World

Data Collection Survey on Human Resource Development Program for Road Asset Management

Final Report

April 2019

Japan International Cooperation Agency (JICA)

Japan Expressway International CO., LTD.
Nippon Engineering Consultants CO., LTD.
Infrastructure Development Institute-Japan

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AACRA	Addis Ababa City Road Authority
AASHTO	American Association of State Highway and Transportation Officials
AM	Asset Management
AMP	Annual Maintenance Plan
ARICS	Annual Road Inventory and Condition Survey
APRP	Annual Public Road program
AU	African Union
BMS	Bridge Management System
BMU	Bridge Management Unit
BOT	Build-operate-transfer
COSTES	Cost Estimation System
C/P	Counterparts
CS	Collector Street
CTTI	Construction Technology Training Institute
DB	Data Base
DDG	Deputy Director General
DG	Director General
DRIMS	Dynamic Response Intelligent Monitoring System
ERA	Ethiopian Roads Authority
FWD	Falling Weight Deflectometer
GIS	Geographic Information System
GM	General Manager
HDM-4	Fourth Highway Development and Management Model
HRTC	Highway Research and Training Center
i-DREAMS	intelligence-Dynamic Revolution for Asset Management system
ICT	Information and Communication Technology
IRI	International Roughness Index
ISO55001	A standard developed for the use of people or organizations involved in asset management
ITS	Intelligent Transport System
JICA	Japan International Cooperation Agency
KeRRA	Kenya Rural Roads Authority
KeNHA	Kenya National Highways Authority
KIHBT	Kenya Institute of Highways and Building Technology
KRB	Kenya Roads Board
KURA	Kenya Urban Roads Authority
KWS	Kenya Wildlife Service
LS	Local Street
MMS	Mobile Mapping System
MTP	Kenya Mid-Term Plan
MOU	Memorandum of Understanding
NCA	Kenya National Construction Authority
NEXCO East/Central/West	East / Central / West Nippon Expressway Co., Ltd.
NHA	National Highway Authority
ODA	Official Development Assistance
OJT	On-the-Job Training
PAS	Primary Arterial Street
PBC	Performance Based Contract
PDCA	Plan - Do - Check - Action

PKR	Pakistan Rupee
PMS	Pavement Management System
RAMS	Road Asset Management System
RAMD	Road Asset Management Department
R/D	Record of Discussions
RIMS	Road Maintenance Information Management System/ ROAD Infrastructure Monitoring System
RR	Ring Road
RSDP	Road Sector Development Program
SAS	Sub Arterial Street
SIP	Cross-ministerial Strategic Innovation Promotion Program
SMH	Smart Maintenance Highway
TAM	Transportation Asset Management Guide
TOT	Training of Trainers
UNECA	United Nations Economic Commission for Africa
WB	The World Bank

Chap. 1 Overview of the Survey

1.1 Background of the Survey

With a high demand for infrastructure development in developing countries, approximately 26 trillion dollars of demand for construction and improvement is forecasted in the Asia-Pacific region by 2030. In addition, the infrastructures, which Japan has supported in developing countries since the 1970s, will soon pass their 50th year and, given the demand for new construction projects, it is essential to reduce the cost by adopting the concept of preventive maintenance and the optimization of operations and maintenance. For this reason, the Japan International Cooperation Agency (hereinafter referred to as "JICA") has been implementing a Technical Cooperation Project (hereinafter referred to as "Technical Project") concerning the operation and maintenance of road infrastructure in around 20 countries as an effort for the dissemination of road asset management (hereinafter referred to as "Road AM"), and has been implementing a core human resources development responsible for road administration.

On the other hand, in "Operation and Maintenance of Infrastructure, Renovation and Management Techniques (hereinafter referred to as "SIP Infrastructure")," a strategic innovation program promoted by the Japanese government, an improvement of the maintenance level through preventive maintenance is expected to be realized at a low cost by using state-of-the-art information and robot technology and by establishing a systemized infrastructure management structure, which will lead to an engagement in the continued creation of the maintenance market as well as the promotion of overseas business operations. JICA also launched the Road Asset Management Platform to implement a comprehensive effort for the important challenges of development in the transportation sector and has expressed its intention of working toward realizing efficient and effective road administration based on the establishment of a preventive maintenance type management of road infrastructure as well as an asset management method in developing countries.

Assuming that inspection diagnostic technology, remaining life estimation and management techniques developed in the SIP Infrastructure will be utilized, SIP Infrastructure and JICA concluded "a memorandum of understanding on the overseas business operations and human resources development of Road AM" for all the countries of the world, mainly in Asia, in October of 2017 utilizing knowledge and technology of both JICA and SIP Infrastructure.

In order to promote the efforts of Road AM of JICA as well, it is necessary to investigate the trends of Road AM at home and overseas and to formulate a support plan for the establishment of Road AM in developing countries as well as organize unified technical guides and manuals along with good examples of the efforts for the domestic Road AM and Technical Projects and acceptance of long-term trainees in universities within Japan.

1.2 Purpose of the Survey

This business operation is to collect information and analysis for the purpose of conducting the following Road AM related tasks 1) to 4) in selected countries such as Pakistan, Kenya, and Ethiopia where Technical Projects are being implemented to help strengthen maintenance and management abilities.

1）Confirm the maintenance management ability
2）Organize the challenges for the establishment of Road AM
3）Study a support plan for the establish of Road AM
4）Study the contents of training for Road AM

1.3 Overview of the Survey

1）Name of the operation: Gathering basic information on Road AM Human Resource Development Program and investigation for verification
2）Period: From November 5, 2018 to April 26, 2019
3）Orderer : Independent administrative institution Japan International Cooperation Agency (JICA)

4）Contractor: Joint Enterprise JEXWAY: Japan Expressway International Co., Ltd.
NE: Nippon Engineering Consultants Co., Ltd
IDI: Infrastructure Development Institute-Japan

1.4 Items of the Survey

The main items of the operations are as follows.

1.4.1 Preparation of Business Plan and Explanation and Consultation of Inception Report T1

1）Business Plan and Inception Report

We will study the basic policies, methods, items and contents, implementation system, schedule, etc. of the implementation of the business. We will also create an inception report (draft) and obtain JICA's approval for the content.

2）Consultation about Inception Report

A consultation about the inception report will be conducted between JICA and persons concerned with the Technical Project to share the outline of this survey, including the purpose, implementation, and implementation system.

1.4.2 Information Gathering on On-going Technical Project T2

We will interview persons concerned with the Technical Project and counterparts (hereinafter referred to as “C/P”) on the spot and exchange opinions on the status of project implementation. While grasping the progress of the project, we will have interviews with both project specialists and C/P to confirm challenges that are recognized from the perspective of both parties. In addition, we will hear the investigations into the ability of local consultants/contractors who receive orders for maintenance and management and confirm the capacity of construction, maintenance management and technical level of the target countries.

Moreover, we will collect the technical guidelines and manuals created in the Technical Project, confirm the contents and confirm the level of technology that is targeted in the Technical Project.

1.4.3 Confirmation of Achievement Level on Road AM T3

Based on 1.4.2 above, we will discuss the level of achievement of Road AM to be aimed at the target country with Japanese specialists and JICA officials. The level of achievement for Road AM needs to be monitored by studying unified indicators which can be introduced in other countries in the future including, for example, how much the Technical Project progressed in on-going Technical Projects and upcoming long-term training with respect to the technical level of Road AM that is aimed for. It is important not to set an excessive level from the beginning, such as setting the level of achievement according to the current technology level. The current level of achievement will be discussed with a Japanese expert.

1.4.4 Extraction of Challenges for Road AM Fixation T4

Based on 1.4.2 and 1.4.3 above, we will organize the challenges to be solved for the establishment of the Road AM after the completion of the Technical Project. Of the challenges that have emerged in the course of the PDCA cycle of maintenance and management, the challenges that require research and development, including new technologies and deterioration forecasting technologies, such as repair technology and long-life technology in accordance with the country's nature/weather conditions will be organized after assuming the method for approach (support scheme) for solving the extracted challenges including, for example, taking them up as research contents of long-term training.

1.4.5 Formulation of Support Measures for Road AM T5

Based on 1.4.2 and 1.4.3 above, we will formulate a support plan after the completion of the Technical Project. When formulating the plan, we will discuss the future support plan discussing closely with Japanese specialists and JICA officials. In consideration of the proposed support plan, we will propose a middle-to long-term support plan while reducing the total business expenses for each fiscal year by effectively utilizing the training project (by country/issue/long-term).

1.4.6 Domestic Research on Trends for Road AM Techniques T6

We will conduct discussions with persons concerned with the introductory technology and the status of the efforts for the establishment of Road AM in such road administrators as the Ministry of Land, Infrastructure, Transport and Tourism, local governments and expressway companies and the efforts and technology, which would likely become references in developing countries as well, will be organized. Also, the development status of technologies that could be expected to be utilized in developing countries, as well as technological research and development in universities, research institutions, and private enterprises will be organized.

1.4.7 Topic-based Training for Road AM and Long-term Special Training Programs T7

Targeting all over the world including selected nations, the topic-based training is intended to be implemented as a continuous human resource development method starting from 2019. When they are scheduled to perform, several times based on the request, a group will be divided according to their individual technical levels. The training period should be about three to four weeks and the training curriculum needs to consider content that make it possible to improve knowledge and technology on the utilization of inspection data. The curriculum plan is examined by referring to the following contents.

1）Lecture

A lecture is provided to improve the understanding of trainees by preparing texts, summaries, etc. and using audiovisual materials if necessary. The lecture shall include contents that fit the needs of each country based on the status of maintenance and management in each country (maintenance, quality control, design, etc.). For each country to optimize their maintenance cost as well as the long-life of the bridges, the lecture contents should be elaborated in a way that would promote the understanding of preventive maintenance.

2）Practice and Workshop

In addition to serving as a field validation of the contents the trainees learned in the lecture above, this practice and workshop is intended for them to utilize inspection results and data for the purpose of developing applied skills and practicing said skill in practical operations after they return. When carrying out the practice and workshop, the existing road infrastructure and similar facilities should be used, and the program needs to make it possible to learn techniques by practicing inspection and diagnosis of. Also, the evaluation of the soundness based on the inspection results may vary depending on the inspectors and for that reason we aim to deepen the understanding of how to use the inspection and diagnosis results of road infrastructure and to create independence among trainees by comparing, discussing and presenting the evaluation results with each other and understanding their differences.

3）Inspection in Related Facilities and Routes in Service

In addition to the knowledge obtained in lectures, this inspection program will be conducted in related facilities and in routes in service in order to acquire knowledge and skills closer to their business. In

inspections at related facilities, such as factories manufacturing construction materials and research institutions, the major objective is to learn the techniques of Road AM and systems and in inspections at routes now in service, the major objective is to learn consideration of safety and implementation methods.

4）Creation Guidance and Presentation of an Action Plan

In order to promote the maintenance and management operations of road infrastructure in line with the situation of each country, the company will guide the creation of action plans tailored to challenges of each country after considering the country report and the status of maintenance and management operations of road infrastructure. Furthermore, we will let each trainee present their action plan and they will discuss and evaluate the plan in order to deepen mutual understanding between trainees and persons concerned in Japan.

The long-term training program is intended to have long-term trainees participate once during their studies in Japan. After the return of long-term trainees, we will choose the inspection destination that would be helpful in carrying out activities for the establishment of the Road AM. We will study content that can be understood efficiently in a short period of time, including the most advanced efforts by expressway companies to those which can be implemented right away.

1.4.8 Report Preparation, etc. T8

The results of the above survey are summarized as a report.

The business flow is shown in Figure 1-1.

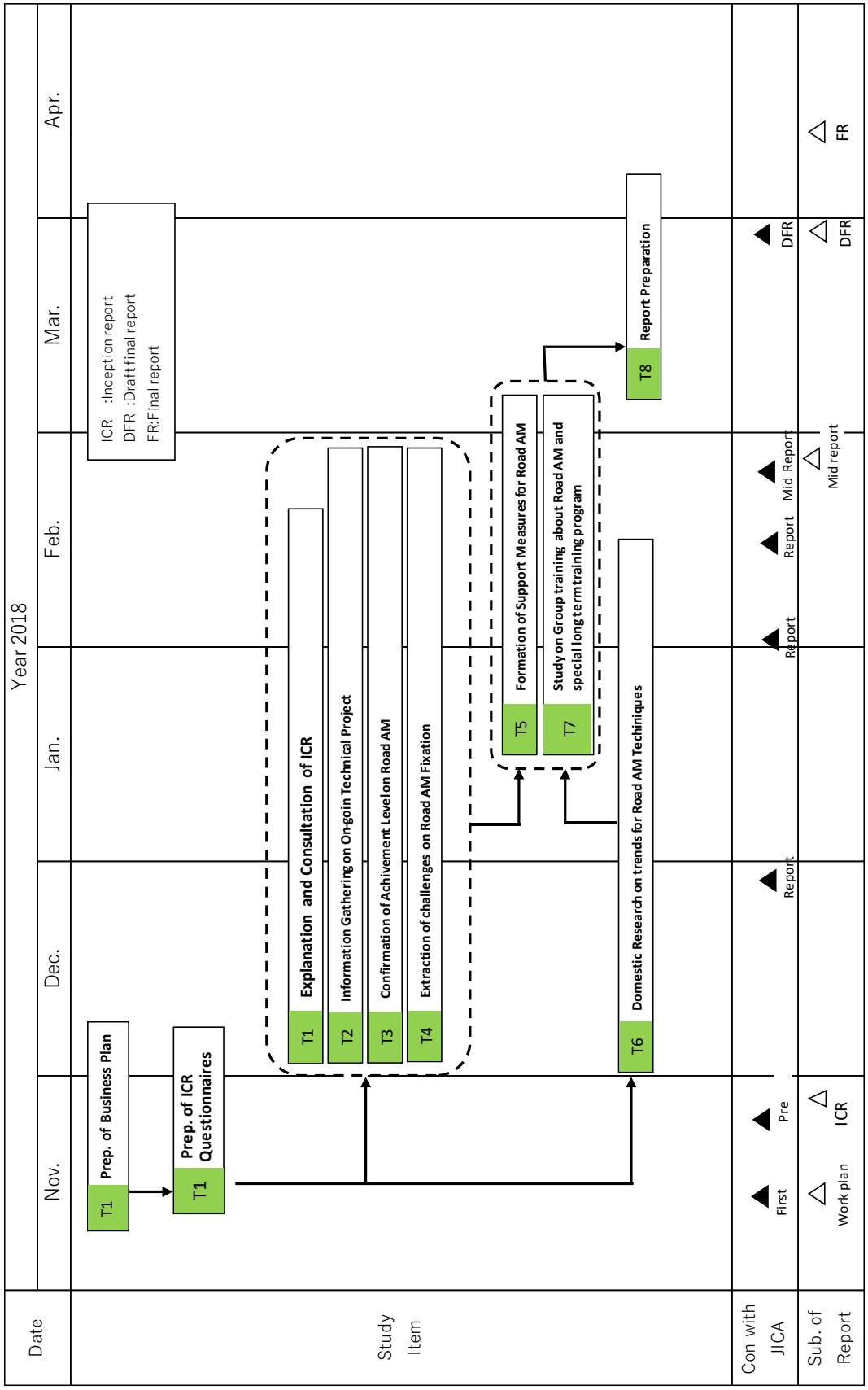


Figure 1-1 Business Flow

1.5 Sites to be Surveyed

The following three countries, which implement Technical Projects that contribute to a strengthening of the maintenance capacity of road infrastructure, are to be targeted.

Table 1-1 Sites to be Surveyed

Name	Target Project	Target Site
Pakistan	Bridge maintenance and management project	Bridges and culverts of national roads managed by National Highway Authority (hereinafter referred to as "NHA") throughout Pakistan. (Model district is around Islamabad.)
Kenya	Project phase 3 for strengthening management ability in an outsourcing of road maintenance business	Throughout Kenya
Ethiopia	Project for capacity development for road maintenance management in Addis Ababa City	Addis Ababa City, Ethiopia

1.6 Counterpart Agencies

Table 1-2 Counterpart Agencies

Country	Name
Pakistan	NHA, Ministry of Communications
Kenya	Ministry of Transport and Infrastructure, Housing and Urban Development,
	Kenya National Highways Authority (KeNHA),
	Kenya Urban Roads Authority (KURA)
	Kenya Rural Roads Authority (KeRRA)
Ethiopia	Addis Ababa City Road Authority

Chap. 2 Identification Method of the Road Infrastructure Maintenance Capacity of Target Countries

2.1 Identification Method for the Achievement Level of Road AM

The evaluation sheet of Road AM is used to confirm the achievement level of the Road AM. The evaluation items are broken down to the point where they can be evaluated and scored at a detailed level and, finally, set up comprehensively using the same items so that a comparison between multiple countries is be possible. Each score for middle items shall be the simple average of the details contained in the area and each score of large items shall be the simple average of the details contained in the area. The Road AM achievement level is to be evaluated by the evaluation items and contents of the Road AM evaluation sheet shown in Table 2-1.

Achievement levels should be set up in such a way that strengths can be developed, and weaknesses can be overcome through a support plan with the clarification of strengths and weaknesses by scoring the achievement levels of each item. In Table 2-1, the evaluation items are divided into technical and operational items, and the technical items evaluate whether the PDCA cycle of inspection, diagnosis, repair planning, repair implementation and recording for road maintenance management is functioning or not. The operational items evaluate the maintenance situation of the indispensable platform to strongly promote the PDCA cycle above in such fields as organization, human resources, financing and system maintenance. The structural diagram of the evaluation sheet (example) is shown in Figure 2-1.

Table 2-1 Evaluation Items and Contents

	Major Items	Contents
Technical Items	Inspection	Check if inspections are regularly conducted using appropriate methods, content and personnel.
	Diagnosis	Check if the cause is being investigated for the damages observed in the inspection and also if a scale has been created to divide repairs according to urgency and importance.
	Repair Plan	Check if appropriate measures according to the cause and extent of the damage are being planned in the middle and long term. Check if the idea of preventive maintenance has been adopted.
	Maintenance Management	Check if daily maintenance (cleaning, mowing, and small repairs) is carried out regularly in a proper manner.
	Repair Work	Check if planned measures are being carried out with superior quality.
	Record	Check if inspection and repair results are properly being recorded and stored and if aged deterioration is monitored.
Operational Items	Organization and Structure	Check if a necessary number of people with willingness and ability are employed and if they are working in cooperation with other departments to promote Road AM.
	Budget and Funding	Check if the budget is properly planned and the necessary funding is available. Also, check if the financial resources for road maintenance are secured.
	Bidding and Contract System	Check if the bidding and contract system has improved and the outsourcing of maintenance and repair work is effectively carried out after an appropriate estimation by the ordering party.
	System, DB	Check if a database (hereinafter referred to as “DB”) to manage assets is improved and if asset management is efficiently implemented using various systems.

Transportation Asset Management Guide (hereinafter referred to as “TAM Guide”) scores each item in five (5) stages on a scale of 1 -5 (Level 1 being the initial stage, 2 being awakening stage, 3 being

structured configuration stage, 4 being development stage and 5 being best practice). The definition is shown in Table 2-2.

Note that among breakdown items, there are some items to ask simply presence/absence or implemented /not implemented, the goal of achievement of those items was level 3. In addition, the degree of achievement of breakdown which up to was calculated level 3 as 100%. and the degree of achievement of breakdown which up to level 5 was calculated level 5 as 100%.

Table 2-2 Level Definition of Evaluation Items (TAM)

Level	Definition
Level 1 Initial Stage	There is no effective technical support in asset management. Only data prescribed as duty is to be collected and they are not being used for communication between internal control and interested persons. Also, there are no internal flows concerning information about business results.
Level 2 Awakening Stage	Basic data collection and processing is performed. PMS and BMS, commercially available software, are being used for the mere purpose of controlling the data base instead of using them as a forecast or decision-making tool. Data collection beyond required items is being conducted in order to answer or tackle challenges from management. There are no internal flows concerning information about business results.
Level 3 Structured Configuration Stage	The information system forms the nucleus of the activity. Decision makers will be informed of the financial forecasts quantitatively and of the basic information about the mission of an organization. Within an organization, the data is processed vertically, from the bottom to the top, and the target is transmitted from the top to the bottom. Consistency with business result and communication have been promoted within an organization, but they are not summarized. Internal flow concerning information about business results is vertical.
Level 4 Development Stage	With the aim of implementing resource distribution and cost management, information about business results is used to manage on-going activities. The prediction model is used to predict the outcome of alternative proposals. The current and projected results are to be communicated to external stakeholders as a means of financing and securing desirable outcomes. The manager relies heavily on this information about business results. The internal flow concerning information about business results is both vertical and horizontal, and it is a prediction of the achievements of a decision.
Level 5 Best Practices	Information technology of the asset management is used to regularly design new and more efficient tools and processes. Continuous improvement of informed decision making and its quality is present at all levels of the organization. The internal flow concerning information about business results is both vertical and horizontal, and it is a continuous process of improvement.

Source: TAM Guide

Using this as reference, the definition of the level of final survey items was set in Table 2-3. In the Technical Project, we will continue to support the goal of level 3. The structural diagram of the evaluation sheet (example) in Figure 2-1, the radar chart of the middle items (example) shown in Figure 2-2. The Blue line in the figure shows the current status, and the Orange line is the achievement expectation assuming five years after the end of the technology project.

Table 2-3 Level Definition of Evaluation Items (The Survey)

Level	Definition
Level 1 Initial Stage	There is no effective technical support in asset management. Inspection, diagnosis, planning of repair plans, maintenance, repair work, records are not implemented. Organization, budget and financing, bid/contract system, systems, DB are not established. There is hardly any communication in or between organizations.
Level 2 Awakening Stage	Asset management collects and processes basic data. Inspection, diagnosis, planning of repair plans, maintenance, repair work, records are partially implemented. Organization, budget and financing, bid/contract system, systems, DB are partially established. Communication in or between organizations is limited.
Level 3 Structured Configuration Stage	Asset management system forms the nucleus of the organizational activity. Inspection, diagnosis, planning of repair plans, maintenance, repair work, records are implemented. Organization, budget and financing, bid/contract system, systems, DB are established. Communication has been promoted in or between organizations, but it is not systemized.
Level 4 Development Stage	Asset management system is being used for resource allocation, cost management and business result management. Inspection, diagnosis, planning of repair plans, maintenance, repair work, records are being systematically operated. Organization, budget and financing, bid/contract system, systems, DB are established and are being systematically operated. Communication has been promoted in or between organizations.
Level 5 Best Practices	Information technology of asset management is used to regularly design new and more efficient tools and processes. Inspection, diagnosis, planning of repair plans, maintenance, repair work, records are being systematically operated. Organization, budget and financing, bid/contract system, systems, DB are improved and being systematically operated. Communication has been promoted in or between organizations and is being improved continuously.

