%
	1-4 Trainings on road maintenance is conducted targeting AACRA staff	1-4. Training Record		**In Progress:** As of end of Sep. 2018, 42 lectures and 25 OJTs, and two trainings in Japan were conducted.	90%
	1-5 Public understanding and cooperation on road maintenance is enhanced.	1-5. PR outputs		**In Progress:** Leaflet on Activity 2 was prepared and distributed. One seminar was held in Apr. 2017. Developing video clip is currently under discussion.	50%
2. The process for formulating road maintenance plans is established.	2-1. PDCA Checklist is developed by January 2016.	2-1. PDCA checklist, Minutes of JCC		**In Progress:** Checklist version 1 was developed. Version will be updates as necessary through the operation.	100%
	2-2. AACRA Annual and Mid/Long term Road Maintenance Plan contains necessary items based on the PDCA checklist are formulated using Road Maintenance Management System developed under the Project, from the beginning of the 4th project year.	2-2 PDCA Checklist, ACCRA Annual and Mid/Long term road maintenance plan, Road Maintenance Management System		**In Progress:** Framework for RMMS and planning procedure were agreed. RMMS ver. 1 was issued July 2017 and ver. 2 in Jan. 2018. Ver. 3 is currently developed and will be finalized in Jan. 2019.	80%
	2-3.AACRA Annual and Mid/Long term road maintenance plan are formulated in consideration of Life Cycle Cost on Road	2-3 ACCRA Annual and Mid/Long term road maintenance plan, AACRA Maintenance Historical Record		**In Progress:** Approach and formulation process for road maintenance planning have been agreed. Annual Road Maintenance Plan for August 2017- July 2018 was prepared in July 2017. Annual Road Maintenance Plan for August 2018- July 2019 was prepared in July 2018.Mid term plan will be presented in October 2018 .	75%
3. The maintenance skills and knowledge of AACRA technical staff are improved.	3-1. Technical Transfer on Road maintenance skills and knowledge targeting AACRA technical staff are conducted .	3-1 Training Record, Report on Pilot Project		**In Progress:** 11 lectures and 14 OJT relevant to maintenance skill and knowledge were conducted.	90%
	3-2. Number of preventive maintenance works executed are increased through the implementation of the project.	3-2. Baseline data(Maintenance record 2015-2016), AACRA Maintenance History Record, AACRA Annual Road Maintenance Plan		**In Progress:** Concept and importance of Preventive Maintenance have been shared through pilot projects.	50%

Activities	Inputs		Important Assumption
	The Japanese Side	The Ethiopian Side	
1-1 Review Implementation Structure of AACRA, and compile suggestions for the structure improvement 1-2 Convene Technical Advisory Committee (TAC) 1-3 Prepare a training plan for AACRA Staff 1-4 Conduct training of AACRA staff for road maintenance: road inspection, maintenance planning, maintenance management system, etc. 1-5 Share Information of road conditions in the City with Road Funds Agency and the City Administration to request the budget for road maintenance 1-6 Promote public relations (PR) activities on road maintenance in the City 2-1 Review the road maintenance cycle of AACRA, compile the PDCA checklist, and revise the checklist if needed 2-2 Conduct road inspections in the City 2-3 Develop and update the road inventory (database) of AACRA, including road condition, traffic volume, unit costs, etc. 2-4 Prepare and revise Medium/Long term Road Maintenance Plan using Road Maintenance Management System developed under the project. 2-5 Prepare Annual Road Maintenance Plan using Road Maintenance Management System developed under the Project. 3-1 Select pilot projects for maintenance works based on the Annual Road Maintenance Plan formulated under the Project 3-2 Share the information of pilot projects between/within Road Asset Management Process and Construction and Maintenance Process 3-3 Conduct the detailed investigations and design specifications of the pilot projects 3-4 Assist AACRA to execute pilot projects 3-5 Feedback achievements and experiences of pilot projects into the next Annual Road Maintenance Plan 3-6 Organize a workshop/seminar of the pilot projects for Ethiopian Roads Authority (ERA) and road agencies at regional and municipal level	1. Experts ・ Chief Advisor/Road Maintenance ・ Road Maintenance Planning ・ Road Inspection (Site Survey) ・ Road Inspection (Database) ・ Maintenance Management System ・ Maintenance Design ・ Construction Supervision ・ Training Planning ・ Monitoring ・ System Development ・ Others as necessary 2. Training of counterpart personnel, including Project Director and Project Manager, in Japan and/or the Third Countries 3. Provision of machinery and equipment ・ Inspection Equipment(Pavement Condition Survey Vehicle) ・ Maintenance Management System ・ Visual Inspection Supporting System ・ Structural Investigation Equipment ・ Others 4. Local expenses for the project activities as necessary	1. Personnel ・ Project Director ・ Project Manager ・ Counterpart personnel 2. Provision of the project office and facilities necessary for the project implementation 3. Traffic survey and pilot projects in Addis Ababa City 4. Administrative and operational expenses necessary for the project implementation ・ Electricity, water, communication, etc. ・ Local traveling costs and daily subsistence allowance (DSA) for counterpart personnel 5. Others as necessary	1. The turnover of AACRA staff does not profoundly affect the project activities. 2. Natural disasters, such as floods, do not profoundly affect the project activities. **Pre-Conditions** Understanding and cooperation on road maintenance in the City are obtained from the project stakeholders such as the City Administration, Addis Ababa City Road and Transport Bureau, Road Funds Agency, etc. ⬇ <Issues and countermeasures>