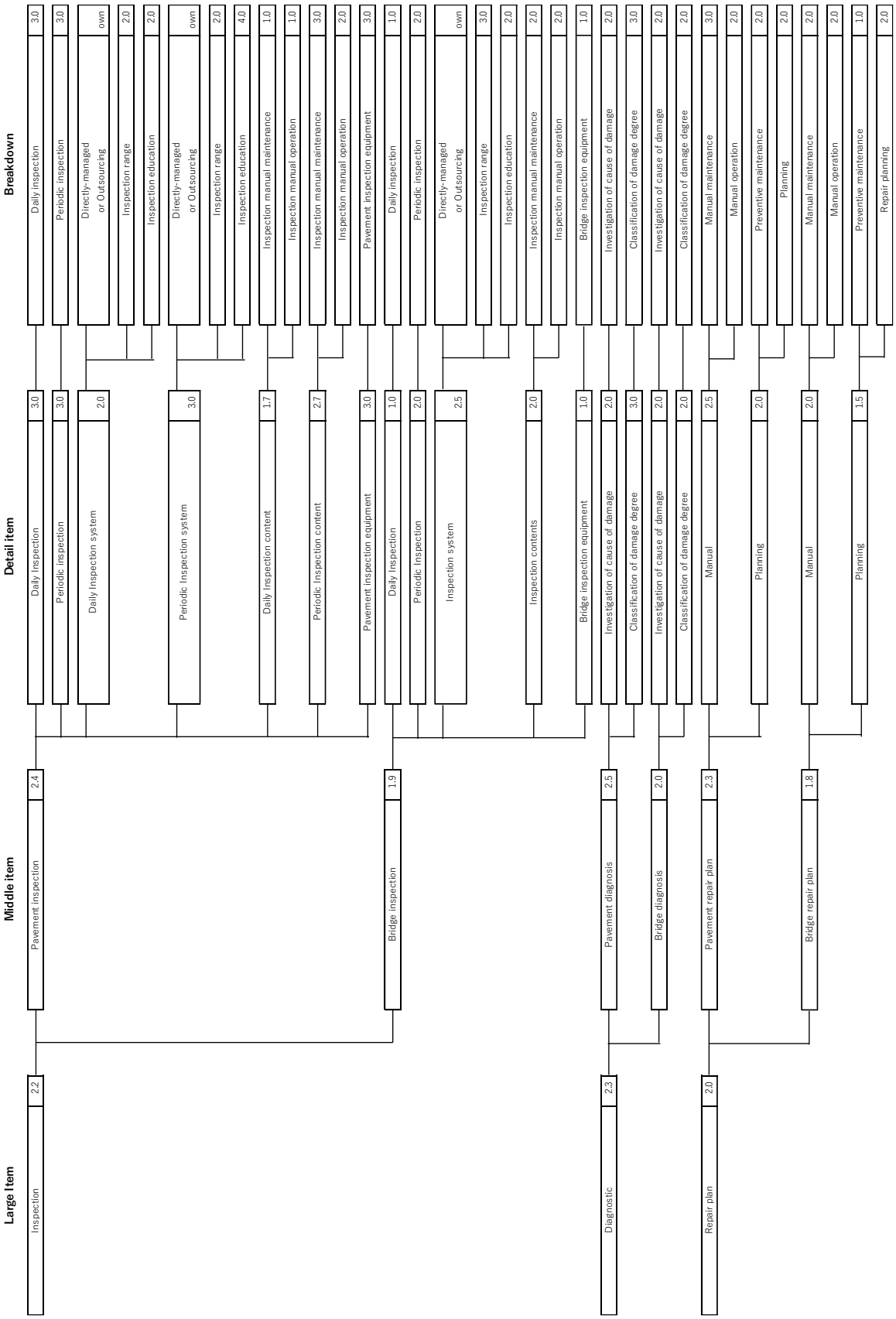
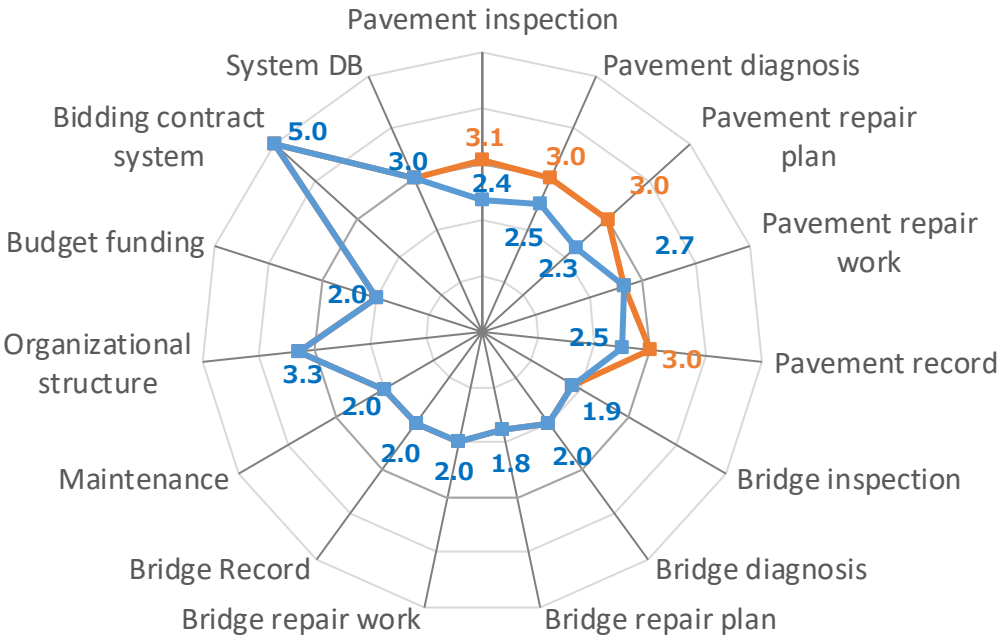


Figure 2-1 Road AM Evaluation Index Structure Diagram (Example)



Note: The Blue line in the figure is current status, and the Orange line is expected achievement of five years after the end of the technical project

Figure 2-2 Road AM Evaluation Index (Middle Items)

2.2 Notes on Field Surveys

Regarding the elements not considered in the evaluation sheet, such as the needs of other countries, various restrictions, opinions from Technical Project specialists, counterparts (C/P), construction companies, etc., they should be positively extracted for the challenges, countermeasures, and Japan's supporting measures. Field surveys will be investigated based on the matters shown in Table 2-4 below.

Table 2-4 Survey Contents of Field Surveys

Project	Method	Target person of Meeting	Remarks
Understanding of the Technical Project progress status	Questions about the content and current status of Technical Projects	Technical Project expert, C/P	Limited to target areas of Technical Project
Understanding of Road AM general challenges and grasping of the situation on a local level	Scoring by a Road AM evaluation sheet	Above + person in charge of Road AM in said country	Object domain of Technical Project is centered, but outside of its domain is covered wherever possible.
	Scoring by a qualitative sheet	Same as the above	

Chap. 3 Current Situation, Challenges and Support Measures of Road AM in Pakistan

3.1 Background of the Technical Project

Pakistan is bordered by India to the east, China to the northwest, Afghanistan to the northwest, Iran to the west and the Indian Ocean to the south. This geographical position relation makes the transportation network highly important in the respect of being trade routes for neighboring countries as well as domestic transit routes. Built by the local government from the early 1960s to 1970s, the highway was a single-lane simple paved road without typical design standards and specifications. Then, fast-growing urbanization, poor maintenance management and undeveloped highway drainage caused rapid aging of the roads. Therefore, the Government decided to designate important interstate roads as federal roads in 1978 and established the National Highway Board (NHB) as an organization that takes over the construction and maintenance of the Allied Highway. After receiving approval from Congress in 1991, the National Highway Authority (hereinafter referred to as "NHA") was established as an organization to inherit the NHB. NHA's mission is to "plan, promote, organize and implement strategic road improvements and programs for maintenance, which were specially commissioned for the construction, development and maintenance of national highways by the federal government or local governments."

Of the 263,000km (2013) of total extensions of the road in Pakistan, those of the national highways account for 12,131km (2013), but the use of national roads represents 80% of domestic transportation with the higher level of importance. National highways are managed by the NHA which is owned by the Ministry of Transport and Communication. Regarding the road pavement, a maintenance plan is being established using HDM-4, a software for the establishment of a maintenance plan introduced in 2003 and a Road Asset Management System (hereinafter referred to as "RAMS"), which was introduced into the Highway Rehabilitation Project (hereinafter referred to as "HRP") of the World Bank in 2008. Also, as one of the systems within RAMS, maintenance data on bridges has been accumulated and the Bridge Management System (hereinafter referred to as "BMS"), a tool for repair planning, has also been established.

On the other hand, approx. 5,000 bridges on the national highways and around 16,000 culverts have had no maintenance plan with no regular inspection although they have experienced an increase in traffic, widespread over loading, early deterioration due to improper design and construction failure and high risk for damages. As a result, the current state is that of corrective maintenance, in which repairs are carried out each time damages are found. However, the situation is already such that countermeasures by repairing was difficult when the damages were found, which caused the bridges to need reconstruction even though the bridges had not reached their design life yet.

Based on this situation, the Government of Pakistan invited the technical cooperation of Japan in order to introduce preventive maintenance management utilizing BMS. In response to this, JICA conducted a detailed planning survey in May and July of 2012 to confirm the necessity and appropriateness of the request, confirmed the contents of the request, performed a review, proposed an arrangement, necessary cooperation, and discussion, and finally JICA concluded the agreement document (Record of Discussions: R/D) on the framework of the Bridge Maintenance Management project in July 2015 to implement a Technical Project.

3.2 Overview of Road Maintenance and Management in NHA

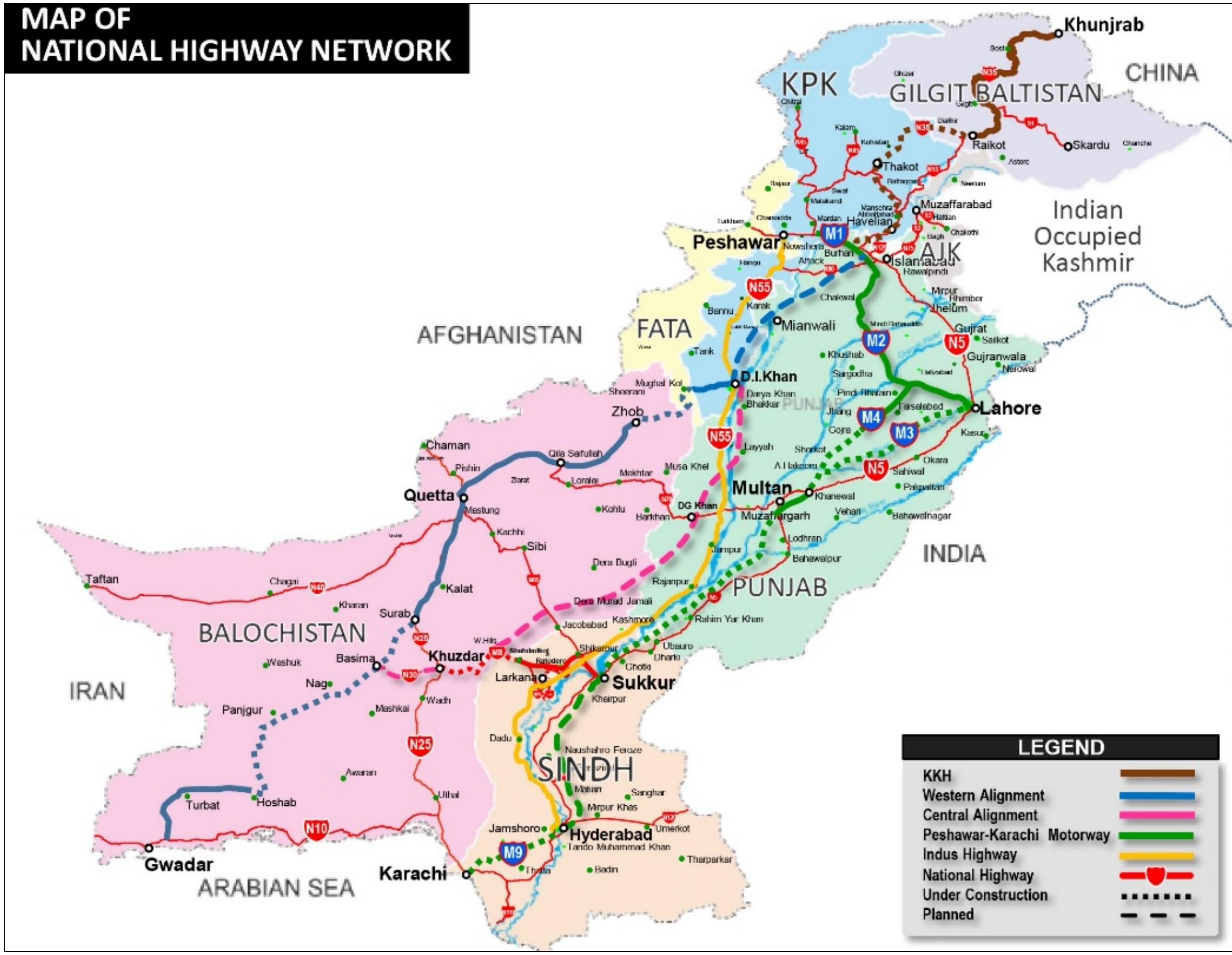
3.2.1 Road Maintenace and Management Extension in NHA

The total extension of the road to be managed by NHA is 12,131km and consists of 26 routes of full-access national highways (9,489km), 3 routes of military-targeted strategic roads (262km), one expressway (100km) of limited access control, and 9 routes of a full control access motorway (2,280km). These routes correspond to only 4.6% of the total road extension but plays an 80% role in logistics. Among these, N5 plays a 65% role in the logistics of the main artery. The current highway network is

insufficient to meet the increasing demand resulting from rapid development. It is necessary to consolidate, maintain and improve current road assets. At the same time, it is also important to gradually expand road networks in remote areas to improve access between the economic center and the provinces and it is necessary to expand cross-border transportation as well. The Road Asset Management Department (RAMD), the NHA's roadway management division, has 12 regional offices under their control and has 49 maintenance offices below them. Daily inspections and simple repairs are carried out at the individual maintenance offices. The administrative range of the management office is 200km from 150km.

3.2.2 Organizational Structure in NHA

The organizational structure of NHA is shown in Figures 3-2 to 3-5. NHA RAMD belongs to an organization under the supervision of the Planning Director (Member planning) having four departments (RAMS, Highway safety, OMU, Business Promotion). In addition to instructions on repair work, RAMS has formulated a budget plan using PMS and BMS. There are many vacancies in the organization, and the small number of departments that operate within RAMS is viewed as an issue. With the Director and Deputy Directors (hereinafter referred to as “DD”) of RAMD focused on this Technical Project, the project is being implemented to form Bridge Management Unit (hereinafter referred to as “BMU”), a different unit.



S#	Road Description		Length (kms)
1	Northern Route		784
-	Khunjrab-Raikot		335
-	Raikot-Thakot		270
-	Thakot-Havelian		120
-	Havelian-Burhan		59
2	Western Alignment		2,461
-	Northern Route		784
-	Burhan-D.I.Khan		285
-	D.I.Khan-Zhob		205
-	Zhob-Quetta		331
-	Quetta-Surab		214
-	Surab-Hoshab		449
-	Hoshab-Gwadar		193
3	Central Alignment		2,545
-	Northern Route		784
-	Burhan-D.I.Khan (Partial Western Alignment)		288
-	D.I.Khan-Jampur		250
-	Jampur-Wangu Hills		363
-	Wangu Hills-Khuzdar		108
-	Khuzdar-Basima		110
-	Basima-Gwadar (Partial Western Alignment)		642
4	Peshawar-Karachi Motorway		1,512
-	Peshawar-Islamabad		155
-	Islamabad-Pindi Bhattian		235
-	Pindi Bhattian-Multan		298
-	Multan-Sukkur		392
-	Sukkur-Hyderabad		296
-	Hyderabad-Karachi		136
5	N-5	Karachi-Lahore-Peshawar-Torkham	1,819
6	N-5A	Khanewal - Bahawalpur (Lodhran)	109
7	N-10	Makran-Coastal; Liari-Ormara-Gwadar-Jiwani	653
8	N-15	Mansehra-Naran-Jalkhad-Chilas	240
9	N-25	Karachi-Kalat-Quetta-Chaman (Partial Western Alignment)	813
10	N-35	Hassanabdal-Thakot-Khunjrab (Partial Northern Route)	806
11	N-40	Lakpass-Dalbandin-Taftan	610
12	N-45	Nowshera-Dir-Chitral	309
13	N-55	Kotri-Larkana-D.G.Khan-D.I.Khan-Peshawar	1,264
14	N-65	Sukkur-Sibi-Quetta	385
15	N-70	Multan-D.G.Khan-Loralai-Qila Saifullah	447
16	N-75	Islamabad-Satra Mile-Lower Topa-Kohala	90
17	N-80	Tarnol-Fateh Jang-Jand-Khushal Garh-Kohat	146
18	N-90	Khwazakhela - Besham	64
19	N-95	Chakdara - Kalam	136
20	N-105	Larkana - Naudero - Lakhi	61
21	N-110	Gharo - Keti Bunder	90
22	N-120	Hyderabad - Mirpurkhas - Umarkot - Khokhrapar (Indian Border)	220
23	N-125	Taxila - Khanpur - Haripur	44
24	N-155	Larkana - Moenjo Daro Road up to Airport	28
25	N-255	Larkana - Nasirabad via Rasheed Wagan	34
26	N-305	Sakrand - Shaheed Benazirabad	35
27	N-455	Larkana - Kamber - Shahdadkot	50
28	N-655	Ratodero - Naudero Road incl. Internal Road of about 2 Km	18
29	S-1	KKH-Skardu Road (Strategic Road)	167
30	S-2	Kohala-Muzaffarabad	40
31	S-3	Muzaffarabad - Chakothi	55
32	M-3	Lahore-Abdul Hakeem	230
33	M-10	Karachi Northern Bypass	57

Figure 3-1 NHA Road Network Diagram

Source: NHA website
http://NHA.gov.pk/wp-content/uploads/2016/04/NHA-Road-Network-Maps-of-Projects-02.01.2012-Part-01.pdf

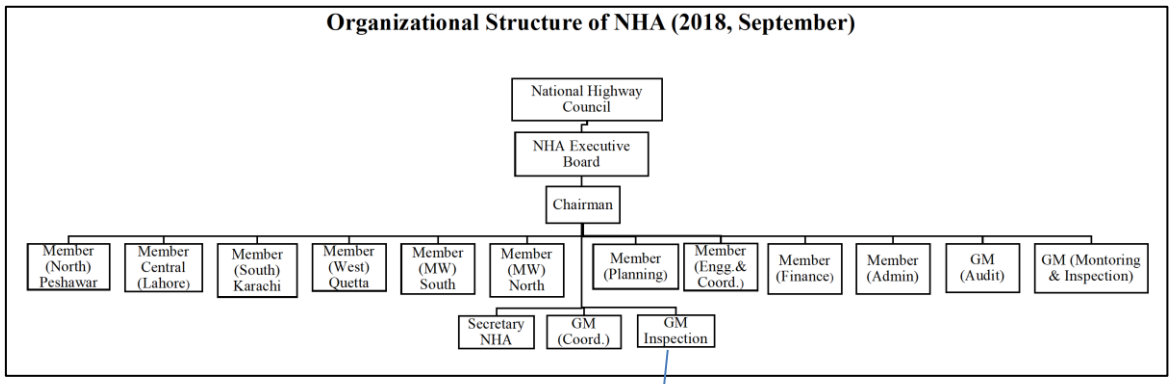


Figure 3-2 Organization chart of NHA

Source: Technical Project Team

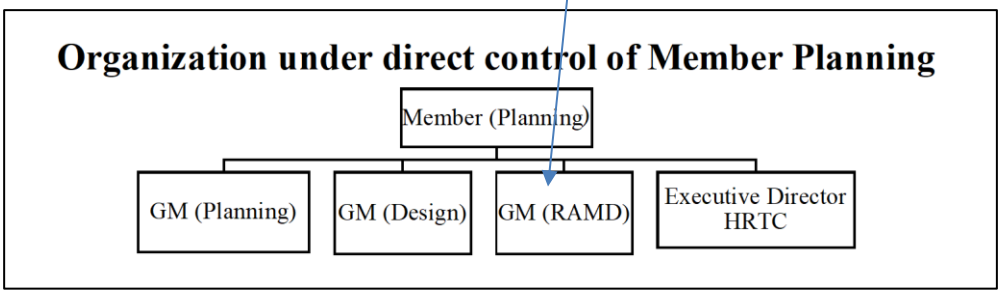


Figure 3-3 Organization chart of Planning Department

Source: Technical Project Team

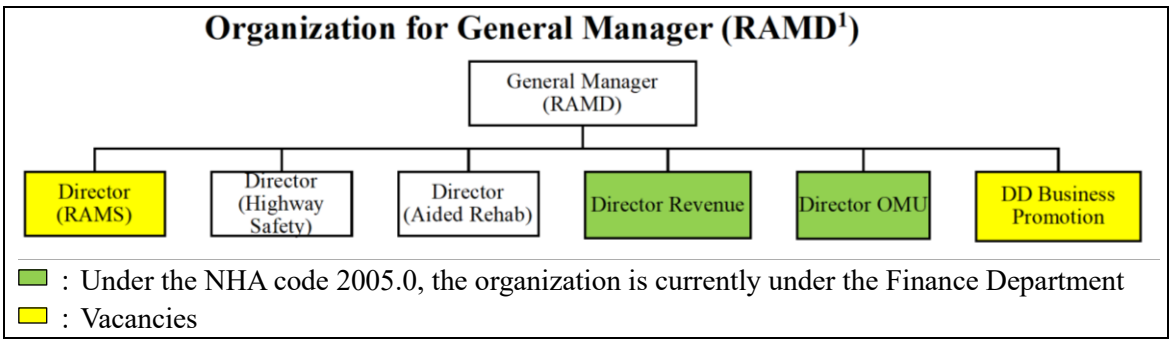


Figure 3-4 Organization chart of RAMD

Source: Technical Project Team

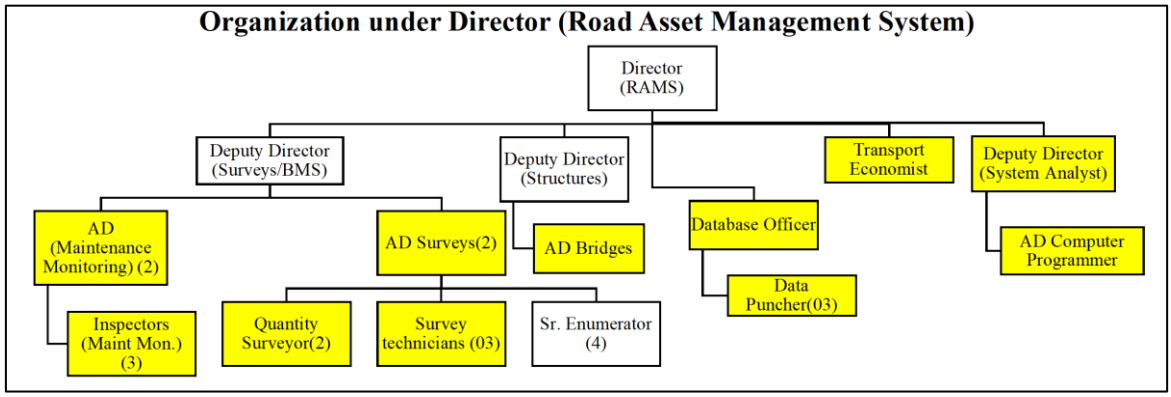


Figure 3-5 Organization in RAMS

Source: Technical Project Team

A shortage of manpower has been created because new staff has not been hired for more than ten years, and it was difficult for the company to proceed with enough project activities with only six C/P. Under the guidance of Technical Project experts, C/P are expected to guide engineers at local offices as trainers. Also, from the second half of the project, eight temporary employees were hired for a total of ten personnel on the project. As a result, technology transfer through the bridge inspection OJT and bridge inspections in target model regions (36 bridges, 5 culverts) was achieved. The future includes direct inspections of around 400 bridges and culverts by hiring another four-temporary staff in 2 years as a short-term plan. In the medium-term plan, the company intends to outsource a total of 4,000 bridges to consultants.

Table 3-1 Technical Project Implementation System (BMU)

Personnel	Title	Name
Person in Charge	Member (Planning)	Mr. Raja Nowsherwan (～2017.10)
		Mr. Asim Amin (2017.10～2018.10)
	Member (Engg. & Cord.)	Mr. Arbab Ali Dhakan (2018.10～)
Project Manager	General Manager (RAMD)	Mr. Ikramus Saqlain Haider
Project Coordinator	Deputy Director (BMU-Ⅰ)	Mr. Muhammad Asif Azam
Counterpart Personnel	Deputy Director (BMU-Ⅱ)	Mr. Ghulam Murtaza Simair (2018.1～)
	Deputy Director (BMU-Ⅲ)	Mr. Sohaib Mansoor (2018.1～)
IT Engineer	Assistant Director	Mr. Ashfaq Ahmed (2018.7～)

Source: Technical Project Team

3.2.3 Budget for Road Maintenance and Management

The source of maintenance and management of the national highways is by means of fee collection, fines for overloading and licensing fees. On the other hand, construction of new roads has been funded by the General Fund. The maintenance budget has been implemented incorporating the Annual Maintenance Plan (AMP) for each business year. Since there are no techniques to calculate bridge maintenance costs, the bridge maintenance cost is secured only as a preliminary expense. In the maintenance budget, priority is given to road surface repairs with a small allocation to bridge maintenance and management. Bridge repair by corrective maintenance is treated as an emergency budget item, and it is desirable to have a budget for maintenance and management of materials as preventive maintenance (planned maintenance).

Within the maintenance budget (daily inspections, periodic inspections, rehabilitation, safety measures, toll stations, weight stations, administrative costs, emergency measures, design costs, linear improvements, bridges and culvert repairs, etc.), the amount for bridges and culverts was 3.8% (business years 2014-2015).

Because of this, it is becoming very important to estimate a rough budget amount when formulating a maintenance plan for each year. According to the "Maintenance Program 2012 – 2014," the total amount of maintenance and management is approximately 27 billion PKR (21.6 billion yen: 1 PKR = 0.8 yen), daily maintenance is about 4.9 billion PKR (3.9 billion yen: 1 PKR = 0.8 yen, 18%), regular maintenance is about 1.3 billion PKR (1 billion yen: 1 PKR = 0.8 yen, 5%), and maintenance of bridges and culverts is about 1 billion PKR (800 million yen: 1 PKR = 0.8 yen, 4%).

Table 3-2 NHA Maintenance and Management Program

Sr. No.	Description	Amount (Rs. M)	No. of Contracts	Length (Kms)
1	Routine Maintenance	4893.966	887	18427.84
2	Periodic Maintenance	13425.52	95	1397.106
3	Rehabilitation	2193.643	17	142.839
4	Highway Safety	597.6014	169	-
5	Corridor Management (Trauma centers)	1.951571	1	-
6	Toll Plazas & Weigh Stations	280.7639	25	-
7	Administrative expenses (services)	31.93738	6	-
8	Logistic expenses / Survey Equipments	109.729	2	-
9	Special Maintenance (Preventive & Reactive)	831.2846	215	-
10	Emergency maintenance allocation	3717.767	332	-
11	Consultancy for Design Review & Supervision	6.255	1	-
12	Geometrics Improvement	166.5561	9	11.35
13	Bridge / Culvert Structural Maintenance	1023.539	144	-
	TOTAL	27280.51	1903	19979.14

1 million rupees (3.8% of total maintenance expenses) was used for the maintenance of bridges and box beams.

Source: Technical Project Team

3.3 Overview of the Technical Project

3.3.1 Objectives of the Technical Project

Based on the current state of Pakistan, we will establish manuals and formats necessary for the examination of bridge inspections and will implement a technology transfer through training so that

personnel in NHA that are directed at bridges/culverts can review bridge inspections with unified contents, standards and repair methods. Another objective is to improve transport infrastructure in Pakistan by utilizing the Bridge Management System (BMS) and bridge inspection database to estimate yearly bridge maintenance costs and conduct planned bridge maintenance. The model project covers 36 bridges and 4 culverts in the Rawalpindi and Wairabad around Islamabad where the NHA headquarters is located.

It is said that there is a total of 4,400 bridges and about 15,000 culverts in the entire NHA, but they are currently under a stage of reinvestigation and the total number is expected to change. Furthermore, those with a span of 3m or more are defined and classified as bridges even if they are culverts in nature.

3.3.2 Overall Goal of the Technical Project

The initial overall goal was "improving bridge maintenance and the management situation of national highways throughout Pakistan," but eventually it was changed to "improving bridge inspection and the maintenance situation on the national highways." Their indicators say, "①The bridges selected based on a maintenance plan prepared in the project are being maintained and repaired following said plan. ②More than 65 bridges are inspected annually in model areas and the bridge maintenance plan is revised yearly."

The main cause of the contents of the change is that, initially, we were supposed to input inspection data surveyed at the project to BMS using the current BMS (Name: Smart Bridge) of NHA. However, after a technical project team reviewed the existing BMS, it turned out that enhancements of the program were impossible despite the necessity of improvements and updates of the data, thus a new BMS was developed in a technical project.

3.3.3 Project Purpose of the Technical Project

The goal of the project is set as "preparing the annual plan for bridge maintenance and management" based on the results of the latest bridge inspections on national highways in the model area. The indicator says, "bridge maintenance plans for the model areas will be created by November 2018."

3.3.4 Expected Effects of the Techical Project

The following three items are listed as expected effects (achievement).

Table 3-3 Expected Effects

Output 1	The manuals, databases and BMS necessary for the inspection and repair of bridges are established.
Output 2	After BMS training, bridge/culvert inspections of the model areas will be carried out.
Output 3	The bridge data in the model areas can be utilized at the BMU of the headquarters, and the Bridge Maintenance Management plan is formed based on the data.

3.3.5 Activities of the Technical Project

Table 3-4 Activities

Output 1	The manuals, databases, and BMS necessary for the inspection and repair of bridges are established.	
	Activity 1	Prepare manuals (draft) on inspections, repairs and data entry for bridges and culverts.
	Activity 2	Prepare formats for the inspection of bridges and culverts.
	Activity 3	Prepare a bridge inspection database and a new BMS prototype.
	Activity 4	Prepare training materials for inspection and repair of bridges and culverts.

	Activity 5	Bridge Management Unit (hereinafter referred to as "BMU") will revise and finalize the above manuals, formats, prototypes and training materials.
Output 2	After BMS training, bridge/culvert inspections of the model areas will be carried out.	
	Activity 1	BMU provides OJT so that BMS training, to be held by NHA, can be operated.
	Activity 2	BMU provides BMS training (road status survey, bridge inspection).
	Activity 3	After BMS training, OJT for survey on road status and bridge inspection will be provided.
	Activity 4	Evaluate inspection results and the ability to provide advice for improving the performance of the BMU.
Output 3	The bridge data in the model areas is made available at the BMU of the headquarters, and the bridge maintenance management plan is developed based on the data.	
	Activity 1	Training on data base (hereinafter referred to as "DB") on bridge inspection and BMS software will be provided for BMU.
	Activity 2	Data on bridge inspection at the model areas in DB will be analyzed using BMS.
	Activity 3	Based on the analysis of the bridge inspection DB registration data, BMU will create an annual plan for maintenance and management of bridges and culverts, including the estimated budget.

3.3.6 Manuals Introduced in the Technical Project

(1) Introduced Manuals

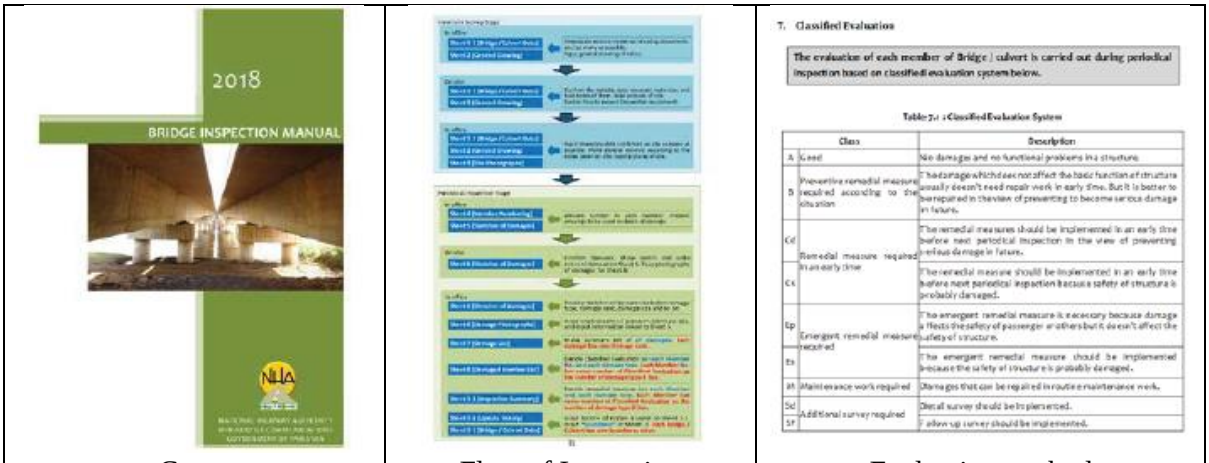
Manuals and their overviews, which are prepared in Activity 1 of the Output 1 of the Technical Project, "prepare manuals (draft) on inspections, repairs and data entry for bridges and culverts," are shown below.

Table 3-5 Manuals Introduced

Name of Manual	Overview
Bridge/Culvert Inspection Manual	➢ A simplified manual taking into consideration the actual situation in Pakistan referring to the bridge inspection guidelines of Japan and the United States. ➢ In the Japanese version, 26 types of damage classification are eliminated or integrated to 17 types without limiting them to periodic inspections, and they are also applicable to daily and special inspections.
Bridge/Culvert Repair Manual	➢ Since more than 95% of the bridges to be managed are concrete bridges, the repair method focuses on methods intended for concrete. ➢ There are no cases in which repair reinforcements were implemented and most cases are of recovery. Because of this, for a construction method which is accompanied by a repair design, the method was kept to an introduction.
Input Manual for Bridge Inspection DB	➢ Items which are needed when using databases on bridge inspection including a series of input, content confirmation, flow of reflection to BMS software, operating environment, installation procedure, notes and how to operate the details are summarized.
Operation Manual for BMS Software	➢ Since the operation and the setting of the calculation of priority are important functions, the idea of priority and operation explanation are described in detail.
Management Manual for BMS Software	➢ For the operation of BMS, not only the state of the software itself but also maintenance to keep the system running continuously and steadily is required. Therefore, apart from the operation manual, a management manual which describes procedures for stable and continuous operation of BMS software is prepared.

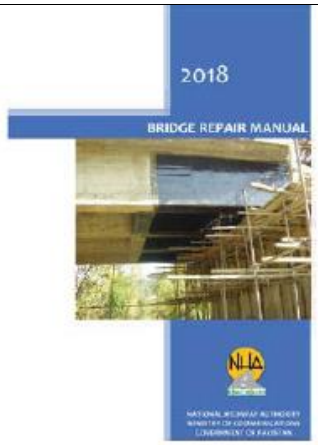
Source: Technical Project Team

Copies of the cover and the summary of each manual are attached below.



Cover | Flow of Inspection | Evaluation method

Figure 3-6 Bridge/Culvert Inspection Manual

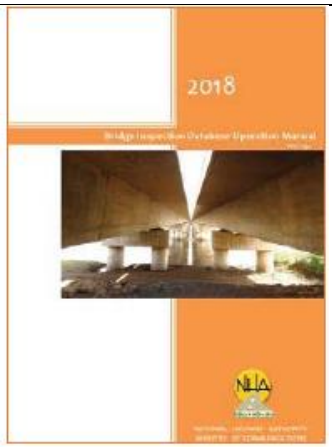


Cover

Classification of damages

Repair method

Figure 3-7 Bridge/Culvert Repair Manual



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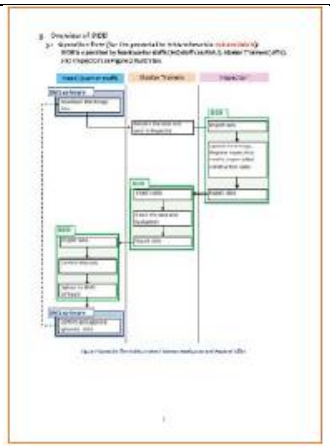
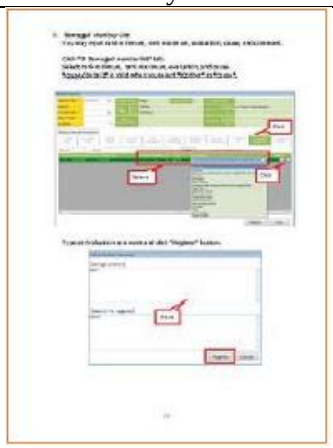


Flow of system use

Requirement for system

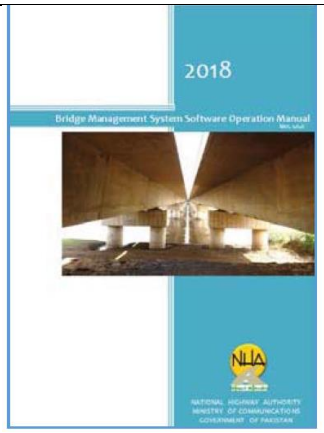
Install Instructions



Operation Instructions

FAQ

Figure 3-8 Bridge Inspection DB Input Manual



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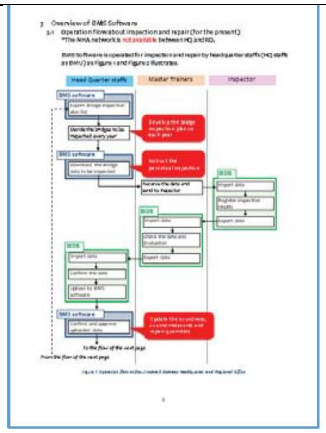
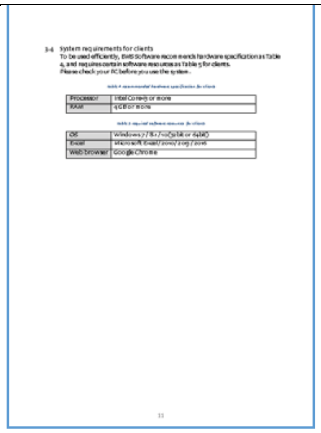
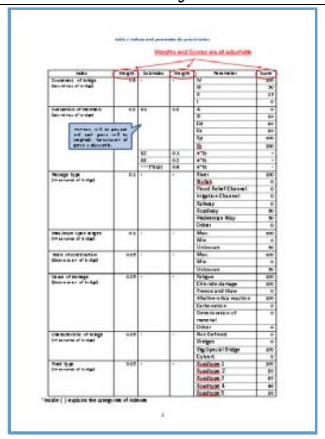


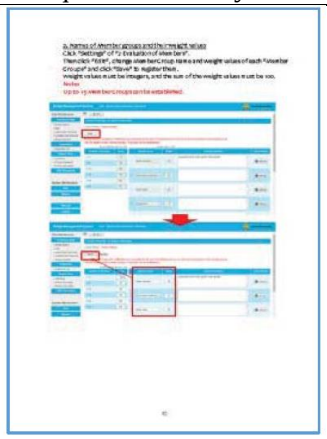
Flow of system use



Requirement for system

Determination of priority



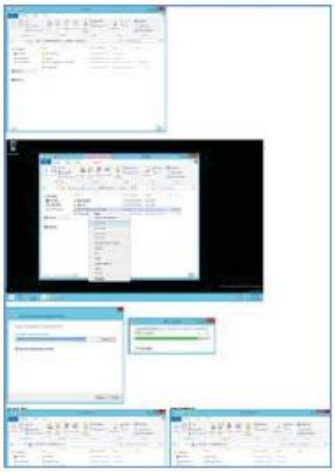


Operation Instructions

Figure 3-9 BMS Software Operation Manual

Cover

System overviews



Install instructions

Figure 3-10 BMS Software Management Manual

(2) Technical Level of Each Manual

The manuals, prepared by the technical project, consist of five items: inspection, repair, DB input, soft operation and software management.

Regarding the inspection manual, damage classification is eliminated or integrated to 17 types without limiting them to periodic inspections nor applying them to special inspection. For the repair manual, repair methods focus on methods intended for concrete. Note that for a construction method which is accompanied by a repair design, the method was kept to an introduction.

As for input of DB as well as manipulation and management of software, necessary items are summarized when using bridge inspection databases. However, human resources fostered in the technical projects need to become master trainers to check if the techniques have made the transition to the level of the person in charge at each maintenance office.

3.3.7 Achived Technical Level in the Technical Project

The following table summarizes the implementation status and the level of the technical project described in the previous section.

Table 3-6 Technical Achievement Level

Project	Level Prior to Technical Project	Achieved Level at the Present Time
Check	➢ The number of bridges to be managed is unclear. ➢ Do not even possess hammers and no inspections are being implemented.	➢ Inspection training was implemented targeting the model areas (36 bridges, 4 culverts). ➢ The record of model parts has been completed and now inspection and recording of about 400 bridges is being carried out. ➢ Maintenance of bridge inspection manuals is being prepared.
Record	➢ The number of bridges to be managed is unclear. ➢ BMS was developed in the past, but the system has not been used due to no updates to the system or data.	➢ Develop BMS and take results of regular inspection at model areas into BMS. ➢ Prepare Input Manual for Bridge Inspection DB.
Development of Repair Plan	➢ No medium- or long-term repair plans have been made due to corrective maintenance.	➢ Draft a plan of pavement repair at model areas using BMS which adopted a concept of preventive maintenance. ➢ Prepare BMS operation and management manuals.
Repair Design	➢ Measures for restoration for bridges with damage ➢ Repair work based on recovery	➢ Prepare maintenance manuals (as for methods that are accompanied by a repair design, construction methods are introduced)
Repair work	➢ Preventive maintenance work has not been carried out. ➢ Repair work based on functional recovery	➢ Prepare repair manuals (as for methods that are accompanied by a repair design, construction methods are introduced)

3.4 Construction, Maintenance Ability and Technical Level

3.4.1 Current Status of Construction Companies

After holding meetings with local construction companies and Japanese trading companies about construction, maintenance, and technical levels of the local businesses, we found that there are the

following challenges. The top 10 major construction companies are shown in Table 3-8. Note that bold letters signify a local company that held meetings.

【Technological Level of Consultant】

Many army officers get jobs at FWO, a military company. They design roads and bridges for themselves in addition to road construction and maintenance. FWO themselves possess and maintain equipment and also employs engineers and owns more than 4,000 units of construction machinery. FWO undertakes most big projects and currently maintains motorway M2 (367km between Islamabad and Lahole) on a concession agreement. This section was built by Korea with BOT and FWO took it over after 15 years of operation. A large-scale improvement work was carried out at the time of business transfer. The total extension of the motorway is about 2,500km and in the concession contract it was fulfilled in a performance-based contract. Descon Engineering, the leading company in the construction industry as high technical skills. On the other hand, small and medium-sized construction companies do not have these high technical skills with their small number of engineers and construction machinery, which bringing problems to the construction work and maintenance.

The maintenance management of the general national roads are divided into small sections of about 100km, and currently contracts are given to small companies that make successful annual bids for construction work and have been fulfilled in specification-based contracts. Small companies that have made successful bids are to maintain and manage for themselves but when they lack enough engineers or workers, they need to secure human resources on a project basis.

【Belt and Road】

A construction of two longitudinal expressways linking China and the Arabian Sea is progressing as one of the projects of Belt and Road. China has continued the construction financing for the government of Pakistan as an onerous loan. Some government officials, however, feel a sense of crisis because Pakistan is in a bad financial condition and it is likely that Pakistan will not be able to pay back the loan in the future.

【Safety Management】

As for safety management, the government has a safety management department establishing a management standard, but it is not in operation. A penalty is to be imposed in the case of a collapse or casualty accident of the bridge, but the reality is that penalties are not even charged in the case of injury or fatal accidents caused by defects on roads. When it comes to quality control, strict control done by a supervisor of the government accounts for only 10% and the remaining have not been controlled strictly. Also, an indifference towards safety by the ordering organization is a cause of neglect for safety. The supervisors on the ordering side do not say anything about safety and there is no administrative advice. You need to change the policy on the ordering side. The investment in safety may be implemented by the efforts of a company, but there is a limit.

【Quality Control】

In terms of quality control as well, they are hardly aware of securing high quality. There are many contractors doing careless work because of the excessive competition. Moreover, Japanese, Korean, European and US companies are highly conscious about quality and safety and, since they do not bring in excessive competition, there are many general contractors that want to participate in the business jointly with these companies. As a model business, it is preferable that something that will become a standard for this country is established.

【Excessive Competition】

Construction orders are now experiencing excessive competition. Chinese state companies bid by lowering the planned price by 15 to 20%. Chinese state companies take no account of the profit. Local construction companies are also in trouble with getting involved in price competition. Construction companies in China neglect quality and safety and do not stick to the work period. In the worst case,

they do not complete the construction. Overall, the impression about China is getting worse. Recently, there have been incidents where people have attacked Chinese engineers and workers.

【Securing Excellent Human Resources】

Pakistan is now dependent upon imports for construction machinery: 80% secondhand and 20% brand-new, respectively. Komatsu Ltd., a Japanese manufacturer, accounts for 70% market share while the remaining 30% are the share of Caterpillar Inc. and other manufacturers. A large quantity of construction machinery made by Komatsu Ltd. has been delivered to the Construction Technology Training Institute (hereinafter referred to as "CTTI") using ODA. CTTI is now composed of a short-term vocational course and three-year diploma course. The graduates of CTTI work as engineers at major manufacturers and the demand for them is high. Currently, there is a plan to promote CTTI to the university level and strengthening measures are being considered. If it is promoted to the university level, the graduate can be change from technician to engineer, enabling the production higher value-added human resources.

Table 3-7 Top 10 Construction Companies in Pakistan

No	Company Name	Location of Headquarters
1	Descon Engineering.	Lahore
2	**HRL (Habib Rafiq Pvt Ltd).**	**Lahore**
3	King Create Builders.	Islamabad
4	FWO (Frontier Works Organization).	Rawalpindi
5	National Logistic Cell (NLC).	Rawalpindi
6	Maqbool Associates (Pvt) Ltd.	Karachi
7	ZKB (Zahir Khan & Brothers).	Islamabad
8	Sachal Engineering Works (Pvt) Ltd.	Islamabad
9	Izhar Construction (Pvt) Ltd.	Lahore
10	Khalid Rauf & Co (Pvt) Ltd.	Lahore

Remarks: **Bold letters** signify local companies that held meetings.
Source: Itochu Corporation Ethiopia Office

3.4.2 Current Status of Consultants

After having meetings with local consultants and Japanese trading companies about the abilities of construction, maintenance and technical levels of local businesses, it turned out that the following can be suggested as problems. The top ten consulting companies are shown in Table 3-8. Note that the bold letters signify a local company that held meetings.

【Technical Level of Consultant】

Located in Lahore, NESPAK (National Engineering Services PAKISTAN), a leading company in the consulting industry, is a government-sponsored company founded in 1973. Their services include pre-feasibility studies, feasibility, surveys, evaluations, detailed designs, bids, drawings, specifications, bills of quantities (BOQ), contracts, preparing of tendering documents, bidding evaluations, construction management, contract management, services after construction and professional services. Items now under contract are 350 in the domestic market and those in foreign countries are 36. Sales in 2018 was 8.897 billion PKR (7.1 billion yen: 1 PKR=0.8 yen), profit was 725 million PKR after tax (580 million yen: 1 PKR=0.8 yen) and sales have been continuously growing since 2009.

They own five subsidiary companies (two in Pakistan, one in Saudi Arabia, Qatar, and Oman) with 1,292 specialists, 867 associate specialists and 601 support staff totaling 2,760 personnel. These figures add up to 5,000 if totaling the employees of affiliated companies and the number of contract workers. The areas of business include energy, water resources, roads and bridges, harbors, architecture, health hygiene, environment, GIS and IT. The type of consultant agreements includes blanket contracts (in the case of design) and hourly contracts (in the case of construction management).

Bridge advisors belonging to CECON of NHA play a central part in the repair work and design of widening construction work.

【Challenges of Consultant】

These challenges include a collection of consulting charges, operation in the case of receiving orders in danger areas, uncertain economic situations (rise and fall of economy) and coping with wrongful acts. A significant fluctuation of order volume depending on the economy is a problem. In the case of NESPAK it is even more so because they are doing almost all of their work in-house. This comes from a commitment to quality without relying on outsourcing and they have received consulting work setting up joint ventures with foreign firms.

They are working on operations such as revitalization of the existing overseas offices, diversification in other countries, capacity building, recruitment of talented personnel, continuous efforts to train existing staff in order for them to provide excellence, an introduction of an IT system for efficient work and paperless environments, standardization of report formats, video conferencing systems at all NESPAK offices, connections through Skype and securing data storage at external sources.

Table 3-8 Top 10 Consulting Companies in Pakistan

No	Company Name	Location of Headquarters
1	**NATIONAL ENGINEERING SERVICES PAKISTAN(PVT) LTD**	Lahore
2	ASSOCIATED CONSULTING ENGRS-ACE (PVT) LTD	Karachi
3	REPUBLIC ENGINEERING CORP. PVT LTD	Lahore
4	OSMANI & CO (PVT) LTD	Karachi
5	REPUBLIC ENGINEERING CORP. PVT LTD.	Lahore
6	CONSULT-TECH	Karachi
7	CIVELECMEC ENGG CONSULTANTS	Lahore
8	ZAHEERUDDIN CONSULTANTS (PVT) LTD	Karachi
9	M/S TECHNO CONSULT INTERNATIONAL (PVT) LTD	Karachi
10	NATIONAL DEVELOPMENT CONSULTANTS (PVT) LTD	Lahore

Remarks: **Bold letters** signify local companies that held meetings.
Source: Itochu Corporation Ethiopia Office

3.5 Confirmation of Achievement Level on Road AM

3.5.1 Structural Drawing of the Road AM Evaluation Index

The structural drawing of the Road AM Evaluation Index is shown in Figure 3-11. This table lists specific figures through interviews and local confirmation. Also, small items show the average value of the details, middle items show the average value of the small items, and large items show the average value of the middle items. The numerical value of the expansion of other areas is a discrete item.

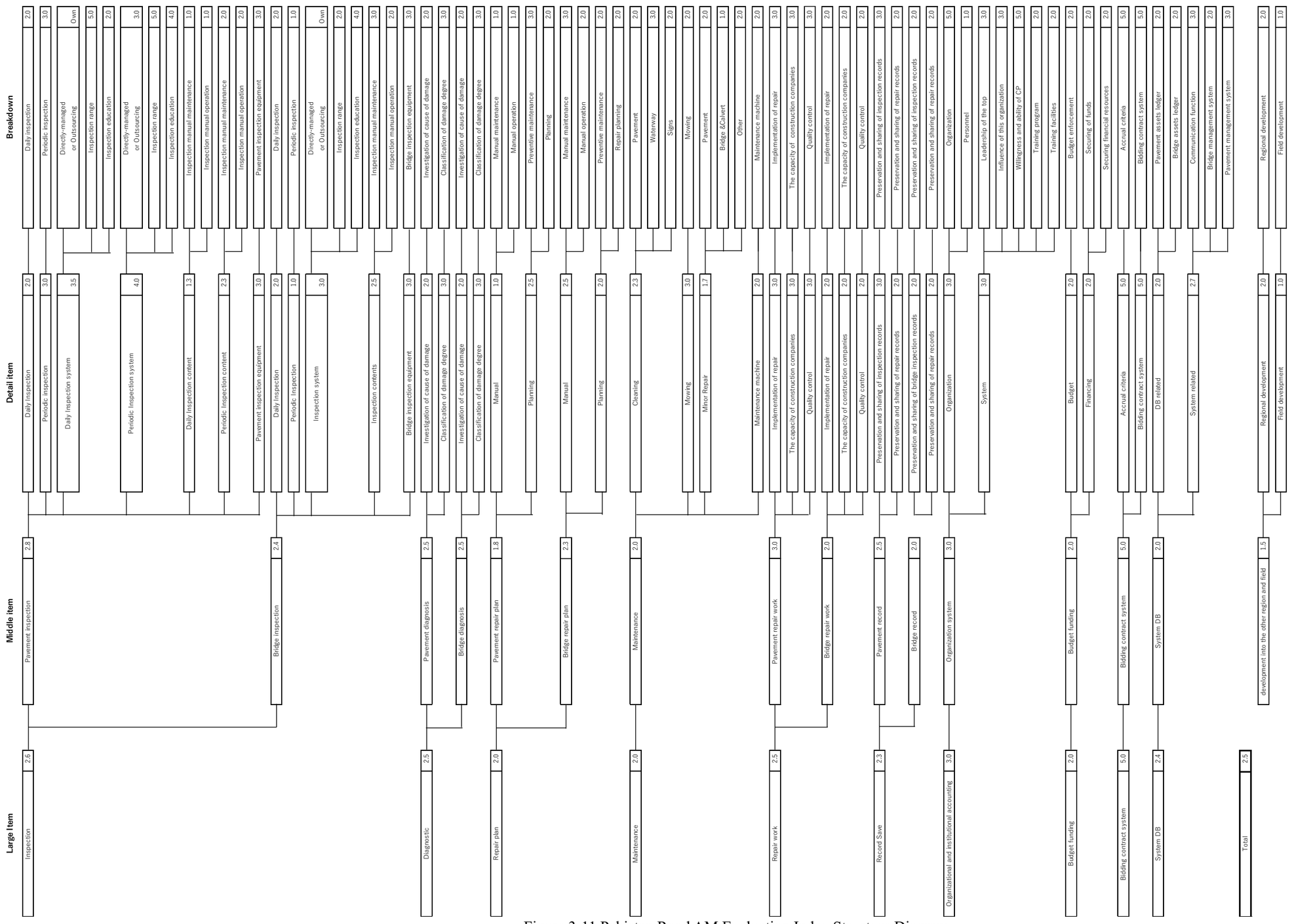


Figure 3-11 Pakistan Road AM Evaluation Index Structure Diagram

3.5.2 Road AM Evaluation Index (Breakdown)

3.5.2.1 Pavement Inspection

The daily pavement inspection is conducted by NHA staff at the management office and a more detailed inspection is conducted if any damage is found. The frequency of the daily inspection is not specially decided. The management office reports to the headquarters of NHA on the spots where repairs are needed after the detailed inspection result. If NHA judges the necessity of a repair the budget will be secured, and the management office will repair them. Reporting to the headquarters of NHA is left to the discretion of the management offices. Although the level of the inspection staff ranges from experienced engineers to inexperienced engineers with variation in their levels, they have received education in civil engineering. The goal of these inspections is corrective maintenance.

Middle Item	Small Item	Breakdown	Scores
Pavement Inspection	Daily Inspection	-	2.0
	Daily Inspection System	Outsourcing Status	Own force
		Inspection Range	5.0
		Education on Inspection	2.0

Regular pavement inspections are outsourced to all consultants and are held annually for all routes. IRI and cracks measured by the measuring instruments and rutting data are directly input to the host computer (HDM-4) of the NHA headquarters. The NHA headquarters will analyze the measurement results to formulate a paving repair plan for the next year. The purpose of this inspection is preventive maintenance.

Middle Item	Small Item	Breakdown	Scores
Pavement Inspection	Periodic Inspection	-	3.0
	Periodic Inspection System	Outsourcing Status	3.0
		Inspection Range	5.0
		Education on Inspection	4.0

Although the daily inspection manuals are partially prepared, they are not perfect and have poor operation. Regular inspection manuals are not prepared, however, there are codes that define the items to be measured along with reference values. Consultants who conduct the measurements perform the measurement work based on the codes. Pavement inspection equipment (IRI, FWD) is owned by consultants.

Middle Item	Small Item	Breakdown	Scores
Pavement Inspection	Daily Inspection Content	Inspection Manual Maintenance	1.0
		Inspection Manual Operation	1.0
	Periodic Inspection Content	Inspection Manual Maintenance	2.0
		Inspection Manual Operation	2.0
	Pavement Inspection Equipment	-	3.0

3.5.2.2 Bridge Inspection

The daily inspection of bridges is conducted by the NHA staff at the management office and a more detailed inspection is implemented if any damage is found. The frequency of the daily inspection is not

specifically decided. Detailed inspections are conducted by bridge experts at the NHA headquarters. As for the spots where repairs are needed after inspection, the bridge experts are responsible for the design and construction management. The level of the inspection staff ranges from experienced engineers to inexperienced engineers with variations in their levels, they have received education in civil engineering. The goal of these inspections is corrective maintenance.

The periodic inspection of bridges was introduced this time by the technical project and will be carried out every five years. Currently, the 36 bridges and 4 culvert boxes, targeted in the technical project, have been completed. The inspection is scheduled to expand nationwide in the future, but the NHA staff alone are not able to handle the job so it is likely to be outsourced. Eight engineers were developed in the technical project, all of who received education in civil engineering as well as inspection training during the technical project. Specifically, the data for 36 bridges and 4 culverts has already been entered into BMS (implemented at in the technical project). Engineers in NHA continuously conduct bridge inspections deciding pilot regions to input data (target: about 400 bridges). The inspection and data input of the remaining regions in the medium-term plan are outsourced to consultants. In addition, because it is assumed that the efforts of the technical project will continue and progress, and the routine and periodic inspections will be carried out regularly in five years, the score for daily inspection improves from 2.0 to 3.0, and the score for periodic inspection improves from 1.0 to 3.0. In addition, the inspection range score improves from 2.0 to 3.0 because it is assumed that the inspection of 50% or more of the routes are carried out.

Middle Item	Small Item	Breakdown	Scores
Bridge Inspection	Daily Inspection	-	2.0 (3.0)
	Periodic Inspection	-	1.0 (3.0)
	Inspection System	Outsourcing Status	Own force
		Inspection Range	2.0 (3.0)
		Education on Inspection	4.0

( ) is expected to be achieved in about five years after the end of the technical project.

The inspection manual was developed in a technical project. The inspection machine is not enough, having only a crack scale and a hammer. When it comes to an inspection of the lower surfaces of bridges, a visual inspection from a short distance is not possible because there are spots where one cannot physically get access to. In addition, since the efforts of the technical project will continue and progress, and it is assumed that the manual operation will be performed on all routes in five years, the manual operation score improves from 2.0 to 3.0.

Middle Item	Small Item	Breakdown	Scores
Bridge Inspection	Contents of Inspection	Manual Maintenance	3.0
		Manual Operation	2.0 (3.0)
	Bridge Inspection Equipment	-	3.0

( ) is expected to be achieved in about five years after the end of the technical project.

3.5.2.3 Diagnostic

Investigation of the causes of pavement damage is carried out to the greatest extent possible. The damages have been ranked in CODE. The cause investigation of the bridge damage is being done but is not enough. The classification of the damage was developed in the technical project. The investigation of the cause of damage score improves from 2.0 to 3.0 because the approach of the technical project continued and progressed, and it is assumed that the cause of damage to bridges will be investigated for important parts in five years.

Middle Item	Small Item	Breakdown	Scores
Pavement Diagnosis	Investigation of the Cause of Damage	-	2.0
	Classification of Damage Level	-	3.0
Bridge Diagnosis	Investigation of the Cause of Damage	-	2.0 (3.0)
	Classification of Damage Level	-	3.0

( ) is expected to be achieved in about five years after the end of the technical project.

3.5.2.4 Repair Plan

The pavement repair plan is created using HDM-4. The plan, which introduces the idea of preventive maintenance to prepare a repair plan by 20 years from now, uses only said plan by the next year. There is no manual for drafting a pavement repair plan. The management office conducts large- and small-scale pavement replacement works. There seems to be no problem with how PDCA is working, but the actual situation is that the repair plan is being prepared as output as a result of inputting the results of inspection of road surface conditions utilizing HDM-4 as an application. With no planning manuals for repair, it is questionable if the contents are fully understood.

Middle Item	Small Item	Breakdown	Scores
Pavement Repair Plan	Manual	Maintenance	1.0
		Operation	1.0
	Planning	Maintenance	3.0
		Plan Development	2.0

The manual for the planning of bridge repair has already been formulated in the technical project and the concept of preventive maintenance has been introduced; the plan to repair the bridge for the technical project will be developed from now on. BMS was introduced by a consultant in Europe in 2006 but the contents of BMS did not infiltrate the NHA headquarters because it was outsourced. In addition, since the efforts of the technical project will continue and progress, and it is assumed that the operation of the manual is performed on all routes in five years, the manual operation score improves from 2.0 to 3.0. In addition, it is assumed that preventive maintenance is carried out in the areas where preventive maintenance is required and since the short-term repair plan is assumed to be drafted, the score improves to 3.0 for both items from 2.0.

Middle Item	Small Item	Breakdown	Scores
Bridge Repair Plan	Manual	Maintenance	3.0
		Operation	2.0 (3.0)
	Planning	Maintenance	2.0 (3.0)
		Development of Repair Plan	2.0 (3.0)

( ) is expected to be achieved in about five years after the end of the technical project.

3.5.2.5 Maintenance Management

Road cleaning has not been conducted due to natural conditions such as rainfall. Removing of fallen objects has been carried out as needed. Cleaning of drainage channels has been carried using manpower. Cleaning of signs has been performed irregularly if necessary. Mowing has been carried out as

necessary because the growing environment is different depending on the location. Basically, works are being done using manpower, but some machines are also being used.

Middle Item	Small Item	Breakdown	Scores
Maintenance Management	Cleaning	Pavement	2.0
		Waterway	3.0
		Signs	2.0
	Mowing	-	2.0

Small repairs of pavement are being done as corrective maintenance when any damages that are observed during the daily inspection are judged to warrant a repair. Small repairs of bridges are also carried out as appropriate repairs for the floor plates.

Middle Item	Small Item	Breakdown	Scores
Maintenance Management	Minor Repair	Pavement	2.0
		Bridges/Culverts	1.0
		Other	2.0
	Maintenance Work Machine	-	2.0

3.5.2.6 Repair Work

The construction company has enough construction experience and there is no problem in the construction ability regarding pavement repair work. With respect to quality, the orderer (including consultants) has properly managed it.

Middle Item	Small Item	Breakdown	Scores
Pavement Repair Work	Implementation of Repairs	-	3.0
	Capacity of the Construction Company	-	3.0
	Quality	-	3.0

As for bridge repair work, there are a lot of construction companies with experience that lack construction capacity is not high, requiring guidance from the orderer side. With respect to quality, the orderer (including consultants) has properly managed it.

Middle Item	Small Item	Breakdown	Scores
Bridge Repair Work	Execution of Repairs	-	2.0
	Capacity of the Construction Company	-	2.0
	Quality	-	2.0

3.5.2.7 Preservation of Records

Inspection record data of pavement is recorded in PMS. Repair results are recorded and stored as electronic data with clear repair content, range and time. The inspection record of the bridge is recorded and stored using a paper basis. In the future, it is scheduled to be sequentially introduced to BMS. Repair results have been recorded and stored as electronic data, but the contents of repairs and their ranges are unclear. In addition, since it is assumed that the work of the technical project will continue and progress, and the inspection and repair records of the bridge are stored and shared five years later, the maintenance, sharing and repair record scores for bridge inspections improve from 2.0 to 3.0.

Middle Item	Small Item	Breakdown	Scores
Pavement Record	Save/share Inspection Records	-	3.0
	Preservation and Sharing of Repair Records	-	2.0
Bridge Record	Save/share Inspection Records	-	2.0 (3.0)
	Preservation and Sharing of Repair Records	-	2.0 (3.0)

( ) is expected to be achieved in about five years after the end of the technical project.

3.5.2.8 Organization

The NHA headquarters has a Road AM Department, but the number of personnel is insufficient. In the case of the Department of Road Assets, there are only three or four personnel in GM, DD. This is attributed to the fact young staff have not been hired for about ten years. It is said that the commitment of the member (a director), the head of the organization, is high. The AM Department has control over the budget and maintenance planning of national highways and has considerable influence over other departments. The willingness and ability of C/P is very high.

There is a training system for human resource development in regard to pavement. As for pavement, the research has been conducted by the Highway Research and Training Center (HRTC) utilizing its complete facilities. The research system for human resource development in regard to bridges was built through a technical project. There is a movement in the HRTC to arrange and develop an organization and facilities for the study of bridges.

Middle Item	Small Item	Breakdown	Scores
Organization	Organization	Organization	5.0
		Personnel	1.0
Organization	System	Top leadership	3.0
		Influence of the Organization	3.0
		C/P Willingness and Ability	5.0
		Training System	2.0
		Training Facilities	2.0

3.5.2.9 Budget Financing

The plan for the budget is being formed annually. Payment of the construction price is delayed on rare occasions due to construction method and legal troubles. The financial resources of the maintenance management are being secured separately from the toll road income and the fines for overloading. Although it is reference information, new construction is carried out based on the finance budget, therefore payments are sometimes delayed due to lack of funds.

Middle Item	Small Item	Breakdown	Scores
Budget Financing	Budget	Budget Enforcement	2.0
	Financing	Securing Funds	2.0
		Securing Financial Resources	2.0

3.5.10 Bidding Contract System

There is an accumulation standard and a bidding system concerning the maintenance management.

Middle Item	Small Item	Breakdown	Scores
Bidding Contract System	Accumulation Criteria	-	5.0
	Bidding Contract System	-	5.0

3.5.11 System and DB

Ledgers have been summarized on a paper basis. Regarding communications, the system of the budget is connected to the NHA headquarters and the local organization with a plan to connect the data for pavement and bridges in the future. At present, however, it is not available. The bridge management system is in a partial operational phase. The pavement management system is being operated. In addition, since the efforts of the technical project will continue and progress, and in five years, the bridge Asset Ledger will be maintained on a paper basis at least, and the bridge management system is assumed to be operating, the bridge asset ledger and bridge management system scores improve from 2.0 to 3.0.

Middle Item	Small Item	Breakdown	Scores
System DB	Related to DB	Pavement Asset Ledger	2.0
		Bridge Asset Ledger	2.0(3.0)
	Related to System	Communication Function	3.0
		Bridge Management System	2.0(3.0)
		Pavement Management System	3.0

( ) is expected to be achieved in about five years after the end of the technical project.

3.5.12 Development in Other Areas

Pavement is being developed nationwide. Bridges are developing in areas other than technical projects.

Middle Item	Small Item	Breakdown	Scores
Development to Other Regions and Territories	Regional Development	-	2.0
	Territory Development	-	1.0

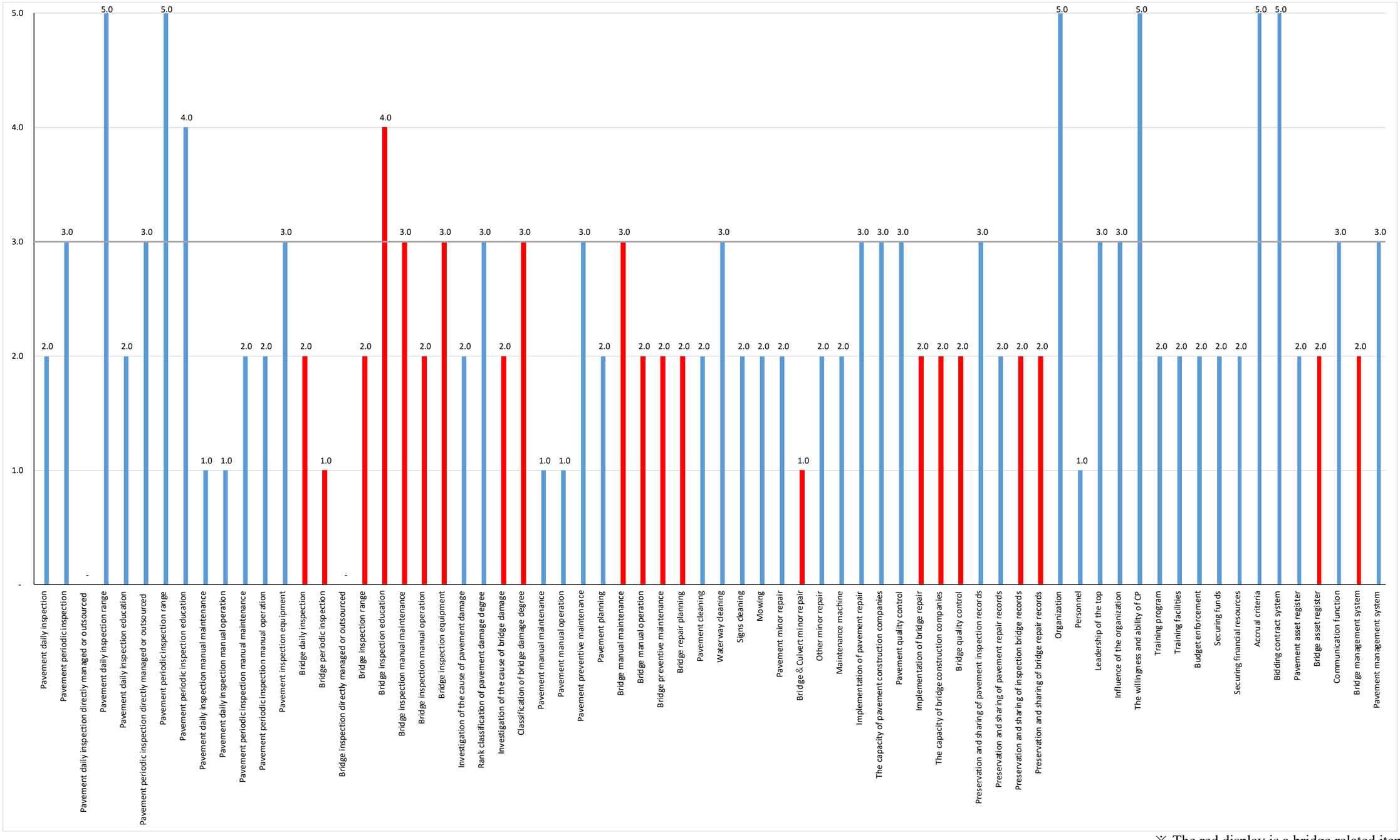
3.5.13 Others

Foreign companies only carry out large-scale construction. There are only a few local companies with a high level of technology. Local companies have low technical levels for the most part.

The JICA projects conduct a survey of slope countermeasures. They lack knowledge of investigating, grasping of the hazardous slopes and knowledge about an implementation of countermeasures for said slopes. We would appreciate it if Japan could cooperate with us for the preparation of manuals and guidelines.

There are only hammer and crack gauges as inspection equipment for bridges. There is no non-destructive inspection equipment such as high elevation work vehicles or GPR (underground exploration radar) at all. Could we obtain cooperation on the introduction of these technologies?

NHA experts seem to be confident in repair technologies, but if we visually inspected the construction situation, there are many problems with the quality, construction technology (rust by the exposure of reinforcing rods, rock pockets, framework retention, and uneven earth pressure on piers).



※ The red display is a bridge related item

Figure 3-12 Road AM Evaluation Index (Breakdown) in Pakistan

Table 3-9 Road AM Evaluation Sheet in Pakistan (Part 1)

Middle item	Small item	Detail item	Scores	Evaluation items	Score Current	Scale	Achieve %	Score 5yers later
Pavement inspection	Daily inspection		1	Inspection is not conducted.	2.0	3.0	67%	2.0
			2	Inspection is carried out at random times.				
			3	Inspection is conducted on a regular basis.				
			4					
			5					
	Periodic inspection		1	Inspection is not conducted.	3.0	3.0	100%	3.0
			2	Inspection is carried out at random times.				
			3	Inspection is conducted on a regular basis.				
			4					
			5					
	Daily Inspection system	Outsourcing Situation	0	Person in charge within an organization is absent and daily inspection is outsourced without evaluating an outsourcing contractor.	Own	5.0	0%	Own
			1	Person in charge within an organization is present and daily inspection is outsourced without evaluating an outsourcing contractor.				
			2	Outsourcing contractors are to be evaluated and their responsibilities, authorities, and contents are specifically defined.				
			3	Information is being shared to achieve target performance.				
			4	Trustees have systems to improve their target performance independently.				
		Inspection range	1	Inspection is not conducted.	5.0	5.0	100%	5.0
			2	Inspection is being conducted, but limited.				
			3	Inspections have been carried out in 50% or more of the road extension of the operating route.				
			4	Inspections have been carried out in 75% or more of the road extension of the operating route.				
			5	Inspections have been carried out in 100% or more of the road extension of the operating route.				
		Inspection education	1	Inspectors have no knowledge of civil engineering and have not received an inspection education	2.0	5.0	40%	2.0
			2	Inspectors have knowledge of civil engineering, but have not received inspection education				
			3	Inspectors have no knowledge of civil engineering, but they have received an inspection education.				
			4	Inspectors have knowledge of civil engineering, and have received an inspection education.				
			5	Inspectors are continuously taking inspection education.				
	Periodic Inspection system	Outsourcing Situation	1	Person in charge within an organization is absent and periodic inspection is outsourced without evaluating an outsourcing contractor.	3.0	5.0	0.6	3.0
			2	Person in charge within an organization is present and periodic inspection is outsourced without evaluating an outsourcing contractor.				
			3	Outsourcing contractors are to be evaluated and their responsibilities, authorities, and contents are specifically defined in contract document.				
			4	Information is being shared to achieve target performance.				
			5	Trustees have systems to improve their target performance independently.				
		Inspection range	0	Inspection is not conducted.	5.0	5.0	100%	5.0
			1	Inspection is being conducted, but limited.				
			2	Inspections have been carried out in 50% or more of the road extension of the operating route.				
			3	Inspections have been carried out in 75% or more of the road extension of the operating route.				
			4	Inspections have been carried out in 100% or more of the road extension of the operating route.				
		Inspection education	0	Inspectors have no knowledge of civil engineering and have not received an inspection education	4.0	5.0	80%	4.0
			1	Inspectors have knowledge of civil engineering, but have not received inspection education				
			2	Inspectors have no knowledge of civil engineering, but they have received an inspection education.				
			3	Inspectors have knowledge of civil engineering, and have received an inspection education.				
			4	Inspectors are continuously taking inspection education.				
	Daily Inspection content	Existence of Inspection manual	0	Inspection manuals are not developed.	1.0	3.0	33%	1.0
			1	Inspection manuals are partially developed.				
			2	Inspection manuals are developed.				
			3					
			4					
		Use of inspection manual	0	The inspection manuals are not being operated.	1.0	5.0	20%	1.0
			1	The inspection manuals are being operated in some routes.				
			2	Inspection manuals are being used in all routes.				
			3	Inspection manuals are being operates in all routes, but no reviews have been made.				
			4	Inspection manuals are being operates in all routes, and have been reviewed regularly or as needed.				
	Periodic Inspection content	Existence of Inspection manual	0	Inspection manuals are not developed.	2.0	3.0	67%	2.0
			1	Inspection manuals are partially developed.				
			2	Inspection manuals are developed.				
			3					
			4					
		Use of inspection manual	0	The inspection manuals are not being operated.	2.0	5.0	40%	2.0
			1	The inspection manuals are being operated in some routes.				
			2	Inspection manuals are being used in all routes.				
			3	Inspection manuals are being operates in all routes, but no reviews have been made.				
			4	Inspection manuals are being operates in all routes, and have been reviewed regularly or as needed.				
	Pavement inspection equipment		0	Inspection equipment is not well-maintained.	3.0	5.0	60%	3.0
			1	Basic inspection equipment is developed, but not in use.				
			2	Basic inspection equipment is being used.				
			3	Basic inspection equipment is being used. State-of-the-art inspection equipment is maintained, but not in use.				
			4	State-of-the-art inspection equipment is being used.				

Table 3-10 Road AM Evaluation Sheet in Pakistan (Part 2)

Bridge inspection	Inspection method	Daily inspection	0	Inspection is not conducted.	2.0	3.0	67%	3.0
			1	Inspection is carried out at random times.				
			2	Inspection is conducted on a regular basis.				
			3					
			4					
		Periodic inspection	0	Inspection is not conducted.	1.0	3.0	33%	3.0
			1	Inspection is carried out at random times.				
			2	Inspection is conducted on a regular basis.				
			3					
			4					
	Inspection system	Outsourcing Situation	0	Person in charge within an organization is absent and inspection is outsourced without evaluating an outsourcing contractor.	Own	5.0	0.0	Own
			1	Person in charge within an organization is present and inspection is outsourced without evaluating an outsourcing contractor.				
			2	Outsourcing contractors are to be evaluated and their responsibilities, authorities, and contents are specifically defined.				
			3	Information is being shared to achieve target performance.				
			4	Trustees have systems to improve their target performance independently.				
		Inspection range	0	Inspection is not conducted.	2.0	5.0	40%	3.0
			1	Inspection is being conducted, but limited.				
			2	Inspections have been carried out in 50% or more of the road extension of the operating route.				
			3	Inspections have been carried out in 75% or more of the road extension of the operating route.				
			4	Inspections have been carried out in 100% or more of the road extension of the operating route.				
		Inspection education	0	Inspectors have no knowledge of civil engineering and have not received an inspection education	4.0	5.0	80%	4.0
			1	Inspectors have knowledge of civil engineering, but have not received inspection education				
			2	Inspectors have no knowledge of civil engineering, but they have received an inspection education.				
			3	Inspectors have knowledge of civil engineering, and have received an inspection education.				
			4	Inspectors are continuously taking inspection education.				
	Inspection contents	Existence of Inspection manual	0	Inspection manuals are not developed.	3.0	3.0	100%	3.0
			1	Inspection manuals are partially developed.				
			2	Inspection manuals are developed.				
			3					
			4					
		Use of inspection manual	0	The inspection manuals are not being operated.	2.0	5.0	40%	3.0
			1	The inspection manuals are being operated in some routes.				
			2	Inspection manuals are being used in all routes.				
			3	Inspection manuals are being operates in all routes, but no reviews have been made.				
			4	Inspection manuals are being operates in all routes, and have been reviewed regularly or as needed.				
	Bridge inspection equipment☒		0	Inspection equipment is not well-maintained.	3.0	5.0	60%	3.0
			1	Basic inspection equipment is developed, but not in use.				
			2	Basic inspection equipment is being used.				
			3	Basic inspection equipment is being used. State-of-the-art inspection equipment is maintained, but not in use.				
			4	State-of-the-art inspection equipment is being used.				
Large Item: Inspection					2.6	4.3	62.5%	2.9
Pavement diagnosis	Investigation of cause of damage		0	The investigation of cause of the damage is not carried out.	2.0	5.0	40%	2.0
			1	The investigation of cause of damage is not carried out partially.				
			2	The investigation of cause of an important part is carried out.				
			3	The cause of the damage is systematically investigated.				
			4	The investigation of the cause of damage has been used to improve the overall maintenance.				
	Classification of damage degree		0	There has been no classification of damage	3.0	3.0	100%	3.0
			1	The classification of damage has been done, but there is a large room for improvement.				
			2	The classification of damage has been done with few rooms for improvement.				
			3					
			4					
Bridge diagnosis	Investigation of cause of damage		0	The investigation of cause of the damage is not carried out.	2.0	5.0	40%	3.0
			1	The investigation of cause of damage is not carried out partially.				
			2	The investigation of cause of an important part is carried out.				
			3	The cause of the damage is systematically investigated.				
			4	The investigation of the cause of damage has been used to improve the overall maintenance.				
	Classification of damage degree☒		0	There has been no classification of damage	3.0	3.0	100%	3.0
			1	The classification of damage has been done, but there is a large room for improvement.				
			2	The classification of damage has been done with few rooms for improvement.				
			3					
			4					
Large Item: Diagnostic					2.5	4.2	70.0%	2.8
Pavement repair plan	Manual	Existence of inspection manual	0	Inspection manuals are not developed.	1.0	3.0	33%	1.0
			1	Inspection manuals are partially developed.				
			2	Inspection manuals are developed.				
			3					
			4					
		Use of inspection manual	0	The inspection manuals are not being operated.	1.0	5.0	20%	1.0
			1	The inspection manuals are being operated in some routes.				
			2	Inspection manuals are being used in all routes.				
			3	Inspection manuals are being operates in all routes, but no reviews have been made.				
			4	Inspection manuals are being operates in all routes, and have been reviewed regularly or as needed.				
	Planning	Preventive maintenance	0	Not aware of the need to introduce preventive maintenance	3.0	3.0	100%	3.0
			1	The need to implement preventive maintenance is assessed.				
			2	Preventive maintenance is being operated in regions where its introduction is rated to be necessary.				
			3					
			4					
		Planning	0	Repair plan has not been drafted.	2.0	5.0	40%	2.0
			1	Repair plan for the next year has been drawn up.				
			2	Repair plan of short-term (about two to three years) has been drawn up.				
			3	Repair plan of middle-term (about five years) has been drawn up.				
			4	Repair plan of long-term (over ten years) has been drawn up.				

Table 3-11 Road AM Evaluation Sheet in Pakistan (Part 3)

Bridge repair plan	Manual	Existence of inspection manual	0	Inspection manuals are not developed.	3.0	3.0	100%	3.0
			1	Inspection manuals are partially developed.				
			2	Inspection manuals are developed.				
			3					
			4					
		Use of inspection manual	0	The inspection manuals are not being operated.	2.0	5.0	40%	3.0
			1	The inspection manuals are being operated in some routes.				
			2	Inspection manuals are being used in all routes.				
			3	Inspection manuals are being operates in all routes, but no reviews have been made.				
			4	Inspection manuals are being operates in all routes, and have been reviewed regularly or as needed.				
	Planning	Preventive maintenance	0	Not aware of the need to introduce preventive maintenance	2.0	3.0	67%	3.0
			1	The need to implement preventive maintenance is assessed.				
			2	Preventive maintenance is being operated in regions where its introduction is rated to be necessary.				
			3					
			4					
		Repair planning	0	Repair plan has not been drafted.	2.0	5.0	40%	3.0
			1	Repair plan for the next year has been drawn up.				
			2	Repair plan of short-term (about two to three years) has been drawn up.				
			3	Repair plan of middle-term (about five years) has been drawn up.				
			4	Repair plan of long-term (over ten years) has been drawn up.				
Large Item: Repair Plan					2.0	4.0	55.0%	2.4
Maintenance	Cleaning	Pavement	0	Cleaning has not yet been carried out.	2.0	3.0	67%	2.0
			1	Cleaning is being carried out but not regularly.				
			2	Cleaning is performed regularly.				
			3					
			4					
		Waterway	0	Cleaning has not yet been carried out.	3.0	3.0	100%	3.0
			1	Cleaning is being carried out but not regularly.				
			2	Cleaning is performed regularly.				
			3					
			4					
		Signs	0	Cleaning has not yet been carried out.	2.0	3.0	67%	2.0
			1	Cleaning is being carried out but not regularly.				
			2	Cleaning is performed regularly.				
			3					
			4					
	Mowing		0	Mowing has not yet been carried out.	2.0	3.0	67%	2.0
			1	Mowing is being carried out, but not regularly.				
			2	Mowing is performed regularly.				
			3					
			4					
	Minor repair	Pavement	0	Repair has been hardly performed.	2.0	3.0	67%	2.0
			1	The minimum repair work has been done				
			2	The repair works are being performed appropriately.				
			3					
			4					
		Bridge & Culvert	0	Repair has been hardly performed.	1.0	3.0	33%	1.0
			1	The minimum repair work has been done				
			2	The repair works are being performed appropriately.				
			3					
			4					
		Other	0	Repair has been hardly performed.	2.0	3.0	67%	2.0
			1	The minimum repair work has been done				
			2	The repair works are being performed appropriately.				
			3					
			4					
	Maintenance machine		0	Working machine for maintenance is not in place.	2.0	5.0	40%	2.0
			1	Aging working machine for maintenance is in place and not in use.				
			2	Although the working machine for maintenance is in place, it is used partially.				
			3	The working machine for maintenance is in place and in use.				
			4	State-of-the-art working machine for maintenance is in place and in use.				
Large Item: Maintenance					2.0	3.3	63%	2.0
Pavement repair work	Implementation of repair		0	Repair has not been carried out.	3.0	3.0	100%	3.0
			1	Repair has been partially carried out.				
			2	A lot of sites have been repaired.				
			3					
			4					
	The capacity of construction companies		0	No repair works are carried out.	3.0	5.0	60%	3.0
			1	Some repair have been generally carried out, and ability to perform repair works is poor.				
			2	Some general repair have been generally carried out, and ability to perform repair works is average.				
			3	Some general repair have been generally carried out, and ability to perform repair works is high.				
			4	Many advanced repair works have been carried out, and the ability to perform repair works is high.				
	Quality control		0	Quality Control of repair work has not been carried out.	3.0	5.0	60%	3.0
			1	Ability of quality control is low.				
			2	Ability of quality control is average.				
			3	Ability of quality control is high.				
			4	Quality control has been done positively, securing a high quality.				

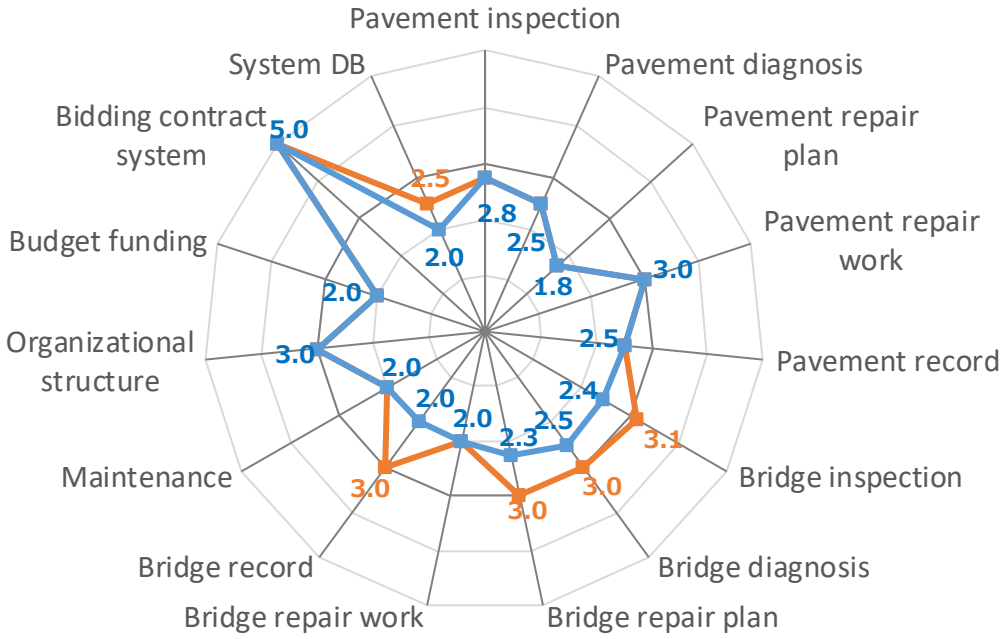
Table 3-12 Road AM Evaluation Sheet in Pakistan (Part 4)

Bridge repair work	Implementation of repair		0	Repair has not yet been carried out.	2.0	3.0	67%	2.0
			1	Repair has been partially carried out.				
			2	A lot of sites have been repaired.				
			3					
			4					
	The capacity of construction companies		0	No repair works are carried out.	2.0	5.0	40%	2.0
			1	Some repair have been generally carried out, and ability to perform repair works is poor.				
			2	Some general repair have been generally carried out, and ability to perform repair works is average.				
			3	Some general repair have been generally carried out, and ability to perform repair works is high.				
			4	Many advanced repair works have been carried out, and the ability to perform repair works is high.				
	Quality control		0	Quality Control of repair work has not been carried out.	2.0	5.0	40%	2.0
			1	Ability of quality control is low.				
			2	Ability of quality control is average.				
			3	Ability of quality control is high.				
			4	Quality control has been done positively, securing a high quality.				
Large Item: Repair work					2.5	4.3	61%	2.5
Pavement record	Preservation and sharing of inspection records		0	Inspection results have neither been recorded nor preserved.	3.0	5.0	60%	3.0
			1	Inspection results have been partially recorded and preserved.				
			2	Inspection results have been recorded and preserved.				
			3	Inspection results have been recorded, preserved, and shared.				
			4	Inspection results have been recorded, preserved, shared, and updated.				
	Preservation and sharing of repair records		0	Inspection results have neither been recorded nor preserved.	2.0	5.0	40%	2.0
			1	Inspection results have been partially recorded and preserved.				
			2	Inspection results have been recorded and preserved.				
			3	Inspection results have been recorded, preserved, and shared.				
			4	Inspection results have been recorded, preserved, shared, and updated.				
Bridge record	Preservation and sharing of inspection records		0	Inspection results have neither been recorded nor preserved.	2.0	5.0	40%	3.0
			1	Inspection results have been partially recorded and preserved.				
			2	Inspection results have been recorded and preserved.				
			3	Inspection results have been recorded, preserved, and shared.				
			4	Inspection results have been recorded, preserved, shared, and updated.				
	Preservation and sharing of repair records		0	Inspection results have neither been recorded nor preserved.	2.0	5.0	40%	3.0
			1	Inspection results have been partially recorded and preserved.				
			2	Inspection results have been recorded and preserved.				
			3	Inspection results have been recorded, preserved, and shared.				
			4	Inspection results have been recorded, preserved, shared, and updated.				
Large Item: Record Save					2.3	5.0	45%	2.8
Organization System	Organization	Organization	0	No person in charge of Road AM.	5.0	5.0	100%	5.0
			1	People in charge of Road AM are unclear.				
			2	Staffs in charge of road AM are arranged for other department as well.				
			3	Staffs in charge of road AM are arranged exclusively.				
			4	Road AM department is already established.				
		Personnel	0	Very few people in charge of Road AM	1.0	5.0	20%	1.0
			1	People in charge of Road AM is about 1/3 of the required number				
			2	People in charge of Road AM is about half of the required number				
			3	People in charge of Road AM is about 2/3 of the required number				
			4	People in charge of Road AM is enough in number.				
	System	Leadership of the top	0	The head of the organization is indifferent to the Road AM	3.0	5.0	60%	3.0
			1	The head of the organization is interested in Road AM, but less commitment.				
			2	The head of the organization sometimes makes commitments.				
			3	The head of the organization relatively often makes commitments.				
			4	The head of the organization frequently makes commitments.				
		Influence of this organization	0	Road AM department has a weak influence on other organizations	3.0	5.0	60%	3.0
			1	Road AM department has some influence on other departments				
			2	Road AM department has influence on other departments				
			3	Road AM department is considerable influence on other departments				
			4	Road AM department has strong influence on other organizations				
		Willingness and ability of CP	0	Awareness is low and ability is inadequate.	5.0	5.0	100%	5.0
			1	High awareness, but ability is inadequate.				
			2	Awareness and ability are both moderate.				
			3	Ability is high, but awareness is low.				
			4	Ability and awareness are both high.				
		Training program	0	No training program for human resource development	2.0	3.0	67%	2.0
			1	Training program for human resource is available, but insufficient.				
			2	Training system for human resources development is in place.				
			3					
			4					
		Training facilities	0	No training facility for human resource development	2.0	3.0	67%	2.0
			1	Training facility for human resource is available, but insufficient.				
			2	Training facility for human resources development is in place.				
			3					
			4					
Large Item: Organizational and institutional accounting					3.0	4.4	68%	3.0

Table 3-13 Road AM Evaluation Sheet in Pakistan (Part 5)

Budget funding	Budget	Budget enforcement	0	Budget plan has not been drafted.	2.0	5.0	40%	2.0
				Budget plan for the next year has only been drawn up.				
			2	Budget plan of short-term (about two to three years) has been drawn up.				
			3	Budget plan of middle-term (about five years) has been drawn up.				
			4	Budget plan of long-term (over ten years) has been drawn up.				
	Financing	Securing of funds	0	Payment for procurement of materials, machinery and labors are often delayed.	2.0	3.0	67%	2.0
			1	Payment for procurement of materials, machinery and labors are sometimes delayed.				
			2	Payment for procurement of materials, machinery and labors are not delayed.				
			3					
			4					
		Securing financial resources	0	There are no revenue sources focusing for maintenance and management.	2.0	3.0	67%	2.0
			1	There are revenue sources focusing for maintenance and management, but funds are not ready.				
			2	There are revenue sources focusing for maintenance and management, and necessary funds are ready.				
			3					
			4					
Large Item: Budget funding					2.0	3.7	58%	2.0
Bidding contract system	Cost estimation methods		0	Cost estimation standard of procurement of materials, machinery and labors are not established	5.0	5.0	100%	5.0
			1	Cost estimation standard of procurement of materials, machinery and labors are established but not used				
			2	Cost estimation standard of procurement of materials, machinery and labors are established but partially used				
			3	Cost estimation standard of procurement of materials, machinery and labors are established and used				
			4	Cost estimation standard of procurement of materials, machinery and labors are established, used and periodically revised				
	Bidding contract system		0	Bidding contract system of procurement of materials, machinery and labors are not established	5.0	5.0	100%	5.0
			1	Bidding contract system of procurement of materials, machinery and labors are established but not used				
			2	Bidding contract system of procurement of materials, machinery and labors are established but partially used				
			3	Bidding contract system of procurement of materials, machinery and labors are established and used				
			4	Bidding contact system of procurement of materials, machinery and labors are established, used and periodically revised				
Large Item: Bidding contract System					5.0	5.0	100%	5.0
System DB	DB related	Paving assets DB	0	No asset DB	2.0	5.0	40%	2.0
			1	Some of the assets are well-maintained as a paper base.				
			2	Assets are well-maintained as a paper base.				
			3	Assets are well-maintained as an electronic data.				
			4	Assets are well-maintained as an electronic data and can be shared.				
		Bridge assets DB	0	No asset DB	2.0	5.0	40%	3.0
			1	Some of the assets are well-maintained as a paper base.				
			2	Assets are well-maintained as a paper base.				
			3	Assets are well-maintained as an electronic data.				
			4	Assets are well-maintained as an electronic data and can be shared.				
	System related	Communication function	0	There is no plan of communications facility development between headquarters and local offices	3.0	5.0	60%	3.0
			1	There is a plan of communications facility development between headquarters and local offices				
			2	Development of communication facilities between Headquarters and office are now ongoing.				
			3	Communications facility development is well-maintained with no data sharing.				
			4	Communications facility development is well-maintained and data sharing is available.				
		Bridge management system	0	No system has been introduced.	2.0	5.0	40%	3.0
			1	The system has been introduced and partially operational				
			2	The system has been introduced and in operation.				
			3	The system has been operated, but needs updating.				
			4	The system has been operated, and been continuously updated.				
		Pavement management system	0	No system has been introduced.	3.0	5.0	60%	3.0
			1	The system has been introduced and partially operational				
			2	The system has been introduced and in operation.				
			3	The system has been operated, but needs updating.				
			4	The system has been operated, and been continuously updated.				
Large Item: System DB					2.4	5.0	48%	2.8
Total					**2.6**	**4.2**	**62%**	**2.8**
Development into the other region and field	Regional development		0	Road AM development has been remaining in its development in a specific area.	2.0	5.0	40%	2.0
			1	Road AM development has begun to develop to the surrounding area of the specific area.				
			2	Road AM development is being developed outside of a specific area.				
			3	Road AM development has been developed more than half of the regions.				
			4	Road AM development has been developed to all regions				
	Field development		0	Road AM development has been remained in the area where the technical cooperation project was conducted.	1.0	5.0	20%	1.0
			1					
			2	Road AM development has begun to develop to the surrounding area where technical cooperation project was conducted				
			3					
			4	Road AM development is progressing to other areas				

3.5.3 Road AM Evaluation Index (Middle Items)



Note: The Blue line in the figure is current status, and the Orange line is expected achievement of five years after the end of the technical project

Figure 3-13 Road AM Evaluation Index in Pakistan (Middle Items)

【Overall Overview】

Although the degree of achievement for pavement is level 3 or less, there are no extremely low items. The degree of achievement for pavement repair planning is low because there is no repair planning manual. As for bridges, the level remained at 3 or less because it supports only the model districts in the technical project. The level of achievement for bridge repair technology is low because of immaturities of skills. The bidding contract is high because the system is developed, but the degree of attainment is low due to lack of personnel and budget. Also, records are not enough.

【Pavement Inspection, Diagnosis, Repair Plan】

HDM-4 manages pavement maintenance and repair but various manuals for pavement maintenance management are not maintained and repairs have been implemented based on results of output from annually measured IRI data input by consultants. It is questionable if the repair plan is rational or not. As for pavement diagnosis, a thorough investigation to the greatest extent possible has been conducted and no damage ranking is available.

【Bridge Inspection, Diagnosis, Repair Plan】

There was improvement for various manuals and BMS of bridge maintenance management, which were supportive in the technical projects. The bridge ledger maintenance and periodic inspections of the model area have already been completed. The company is planning to directly maintain a ledger and conduct periodic inspection in the middle term and is also planning to hire consultants to do these jobs in the long-term plan.

【Maintenance, Pavement Repair, Bridge Repair】

Cleaning, mowing, small repair and pavement repair work have been carried through subcontracting. Construction companies have enough experience in general type of construction for pavement repair

works with good quality control. On the other hand, the repair work of bridges and its quality control remain at a low level due to poor construction experience in the companies.

【Recording, Systems】

HDM-4 data is being updated annually for the inspection record of pavement. The inspection record of bridges, however, has just started with data input of BMS. Introduction of a communication network that connects regional offices and the headquarters is under consideration.

【Organization, Budget, Bidding System】

The organization has a Road AM Department, but there are only four staff and eight temporary staff including the DG with insufficient absolute numbers. As for the budget, toll road income and fines for overloading vehicle are allocated, but it is chronically insufficient. The top of the Road AM is providing regular commitment. Moreover, C/P is excellent and the consciousness to positively promote the Road AM is high.

【Assumption for 5 years from now】

The evaluation point that assumed about five years after the end of the technical project was described by the Orange Line. By implementing this technical project, bridge inspections, diagnostics, repair plans, and records have been improved to a score of 3.0. In addition, the system DB is expected to improve by the maintenance of the bridge asset ledger and the operation of BMS.

On the other hand, other items including the repair work of the bridge do not improve because it is outside the support of the technical project.

3.6 Extraction of Challenges for Road AM Fixation

3.6.1 Challenges on Pavement Maintenance and Management

The staff of the management office of the NHA performs the daily inspection of pavement as necessary, and the systems is responsible for further detailed inspections when any damage is discovered. Specifically, it is said that repair work is carried out when the detailed inspection result is reported to the NHA headquarters and approved. At present, the inspection manual has not been developed. On the other hand, outsourced consultants annually conduct surveys on road surface properties such as IRI, cracks and rutting, and input the directly measured values to HDM-4. As a result of analysis of the system, the NHA headquarters plans a pavement plan for next year. Since pavement repair planning manuals are not available, the application of HDM-4 is depended upon. Therefore, it is necessary to create and operate the repair planning manual.

3.6.2 Challenges on Bridge Maintenance and Management

Structures under NHA Management (Bridges and Culverts) to be inspected are 4,405 bridges and 2,180 culvert boxes. Through the technical project, bridge inspection, repair, repair planning manuals and BMS were created. Also, the inspection of 36 bridges and 4 culvert boxes, as the object of Technical Projects, and maintenance of the ledger was completed. In the future, NHA staff will conduct inspections of 400 bridges and culvert boxes in the short-term plans. Currently, two NHA staff and eight temporary staff are conducting inspections. Another four temporary staff will be added. In the medium-term plan, inspections for all regions (approximately 4,000 bridges) are scheduled to be outsourced to inspection consultant consultants.

Maintenance of bridges has yet to commence. Regarding places where inspection is difficult, such as high piers, rivers and places where short range visual observation is impossible due to the natural environment, bridge inspection vehicles and non-destructive inspection devices (drones, high-definition cameras) will be introduced to improve the effectiveness of inspections. Also, it is effective to introduce screening technology to improve efficiency of inspections. Furthermore, Mid-term plan and a

development of the system that NHA was supposed to draft after the completion of the technical project, and an update of BMS by NHA alone is difficult.

3.6.3 Challenges of Quality Control and Safety Management

The management office of the NHA conducts replacement works for large-scale reconstruction of pavement and small-scale repair works, and construction companies have abundant construction results but little room to make improvements on quality control and safety management based on the results of meetings. With respect to bridge repairing technology, NHA experts seem to be confident, but as far as we provided visual observation there are a lot of potential improvements in quality and construction technology (rust by the exposure of reinforcing rods, rock pockets, framework retention, uneven earth pressure of piers).

3.6.4 Staff Shortage of NHA Road AM Department

There are few personnel in the Road AM department at the NHA headquarters with only a GM and four DD. Although the organization does exist, it is almost vacant. We are currently conducting daily inspections of bridges mainly using temporary inspection personnel. In the medium-term, a continuity will be secured by outsourcing the work to consultants, but it is necessary to establish an organization where the staff of NHA can make a commitment. At least, temporary staff need to become master trainers to be hired as regular staff of NHA. In addition, we believe that the maintenance management staff of the Management Office need to improve the bridge maintenance capacity.

3.7 Development of Support Measures for Road AM Fixation

3.7.1 Support Measures for Pavement Maintenance and Management

We will support the work by dispatching short-term specialists and consultants so that we can prepare and operate pavement inspections, repair and repair planning manuals. In addition, it is effective to improve the maintenance ability of pavement through OJT education, topic-based training and national training by inviting trainees to the expressway administrators of Japan. It seems that HDM-4 is being operated as a mere application, therefore it is also effective to introduce models that can be customized locally such as the Japan Pavement Management system (Kyoto model).

3.7.2 Support Measures for Maintenance and Management of Bridges

After the completion of the technical project, we will continue to provide support such as dispatch of short-term specialists and consultants for the review of NHA's mid-term plan and the system update for BMS. It is effective to improve the potency of inspections by introducing equipment such as bridge inspection vehicles, non-destructive inspection methods and screening technology.

3.7.3 Support Measures for Quality Control and Safety Management

Efforts are to be strengthened to comply with quality control and safety management standards (awareness reform by holding seminars, application of penalties to violations). In addition, it is effective to improve the ability of quality control and safety management capacity through OJT education, topic-based training and national training by inviting trainees to expressway administrators of Japan. Moreover, as for bridge repair technology, it is also effective to transfer the technology by practicing bridge repair work in a pilot project because there are many points to be improved.

3.7.4 Staff Shortage of Road AM Department of NHA

Temporary staff in NHA that are trained in the technical project this time will become master trainers, and they will continue the system to train consultants and staff in NHA so that it can cover the continuity and staff shortage while also monitoring them. After the completion of the technical project, tie ups between universities in Japan and those in Pakistan (hereinafter referred to as "TAXILIA") will be promoted to develop human resources for future NHA technicians and private engineers. In addition, it is considered effective to send C/P and other candidates to Japanese universities as foreign exchange students.

Furthermore, regarding the OJT education in Japan, around five staff will participate in the training for one to three months utilizing training facilities and curriculum of expressway companies for the acquisition of lectures and practice at field sites. At the end of this training, it is considered that they will take a simplified version of an inspection diagnosis qualification test (inspection and diagnosis qualification test of the expressway) and those who pass will receive the inspection qualification.

3.7.5 Contents of Research at Japanese Universities

In Pakistan, due to the lack personnel familiar with budget constraints, knowledge, experience and skills, the improvement of pavement quality, improvement of maintenance and repair technology of bridges and improvement of Road AM capacity are major challenges. Therefore, it is considered necessary for Japanese universities to work on the following research topics regarding pavement maintenance and bridge engineering as well as bridge maintenance and management technologies.

Table 3-14 Research programs at Japanese Universities (Draft)

Challenges	Research Program
Pavement Maintenance and Quality Improvement	Study of effective pavement repair design methods considering existing pavement structure and strength
	Study of construction methods for pavement repair considering long-term durability
	Study of long-term durability of pavement materials
	Study of efficient and effective methods of recycling pavement materials
	Study of pavement and embankment structures, development of diagnostic automation technology
Improvement of Bridge Maintenance and Repair Technology	Study of deterioration diagnosis technology for steel bridges and concrete structures
	Study of utilization and analysis of bridge damage data
	Study of health evaluations for bridges
	A study of preventive maintenance methods for bridges considering reliability and risk
	A study of the setting and the standard of the performance level which should be given to bridges
Road AM capability Upward	Bridge Maintenance Integrated Database System
	Development of the road infrastructure management cycle and general research aimed at domestic and overseas implementation
	Implementation by the ME Network of SIP maintenance management that you want to use
	Research and development for the social implementation of innovative advanced technology for infrastructure maintenance management

Chap. 4 Current Situation, Challenges and Support Measures of Road AM in Kenya

4.1 Background of the Technical Project

As indicated by Table 4-1, the total length of roads in Kenya is approximately 160,000km and the rate of pavement roads with a score of good or more remains nearly 40 percent. In the situation where road traffic accounts for 90% or more of all transportation means, the improvement of expressways and their maintenance are becoming essential development challenges for Kenya to continue to achieve economic growth.

Regarding the road administration of Kenya, different institutions manage roads depending on the type of roads, such as expressways, roads in urban areas, roads in villages and roads in national parks under the supervision of the Ministry of Transport, Infrastructure, Housing and Urban Development. Most of the road maintenance is implemented by outsourcing to private companies, but the ability of contract management as well as an estimation of road management institutions is not sufficient, causing no formulation of budget planning, work planning, delays in procurement by the traders and the maintenance work itself as well as challenges of non-consistency in quality.

In response to this situation, JICA implemented, in two phases, the "enhanced management capacity project concerning outsourcing of the road maintenance." In this project, JICA cooperated in such fields as preparation of standard contracts, procedure manuals and an integration system.

This project (phase 3), through the establishment of a training course for the road management organization and private contractors, etc., to develop the results of cooperation that has been conducted over the past two phases nationwide, was requested by the Kenyan Government in September 2015 for the purpose of integrating the road management authority and strengthening the contract supervision capacity.

4.2 Overview of Road Maintenance and Management in KeNHA and Others

4.2.1 Road Maintenace and Mangement Extention in Kenya

The road length in Kenya is shown in Table 4-1. With a total of 160,000km of road length, 40,000km is the remaining 120,000km on the national roads.

Table 4-1 Kenya Road Management Extension

Road Specifications		Extend (Km)	Remarks
National Roads Networks	Class A and S	7,698	S: Thika Road A: International Trunk Road
	Class B	10,851	B: National Trunk Road
	Class C	21,446	
	Subtotal	39,995	
County Roads Networks	Class D	11,123	
	Class E	14,047	
	Class F	9,625	
	Class G	86,659	
	Subtotal	121,454	
Total		161,449	

Source: KRB: Annual Public Road Program 2018/2019

Table 4-2 Kenya Road Conditions (2018)

	Condition of road		
	Good	Fair	Poor
Paved road	33%	48%	19%
Gravel road	31%	42%	27%
Soil path	25%	23%	52%
Other	25%	1%	74%
Total	27%	30%	43%

Source: KRB: Annual Public Road Program 2018/2019

4.2.2 Holding Management System

In Kenya, road maintenance was originally carried out by the Ministry of Roads. The Ministry of Transport, Infrastructure, Housing and Urban Development, which was implemented by the Kenya Road Act in 2007, became the authority in charge of maintenance. Figure 4-1 shows the organization chart of government agencies.

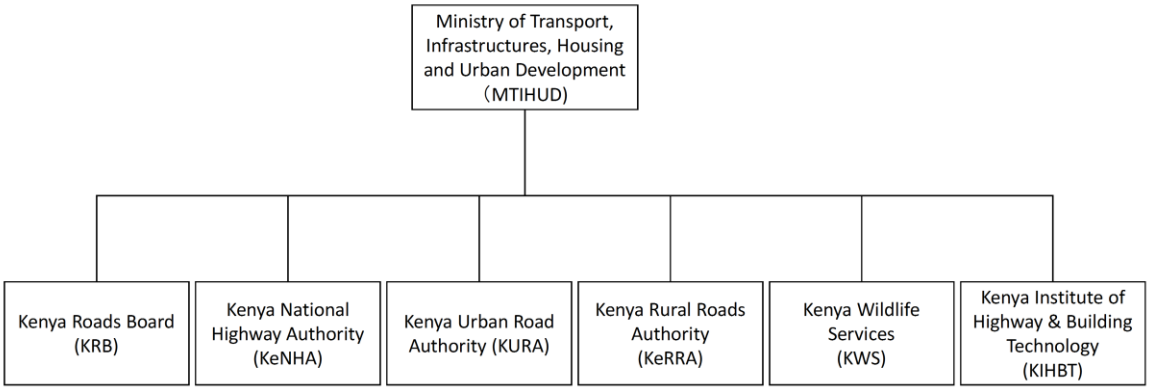


Figure 4-1 Kenya Government Road Agencies

The road managed length by road corporations is shown in the table below. KeNHA, KeRRA, KURA, etc. have jurisdiction over class S to C class national highways.

Table 4-3 Extension of Road Management by Kenya Institution

	Extend (Km)	Remarks
KeNHA	18,101	Class S, A, B Roads
KeRRA	19,529	Class C Roads
KURA	2,365	Above S, A, B, C Roads within the city
KWS	0	
County Governments	121,454	Roads governed by local governments
Total	161,449	

Source: KRB: Annual Public Road Program 2018/2019

(Ministry of Transport, Infrastructure, Housing and Urban Development: MTIHUD)

As per the Kenya Road Act of 2007, the Ministry of Transport, Infrastructure, Housing and Urban Development specialized in policy and planning, and the road business implementation was to be carried out by each road organization described below. In addition, we are carrying out a summary of each road related organization concerning the implementation of the road business. In recent years, the organization has adopted new graduates and is developing human resources through training and other

activities. We recognize that we need to continue to develop the PBC and work on bridge maintenance and management.

(KeNHA)

KeNHA is doing construction and maintenance of the main national highway. 7,500km (approximately 46%) of the managed length of 18,000km is being carried out in PBC (2018/2019). They have rapidly stretched the adoption of the PBC scheme in recent years. With regard to periodic inspections, the KeNHA staff conducts periodic inspections every year on a daily basis and records data on all routes. In addition, the data of both systems is utilized in the yearly budget requirements by performing IRI measurement using the DRIMS to match.

In addition to the PBC system, there are regular road maintenance methods, but the PBC is rapidly increasing in KeNHA. PBC has been developing and revising integration standards, systems, and contract methods in technical projects and has been able to operate and revise the C/P themselves after the end of the project. The network is built between the headquarters and the office, and database sharing is done. Recently, the Maintenance Department has been renamed to the Road Asset & Corridor Management Department.

(KURA)

KURA is conducting construction and maintenance of roads within the city. The managed length is approximately 2,000km, and there are few PBC. It is thought that it is necessary to clarify the affairs jurisdiction with the Counties (local autonomous bodies) before continuing with certain improvement work, and to take in the future because PBC is not as well adopted as in KeNHA.

(KeRRA)

KeRRA is responsible for the construction and maintenance of local roads and its managed length is about 20,000km. PBC has been implemented in the past, but recently the order of PBC is refrained. In the medium-term plan, 10,000km of local roads will be upgraded from the current gravel roads and soil roads to the paved road in five years, and the introduction of PBC will be carried out from the point where the upgrade has ended.

(KRB)

KRB has the authority to allocate the budget to each road corporation. The distribution rate for 2018 was KeNHA with 40%, KeRRA with 22%, KURA with 10%, County with 15%, KWS with 1%, and other programs with 12%. In Kenya, the road asset ledger and road conditions (fair, good, poor) of all roads are understood and registered in the system. After the completion of the technical project, KRB will set up a standing committee to ensure sustainability and will be able to discuss the PBC between each road corporation.

(KIHBT)

KIHBT conducts intensive training in PBC. Training is also being conducted for TOT (Training of Trainers), government officials and private contractors.

Instructors are also trained by a wide range of instructors who are also responsible for the staff of each road corporation.

(NCA)

NCA has conducted a qualification review of private contractors. We also have seminars on contractors.

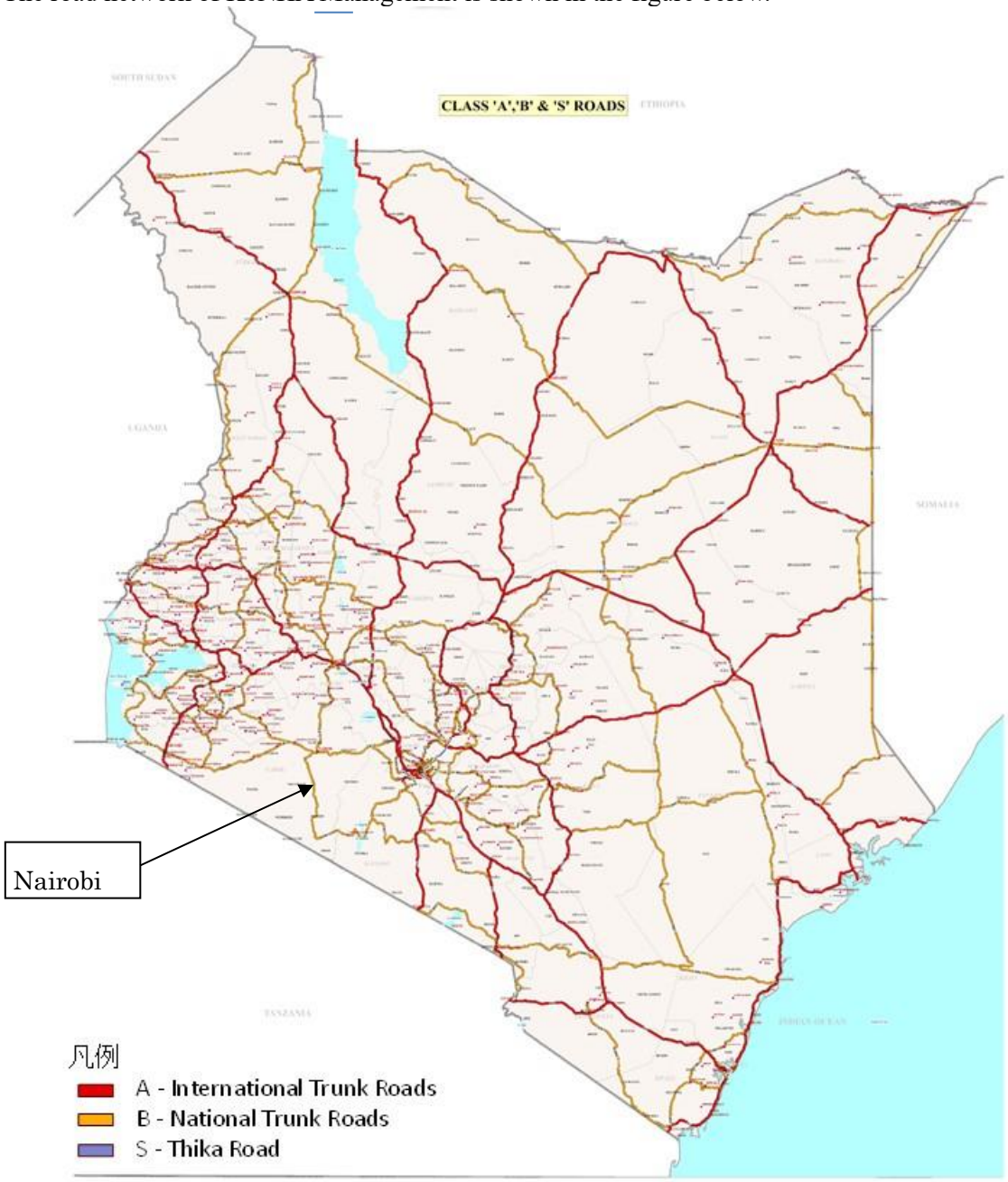
(University of Nairobi)

The University of Nairobi has a faculty of Engineering, and has signed an MOU with China, Germany, Finland, and other exchanges. They have not signed an MOU with Japanese universities, but are sending many international students to Japan. They are cooperating with Kenya road agencies on individual

challenges and are particularly monitoring and evaluating projects. There are professors who are in charge of road maintenance.

In this study, we will proceed with the investigation centering on KeNHA. The reason is that KeNHA has managed the major national highways and is systematically organized and they have also introduced PBC. In addition, the trend of the other road corporations is to collect information as necessary.

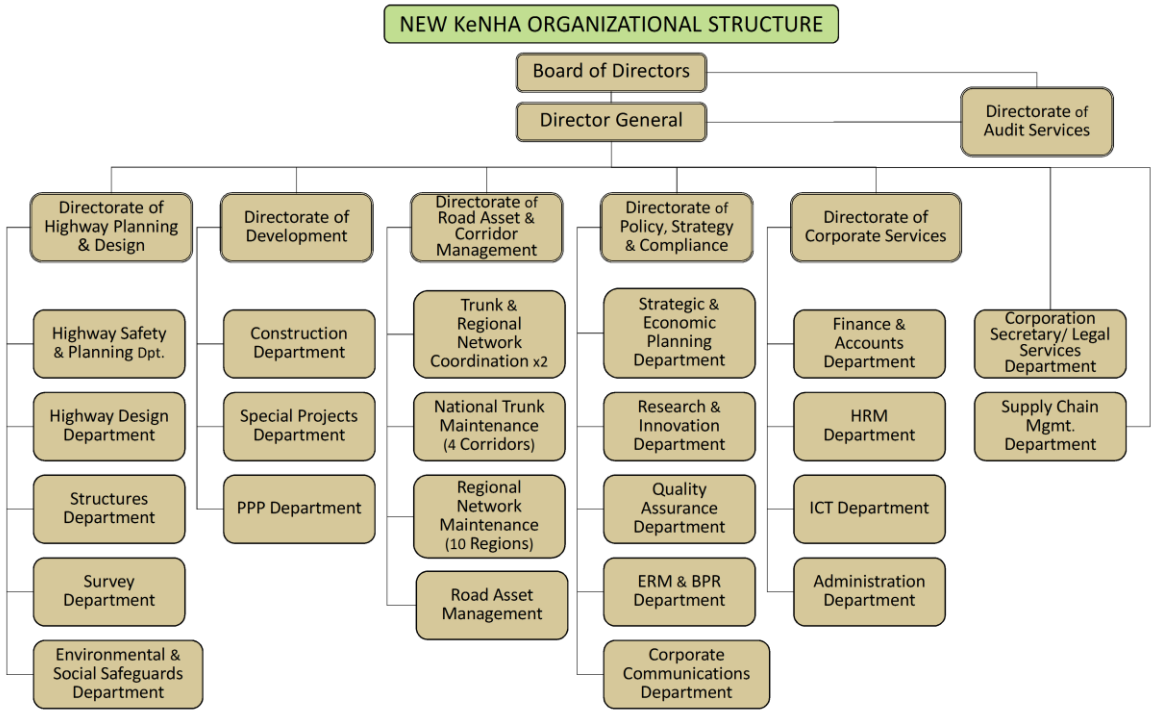
The road network of KeNHA Management is shown in the figure below.



Source: KeNHA Annual report 2017/2018

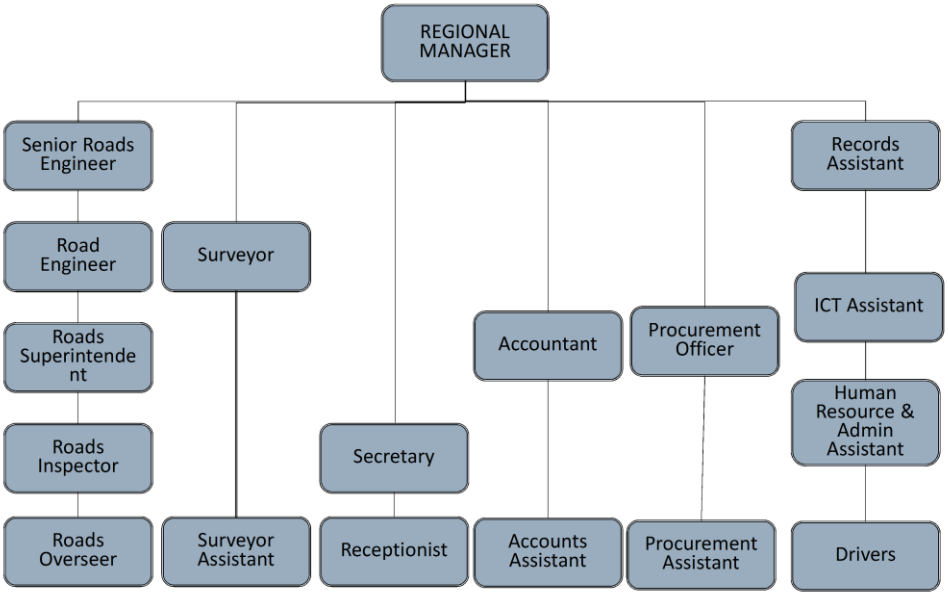
Figure 4-2 KeNHA Road Network

The organization chart of the headquarters and the office of KeNHA is shown in Figure 4-3 and Figure 4-4.



Source: KeNHA Annual report 2017/2018

Figure 4-3 Organization Chart of KeNHA Headquarters



Source: KeNHA Annual report 2017/2018

Figure 4-4 Organization Chart of KeNHA's Regional Office

4.2.3 Road Maintenance Budget

The transition of the budget amount for the maintenance cost of the road organizations in Kenya is shown in the table below. The road resources have been designated as specific financial resources, and 18 KS per liter (1 KS = 1.1 Yen as of March 2019) is being used. The total budget is steadily increasing

annually, as shown in Table 4-4, and the budget amount for the 2018/2019 fiscal year has reached 69 billion KS. In addition, KRB has the authority to allocate the entire budget to each road corporation and the budget is now allocated at a rate of KeNHA with 40%, KeRRA with 22%, KURA with 10%, County with 15%, KWS with 1% and other programs with 12%.

Table 4-4 Road Maintenance and Repair Costs by Road Organization in Kenya

(Unit: Million KS)

	2016/2017	2017/2018	2018/2019
KRB	1,209	1,269	1,380
KeNHA	20,459	21,464	23,639
KeRRA	10,894	1 1 ,438	12,428
KURA	5,106	5,362	5,826
KWS	500	525	570
County Governments	7,875	7,875	8,269
KRB/CS Allocation	5,000	5,250	5,704
Road Annuity Fund	9,800	10,290	11,180
Total	60,469	63,474	68,996

Source: KRB: Annual Public Road Program 2018/2019

4.3 Overview of the Technical Project

4.3.1 Obectives of the Techical Project

The Technical Project (phase 3), through the establishment of a training course for road management agencies and private contractors, etc., will develop the results of the cooperation that has been implemented over the past two phases nationwide.

The purpose of this is to strengthen the integration of road management organizations and the ability to manage contracts.

4.3.2 Overall Goal of the Technical Project

The following are the overall goal for the technical project:

1) The road Maintenance management method developed in the project will be mainstream in the Kenya construction industry.
2) Kenya’s domestic road network is maintained in a proper state.

4.3.3 Project Purpose of the Techinical Project

The project purpose of the Technical Project is to improve the road maintenance management method and to use it widely in Kenya.

4.3.4 Expected Effect of the Techiical project

The following three items are listed as the expected results of the project implementation:

Table 4-5 Expected Effect

Output 1	Improving the public integration capabilities of each road management organization.
Output 2	The ability of the road management authority to manage road maintenance by PBC is strengthened.
Output 3	The ability of training organizations (KIHBT, NCA, etc.) for road management and private contractors to be strengthened by PBC for road maintenance management.
Output 4	Road flatness survey methods spread to domestic road management organizations.

4.3.5 Activites of the Technical Project

The content of the technical project is described in Table 4-6.

Table 4-6 Activities

Output 1	Improving the public integration capabilities of each road management organization	
	Activity 1	Review the PBC Integrated Database system (COSTES 2011 and 2015) and review the improvement measures
	Activity 2	Consider standard methods for productivity, price surveys, etc.
	Activity 3	Do cumulative surveys to improve the COSTES database
	Activity 4	Improve COSTES software
	Activity 5	Create a work plan for the installation of cost accumulation units in each road management organization
	Activity 5	Support the activities of the integrated units installed
	Activity 6	Use COSTES to index road maintenance costs
Output 2	The ability of the road management authority to manage road maintenance by PBC is strengthened	
	Activity 1	Technical support for revisions to standard contract books
	Activity 2	Review the contents of the PBC business by the Road Corporation and flush out the challenges
	Activity 3	Support revisions to the PBC guidelines
	Activity 4	Technical support for the introduction of contract evaluation to the road corporations
	Activity 5	Supporting the establishment of the PBC contractor category
Output 3	The ability of training organizations (KIHBT, NCA, etc.) for road management and private contractors to be strengthened by PBC for road maintenance management	
	Activity 1	Monitoring the PBC training by KIHBT and making proposals for improvement
	Activity 2	Support for revisions and updates to the PBC training manuals and materials
	Activity 3	Conduct a seminar on PBC dissemination
	Activity 4	Conduct training for teachers in PBC
	Activity 5	Conduct instructor training for DRIMS
Output 4	DRIMS road flatness survey methods spread to domestic road management organizations	
	Activity 1	Check the current status of other organizations pertaining to road surveys (current status of surveys, equipment used, technical standards, etc.)
	Activity 2	Based on the above activity, propose how to utilize DRIMS
	Activity 3	Support for the standardization of DRIMS equipment in the road maintenance management of Kenya
	Activity 4	Conduct awareness activities for DRIMS in neighboring countries
	Activity 5	Present the results of the entire project through workshops, etc.

4.3.6 Manuals Introduced in the Technical Project

The manuals and summaries created in the activities of the technical project are shown in Table 4-7.

Table 4-7 Manuals Introduced

Manual Name	Overview
PBC Guidelines	➢ The basic idea of the PBC, how to set the service level, specific examples of performance regulations, how to conduct periodic inspections, and how to evaluate contractors
PBC Agreement	➢ Standard contracts and specifications for PBC applicable nationwide throughout Kenya ➢ Standardization of project results by the government of Kenya
PBC Integration Manual	➢ Describes the standard method for integrating PBC ➢ PBC, the construction of a system that is calculated by entering various parameters such as extension of construction, traffic volume, lane width, contract years, and existing pavement conditions ➢ Methods of the accumulation of maintenance work other than PBC are described, and the one created in 2011 is revised to the 2017 edition; will eventually be completed as 2019 edition
PBC Training Manuals (Theoretical compilation)	➢ Summary of the training materials for PBC ➢ The training is divided into courses for road managers and contractors
PBC Training Manuals (Practical compilation)	➢ Introduces specific examples of implementing PBC ➢ Describes a series of flows from the beginning to the end of PBC ➢ Contractor also presents a variety of forms to be submitted to the outsourcer ➢ Contents and points of the periodic inspection by monthly ordering person; outline the measures when there is a penalty
DRIMS Manual	➢ A collection of DRIMS training materials describes how to handle equipment, how to operate, how to check, and how to record inspection results

Source: Materials Provided by the Technical Project Team

4.3.7 Technical Level of Various Manuals

The guidelines and manuals created in the technical project are related to the contract contents and contract method of PBC, cost accumulation, PBC training, inspection method by DRIMS, and construction of PBC scheme. In consideration of the local situation, it is summarized in the content which was at the technical level of Kenya's ordering authority and the construction company, and the perfection is high.

In addition, the following is a problem in the further deployment of PBC in the future.

Cost accumulation method of routine work such as mowing and cleaning has been incorporated as a performance evaluation item established, small repair portion that is not routine work such as pothole repair and guardrails, based on the instruction of the outsourcer by specification regulations under which it has been implemented. When incorporating those small repair works (referred to as hybrid type PBC) into the performance regulations, it is necessary to estimate the probability of occurrence of damage, so that the cost accumulation can be carried out. In the technical project, the probability of occurrence of damage is predicted and cost accumulation is possible, but it is necessary to increase the accuracy and to withstand practical use.

In order to improve the quality control of contractors in PBC, it is hoped that the small repair work shown above also proceeds to the performance regulations. In addition, PBC is now standard for three

years, but it is also useful to aim for a long-term contract of about 10 years to improve motivation for contractor quality control.

In the repair work in the PBC, the material test, etc. are also carried out by the ordering person, the local construction management is not done by the ordering person, and it is voluntary management by the contractor. In order to improve the quality of the repair work, it is necessary to appropriately evaluate the contractor and to consider the results of evaluation in the past construction in future supplier selection. It is important to construct a system that allows the contractor to take priority orders for construction in the future.

4.3.8 Achieved Techical Level in the Technical Project

In phase I of the technical project, a long-term expert introduced the Japanese integration standard to Kenya. In phase II, we worked on the introduction of PBC by long-term and short-term specialists to create PBC standard contracts and integrated manuals. In phase III, the nationwide expansion and fixation of PBC was achieved.

The contract status of PBC in KeNHA is shown in Figure 4-5. The introduction began in 2011, and since the start of phase III in 2016/2017, the introduction of the PBC length has increased sharply. In 2018/2019, it is scheduled to be introduced to 7,466km, which is about 40% of the total length of 18,000km under KeNHA. KeNHA also plans to introduce PBC to 13,500km, which is equivalent to 75% of its total managed length in three years.

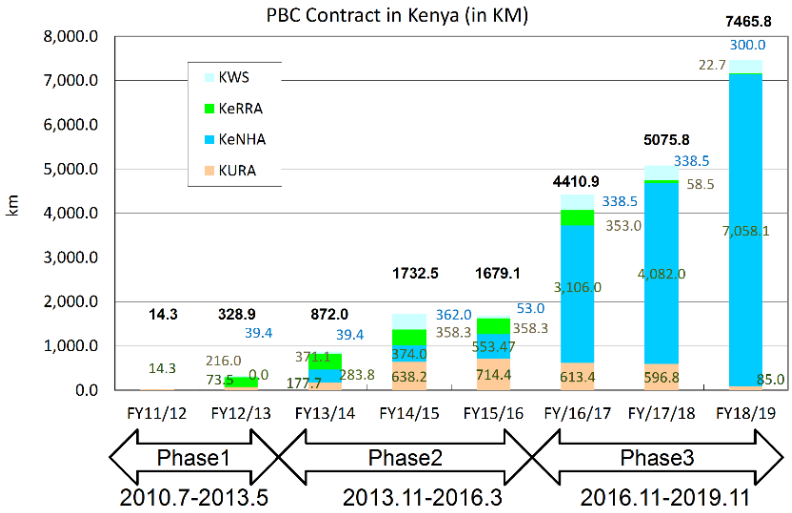


Figure 4-5 Road Extension of PBC in Kenya

In addition, KeRRA and KURA are scheduled to implement PBC after the improvement from gravel road to paved road, and the transfer of road management affairs jurisdiction to the local government is scheduled. The PBC of 2018/2019 has not been recorded for only a slight area of roads.

Table 4-8 summarizes the implementation status of technical projects and the level of technical achievement. The PBC that are progressing in KeNHA are described here.

Table 4-8 Technical Achievement Level

Project	Previous Level	Current Level	Intended Level
PBC	➢ The PBC that the World Bank proposed was being implemented, although slightly ➢ No standard contract	➢ The PBC is adopted on 40% of the managed length in KeNHA ➢ Created a PBC standard agreement	➢ Examination of the evaluation method of contractor at the end of construction period ➢ The establishment of the standing committee to consider the continuous PBC method
Cost Accumulation	➢ Individual technicians as engineers were calculating the planned price at the discretion of the individual	➢ To ensure transparency and fairness, we can calculate construction prices using an integrated system ➢ In the PBC, it is possible to calculate the GR damage and pothole incidence from actual values	➢ We ask consultants to update the accumulated data, and develop an environment that can update the system at any time after the end of the technology project
PBC Training	➢ No training has been conducted on the PBC	➢ KIHBT has conducted various PBC training sessions for both contractors and outsourcers	➢ To allow the training business to become independent without JICA's financial support in KIHBT
Flatness measurement by DRIMS	➢ Only understand the road situation by visual observation	➢ Implementation of the IRI value measurement using smartphones in KeNHA from 2014 ➢ The partnership between Japanese companies and local companies has been realized so that system updates can be made available locally	➢ Examine the performance of other IRI measuring instruments to clarify the advantage of DRIMS

4.4 Construction, Maintenance Ability and Technical Level

The results of interviews with JICA technical project specialists, each road corporation, local construction companies and consultants for local construction and maintenance capabilities are shown below.

- ✓ The system maintenance such as the contract and the cost accumulation are done well, but the construction technology is the future. It is common in projects other than PBC, that the outsourcer does not check the construction. The temperature control has not been carried out only by filling the material suitably for the repair of potholes. The ability to improve KeNHA for construction and quality control is indispensable. (JICA specialists)
- ✓ Recognized that the quality of pothole repairs by PBC is not good, and if the quality is not improved, the introduction effect of PBC does not appear visibly. (JICA specialists)
- ✓ It is necessary to train not only the PBC but also the overall road maintenance management. It is important, for any project, to inspect it reliably and to do the construction well. (KURA)
- ✓ Although the daily maintenance management by PBC has encompassed a large length, it is difficult to say that the technical capability is improved for the quality assurance of repair work. It is not

possible to collect enough traffic data and the design is not complete. Also, since the history of the repair implementation portion is not arranged as a database, it is not possible to immediately obtain information about what repairs in the section were carried out in the past. (KRB)

- ✓ PBC terms are considered standard at three years, but the risk transfer to contractors is not enough. If it is not for a long period of about ten years, the motivation for contractor quality control does not work. (KRB)
- ✓ Most large-scale projects in Kenya are dominated by Chinese companies. In the case of the Chinese government financing project, design and construction are often packaged.
- ✓ The number of construction companies and consultants in the Kenyan construction industry is fierce and competitive. (Local consultants)
- ✓ Control is conducted by consultants. Japanese construction companies seem to carry out their own quality control, but construction companies do not carry out quality control in Kenya. The quality of the construction depends on whether the consultant is firmly in control. (Local consultants)
- ✓ The ability of a local construction company is only inferior to China's financial aspect. Local construction companies are no match for financially-willing Chinese companies because government payments are slow. (Local consultants)
- ✓ The construction order of the Kenyan government agencies is at risk of delayed payment, and it is difficult for local construction companies to partake. If there is no financial power like with Chinese companies, it goes bankrupt. (Local construction company)
- ✓ If the contractor of the PBC is a trader of Grades I to III, there is no problem, but when dealing with other levels, the KeNHA staff will have to instruct the operations. (KeNHA Regional Office)
- ✓ Contractor's ability is not low and believes there are no operational challenges. (KeNHA headquarters)
- ✓ The technical capabilities of local contractors are not sufficient. The reason is that high quality is not demanded from above. If we teach and are scrupulous, the quality will rise. They are also responsible for the construction of KURA, but KURA technicians rarely come to the scene. There seems to be no desire to learn technology at the site. (Japanese construction company)
- ✓ Although the interview partners and the situation in which it was done are not unconditional, the following is presumed about the local construction and maintenance ability from the above.

①The level of construction technology and quality control of local construction companies are not so high. The following construction companies must be instructed by the outsourcer in grades. However, there is room for improvement if instructed properly.

②There are a lot of delays in government contracting payments, and local construction companies and consultants with scarce financial resources are limited in their participation in construction and research. Therefore, the experience of construction and the investigation becomes scarce.

③There is no motivation for field management and quality control by the government agency engineers, and the function to check the construction and quality control by the outsourcer is not working. Also, the ability of consultants to strictly check quality control is not so high.

4.5 Confirmation of Achievement Level on Road AM

4.5.1 Road am Evaluation Index Structure Diagram

The structure of the Road AM Evaluation Index is shown in Figure 4-6. The numerical value of the evaluation Index (breakdown) is determined through interviews and local confirmation. In addition, small items are the average value of the breakdown, middle items are the average value of the small items and large items are the average value of the middle items. The numerical value of the expansion of other areas is a separate item.

In addition, there are several road corporations in Kenya, and the implementation situation of the asset management of each road corporation is also different. Here, with KeNHA, which has jurisdiction over the main national highway and the introduction of PBC, is described as a representative case.

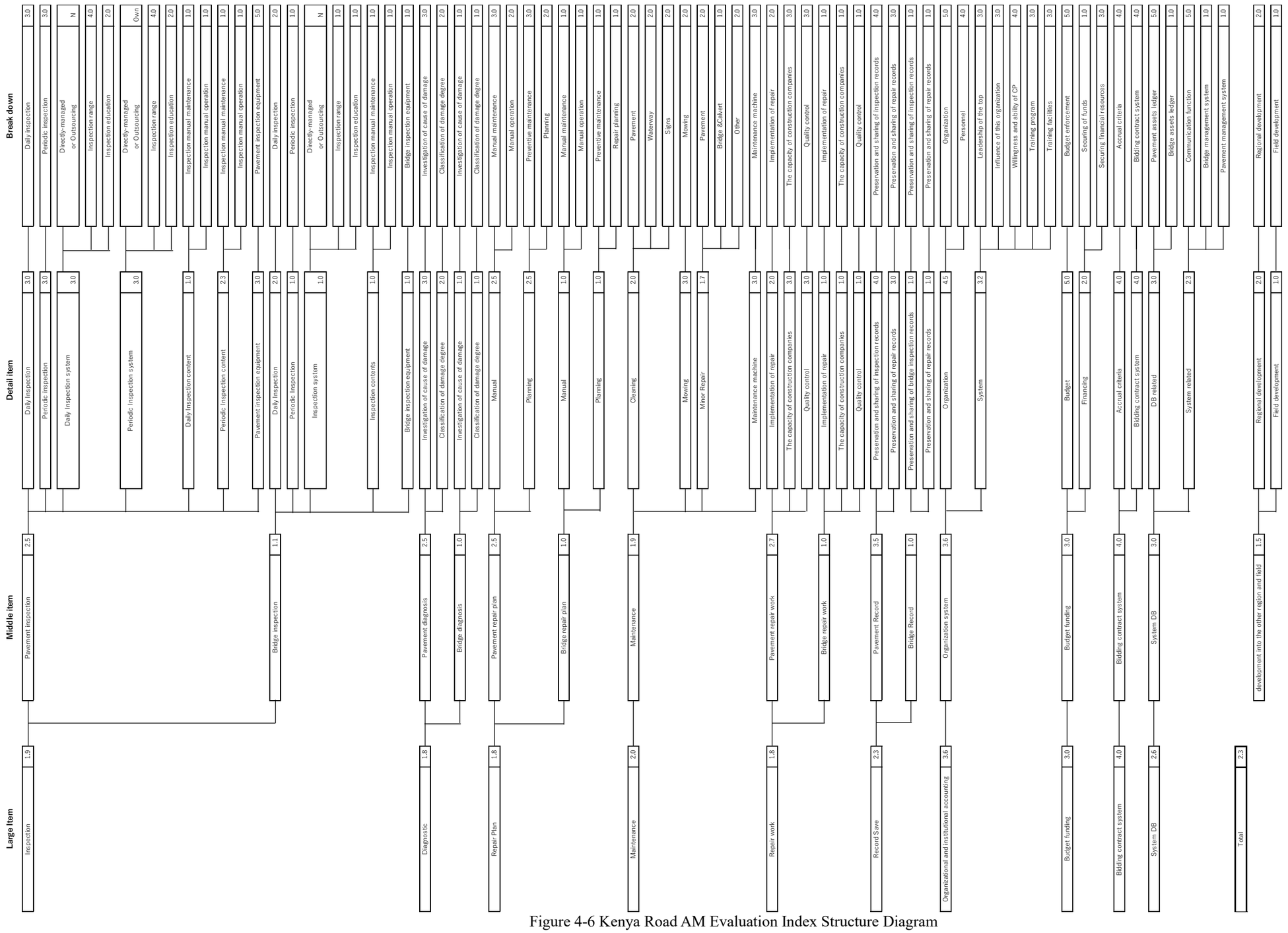


Figure 4-6 Kenya Road AM Evaluation Index Structure Diagram

4.5.2 Road AM Evaluation Index (Breakdown)

4.5.2.1 Pavement Inspection

The pavement daily inspection is carried out in the road patrol that KeNHA's office staff conducts every day. The patrol is not only about the condition of the road surface, but all events in the control area, such as fallen objects, accidents and contractor's local work conditions. The inspection results in the management area are reported to the engineer in charge of the office every day, and the technician in charge decides whether an urgent correspondence is necessary. The inspection is carried out by the staff who have received education of civil engineering, and there is no special training on the inspection. In the PBC section, contractors conduct daily inspections and report the inspection results to the KeNHA office. Three years later, the PBC is planned to reach 13,500km, which is equivalent to 75% of all KeNHA routes, and after five years later, the training on daily inspections will be conducted in PBC courses. The inspection education score was to improve from 2.0 to 4.0.

Middle Item	Small Item	Breakdown	Scores
Daily Pavement Inspection	Daily Inspections		3.0
	Daily Inspection System	Outsourcing Status	Parts other than PBC are directly operated
		Inspection Range	4.0
		Inspection Education	2.0 (4.0)

( ) is expected to be achieved in about five years after the end of the technical project

KeNHA has carried out once a year a periodic inspection called ARICS (Annual Road Inventory and Condition Survey) by direct management along with IRI measurement of the administration route line, and the determination of the road damage degree by visual inspection. Regarding IRI measurement, the DRIMS developed by the University of Tokyo has acquired the whole line data using smartphones. In addition, by checking the whole line by foot, the visual survey has confirmed the damage such as potholes and cracks in the sections with minimum unit of 200m interval.

Middle Item	Small Item	Breakdown	Scores
Periodic Inspection of Pavement	Periodic Inspections		3.0
	Periodic Inspection System	Outsourcing Status	Own force
		Inspection Range	4.0
		Inspection Education	2.0

Periodic inspection manuals are not being maintained, but the style of filling out the inspection results is arranged. In addition, supplementary explanatory material for filling in the periodic inspection style is also maintained, and it is made to be a consistent record. In addition, KeNHA uses DRIMS for the latest system with respect to pavement inspection equipment, and it is determined that the periodic inspection is carried out using DRIMS by the company ISO Standard. In addition, the Ministry of Transport, Infrastructure, Housing and Urban Development also owns a road surface measurement machine.

Middle Item	Small Item	Breakdown	Scores
Pavement Inspection	Daily Inspection Contents	Inspection Manual Maintenance	1.0
		Inspection Manual Operation	1.0
	Periodic Inspection Contents	Inspection Manual Maintenance	1.0
		Inspection Manual Operation	1.0

Middle Item	Small Item	Breakdown	Scores
	Pavement Inspection Equipment		5.0

4.5.2.2 Bridge Inspection

Daily inspections on bridges are not included in the daily inspections of KeNHA. However, the PBC includes daily inspection of structures including bridges and it has become to report the inspection results to the outsourcer. In addition, periodic inspections of bridges have not been carried out in the KeNHA office, and periodic inspections are not included in the PBC. KeNHA's side is recognized for the non-implementation of periodic bridge inspections, and it shows the intention that it wants to carry out the bridge inspection and repair in the future with the support of Japan.

Middle Item	Small Item	Breakdown	Scores
Bridge Inspection	Daily Inspections		2.0
	Periodic Inspections		1.0
	Periodic Inspection System	Outsourcing Status	1.0
		Inspection Range	1.0
		Inspection Education	1.0

The regular inspection manual of the bridge has not been developed. In addition, we have not been able to confirm the maintenance of inspection equipment such as bridge inspection vehicles, but we thought that there was no inspection equipment because we did not conduct inspections until now.

Middle Item	Small Item	Breakdown	Scores
Bridge Inspection	Contents of Inspection	Manual Maintenance	1.0
		Manual Operation	1.0
	Bridge Inspection Equipment		1.0

4.5.2.3 Damage Diagnosis

If the investigation of the pavement substructure is severe, the cause of the pavement damage is investigated by requesting an examination under the Ministry of Transport, Infrastructure, Housing and Urban Development. Although the degree ranking of individual damage has not been made, the damage of the section is determined by the number of damages per 200m interval (potholes, amount of cracking, etc.). Although the number of individual damages is recorded, it does not go into a damage ranking.

Middle Item	Small Item	Breakdown	Scores
Pavement Diagnosis	Investigation of the Cause of Damage		3.0
	Classification of Damage Level		2.0
Bridge Diagnosis	Investigation of the Cause of Damage		1.0
	Classification of Damage Level		1.0

4.5.2.4 Repair Plan

The pavement repair plan is created based on the damage status of each interval in the periodic inspection results and the place to be repaired is determined preferentially in consideration of the

importance of the degree of damage and route per interval. Although there are repair manuals developed in the field in 2010, there are many items that should be improved. In addition, the construction of crack seal engineering regarding preventive maintenance has been made. Although there is a five-year mid-term plan (MTP), it is not a systematic plan based on the inspection results. On the other hand, in accordance with the results of the annual plan (APRP), repair parts and repair contents have been formulated and submitted to KRB by each road corporation. Basically, there is a budget every single year.

Middle Item	Small Item	Breakdown	Scores
Pavement Repair Plan	Manual	Manual Maintenance	3.0
		Manual Operation	2.0
	Planning	Preventive Maintenance	3.0
		Plan Development	2.0

As for bridge repair, the maintenance of the repair manual, which is hardly put in hand, will be a problem in the future.

Middle Item	Small Item	Breakdown	Scores
Bridge Repair Plan	Manual	Manual Maintenance	1.0
		Manual Operation	1.0
	Planning	Preventive Maintenance	1.0
		Development of Repair Plan	1.0

4.5.2.5 Maintenance Management

Road surface cleaning is carried out in PBC to remove the fallen objects on the roadway and the piled sand on the shoulder. Waterway cleaning is also carried out cleaning in PBC and the normal maintenance management contracts. For signs, it is stated that the labeling is easy to see in PBC, but cleaning is not included in the normal maintenance. In three years, the PBC is expected to reach 75% of all KeNHA routes, and since the daily maintenance of cleaning, mowing, etc. is assumed to be carried out regularly after five years, each item's score was to be improved from 2.0 to 3.0.

Middle Item	Small Item	Breakdown	Scores
Maintenance Management	Cleaning	Pavement	2.0 (3.0)
		Waterway	2.0 (3.0)
		Signs	2.0 (3.0)
	Mowing		2.0 (3.0)

( ) is expected to be achieved in about five years after the end of the technical project

Small repair work is the result of the daily and periodic inspections and, when the damage has been confirmed, the maintenance work is ordered corresponding to each case. In addition, damage found in the daily inspection by contractors in PBC is supposed to be repaired within the stipulated period. However, it is assumed that the bridge is only inspected during the PBC daily inspection, and repairs are made after instruction of the outsourcer. Three years later, the PBC is expected to reach 75% of all KeNHA routes and is expected to be implemented as appropriate except for the bridge for maintenance in five years, and the road surface score and others were to be improved from 2.0 to 3.0.

Middle Item	Small Item	Breakdown	Scores
Maintenance Management	Minor Repair	Pavement	2.0 (3.0)
		Bridges/Culverts	1.0
		Other	2.0 (3.0)

Middle Item	Small Item	Breakdown	Scores
	Maintenance Work Machine		3.0

( ) is expected to be achieved in about five years after the end of the technical project

4.5.2.6 Repair Work

At the initial stage after the conclusion of the contract, the PBC implements a performance-prescribed maintenance control after raising the maintenance level by performing pothole repairs and overlays. In addition to PBC, a large section of damage has been repaired by overlay or the like as rehabilitation work.

In the case of moderate or less damage, rehabilitation work has been ordered, including small repair work and maintenance operation as a periodic maintenance construction. If the grade at the time of construction contractor registration is relatively high there may be no problems with the construction capacity and construction experience, but it seems to require frequent instruction of the ordering person when the grade is not so high. As for the quality in general, it was an answer that it did not have dissatisfaction on the ordering person's side. In three years, the PBC is expected to reach 75% of all KeNHA routes, and since the number of pavement damage is expected to be repaired promptly by PBC contractors after five years, the implementation of the repair score was to be improved from 2.0 to 3.0.

Middle Item	Small Item	Breakdown	Scores
Pavement Repair Work	Implementation of Repairs		2.0 (3.0)
	Capacity of the Construction Company		3.0
	Quality Control		3.0

( ) is expected to be achieved in about five years after the end of the technical project

Bridge repair work has not yet been implemented.

Middle Item	Small Item	Breakdown	Scores
Repair Work	Implementation of Repairs		1.0
	Capacity of the Construction Company		1.0
	Quality Control		1.0

4.5.2.7 Record Save

Although the database of the daily inspection of the pavement is not done, the database of the periodic inspection result is made, and data is shared. In addition, the record of repair work is the extent that is recorded for payments to contractors and it is not a database that can be used when formulating a repair plan. No records of inspections and repairs have been made for bridges.

Middle Item	Small Item	Breakdown	Scores
Pavement Record	Inspection Records Save/Share		4.0
	Repair Record Save/Share		3.0
Bridge Record	Inspection Records Save/Share		1.0
	Repair Record Save/Share		1.0

4.5.2.8 Organizational Structure

In KeNHA under the conventional maintenance (Maintenance unit) and the Road Asset & Corridor Management Unit (Road AM section), it is a policy to manage not only the narrow sense of maintenance but also the road as an asset in good condition. There is a slight vacancy in the Road AM area, but there is not a large capacity shortage. The director general, the top of KeNHA, has regularly toured road conditions over one to two weeks in a quarter, and has a high interest in Road AM. In addition, all departments in KeNHA are concerned about Road AM, and Road AM is influential to other departments.

The ability C/P of the technical project was high, and it was JICA expert's opinion that they needed some assistance, and the desire was moderate. However, after the end of the technical project, the standing committee was established, and there was willingness to cooperate with C/P to ensure that the operation of the PBC business will continue smoothly. Regarding the training system, KIHBT, a training organization under the Department of Transportation Infrastructure, Housing and Urban Development, conducts extensive training activities and has conducted many training programs for PBC. In addition, recently, the training scheme sponsored by The World Bank is RFTI (Regional Flagship Training Vocational Education Institute) and the curriculum is going to be adopted by the PBC, which is being implemented in Kenya, and various training projects are being conducted.

Middle Item	Small Item	Breakdown	Scores
Organizational Structure	Organization	Organization	5.0
		Personnel	4.0
	System	Top Leadership	3.0
		Influence of the Organization	3.0
		C/P Willingness and Ability	4.0
		Training System	3.0
		Training Facilities	3.0

4.5.2.9 Budget Financing

For the budget plan, KRB is the center of a 15-year long-term plan and five-year mid-term plan. As for the financing, the delay of contract amount payment is become a routine due to the reason of the government road organization exceeding the budget and ordering the construction and the investigation. In addition, the financial resources of the maintenance management are making a part of fuel taxes a certain fund.

Middle Item	Small Item	Breakdown	Scores
Budget Financing	Budget	Budget Enforcement	5.0
	Financing	Securing funds	1.0
		Securing Financial Resources	3.0

4.5.2.10 Contract System

Through the activities of the technical project, the accumulation standard for road maintenance management has been established, and it is used for the planned price calculation. Also, the standard rate is set for maintenance work other than PBC and cost accumulation is facilitated. Maintenance of the integrated system is also carried out in conjunction while traffic volume in the PBC and construction cost can be calculated if you enter a simple parameter such as rainy season and dry season days.

In addition, changes due to other changes such as materials, machinery and equipment, productivity, etc., are planned to be outsourced to consultants and revised at any time.

Regarding the contract system, PBC's standard agreements have been developed, and PBC have been applied on more than half of KeNHA's jurisdiction. In addition, the general competitive bidding is adopted in both construction and investigation, and the design for the selection of the trader and the bidder is selected by the price competition from companies with the technical ability.

Middle Item	Small Item	Breakdown	Scores
Bidding Contract System	Accumulation Criteria		4.0
	Bidding Contract System		4.0

4.5.2.11 System DB

The KRB has a database of inventory as an asset ledger, and data sharing is possible. In addition, the contents of the ledger are road length, width, point of origin, number of lanes, pavement and unpaved classification, etc., and these are linked with the location information by ArcGIS. Moreover, road condition is classified into three stages: good, fair, poor. These classifications are used not only for budget requests but also for monitoring that the allocated budget is used appropriately and that the state of the road is reliably improved. KeNHA's 10 regional offices and headquarters are equipped with a telecommunications network, and the headquarters database can be viewed at the office. Note that PMS and BMS are not maintained.

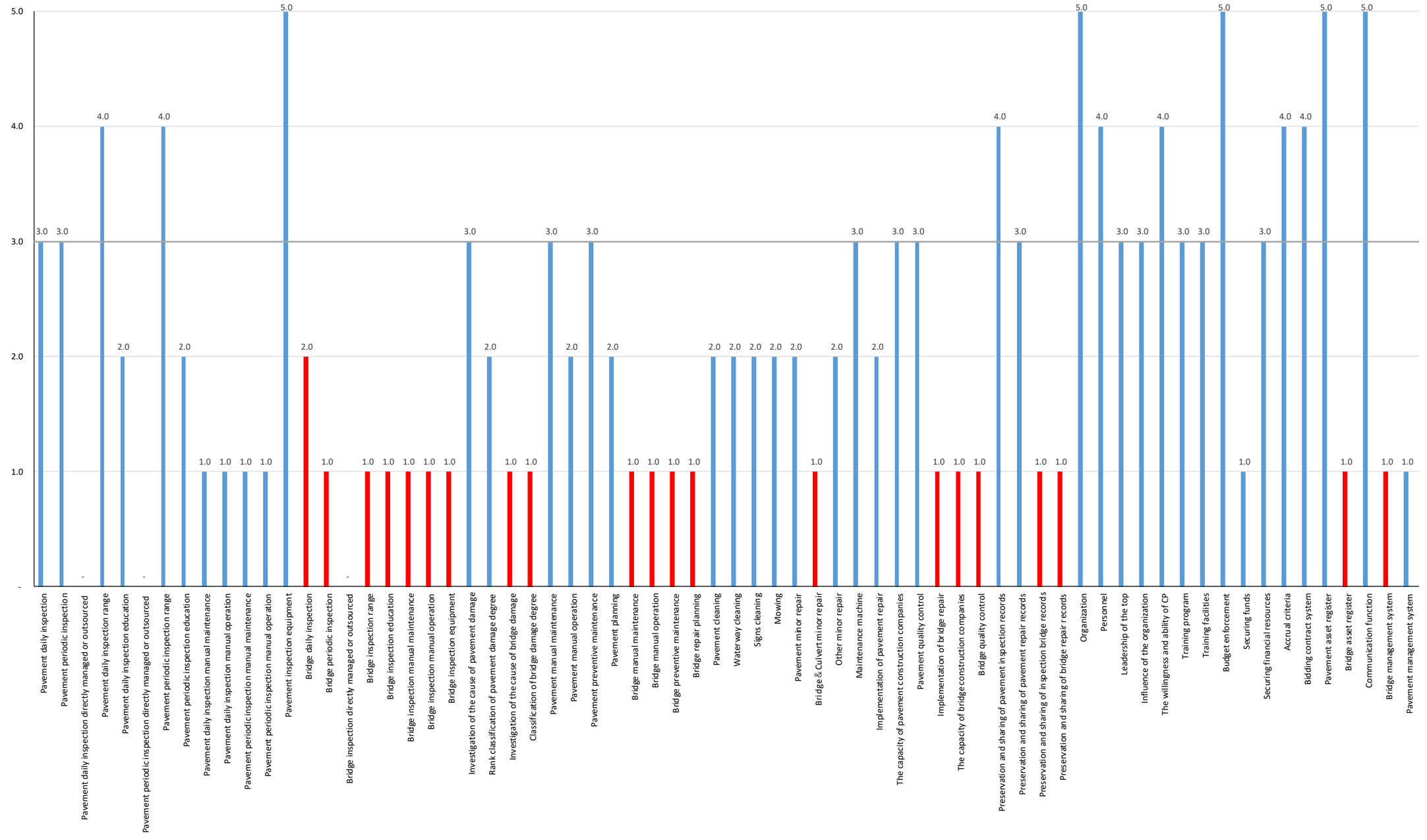
Middle Item	Small Item	Breakdown	Scores
System DB	DB Related	Pavement Asset Ledger	5.0
		Bridge Asset Ledger	1.0
	System Related	Communication Function	5.0
		Bridge Management System	1.0
		Pavement Management System	1.0

4.5.2.12 Expanding to Other Regions

The PBC was expanded to a route of about 40% of the KeNHA jurisdiction in 2018. In addition, regarding DRIMS, it is also going to be promoted to other regions such as by conducting public relations and dissemination activities in neighboring countries. Three years later, the PBC was expected to reach 75% of all KeNHA routes, and it was expected to improve from 3.0 to 4.0 because it expects the regional expansion of PBC in five years.

Middle Item	Small Item	Breakdown	Scores
Deployment to Other Regions and Areas	Regional Deployment	-	3.0 (4.0)
	Area Deployment	-	1.0

( ) is expected to be achieved in about five years after the end of the technical project



*The red display is a bridge related item

Figure 4-7 Kenya Road AM Evaluation Index (Breakdown)

4.5.3 Road AM Evaluation Sheet (details)

Table 4-9 Road AM Evaluation Sheet in Kenya (Part 1)

Middle item	Small item	Detail item	Scores	Evaluation items	Score Current	Scale	Achieve %	Score 5years later
Pavement inspection	Daily inspection		1	Inspection is not conducted.	3.0	3.0	100%	3.0
			2	Inspection is carried out at random times.				
			3	Inspection is conducted on a regular basis.				
			4					
			5					
	Periodic inspection		1	Inspection is not conducted.	3.0	3.0	100%	3.0
			2	Inspection is carried out at random times.				
			3	Inspection is conducted on a regular basis.				
			4					
			5					
	Daily Inspection system	Outsourcing Situation	0	Person in charge within an organization is absent and daily inspection is outsourced without evaluating an outsourcing contractor.	N	5.0	N	N
			1	Person in charge within an organization is present and daily inspection is outsourced without evaluating an outsourcing contractor.				
			2	Outsourcing contractors are to be evaluated and their responsibilities, authorities, and contents are specifically defined.				
			3	Information is being shared to achieve target performance.				
			4	Trustees have systems to improve their target performance independently.				
		Inspection range	1	Inspection is not conducted.	4.0	5.0	80%	4.0
			2	Inspection is being conducted, but limited.				
			3	Inspections have been carried out in 50% or more of the road extension of the operating route.				
			4	Inspections have been carried out in 75% or more of the road extension of the operating route.				
			5	Inspections have been carried out in 100% or more of the road extension of the operating route.				
		Inspection education	1	Inspectors have no knowledge of civil engineering and have not received an inspection education	2.0	5.0	40%	4.0
			2	Inspectors have knowledge of civil engineering, but have not received inspection education				
			3	Inspectors have no knowledge of civil engineering, but they have received an inspection education.				
			4	Inspectors have knowledge of civil engineering, and have received an inspection education.				
			5	Inspectors are continuously taking inspection education.				
	Periodic Inspection system	Outsourcing Situation	1	Person in charge within an organization is absent and periodic inspection is outsourced without evaluating an outsourcing contractor.	Own	5.0	N	Own
			2	Person in charge within an organization is present and periodic inspection is outsourced without evaluating an outsourcing contractor.				
			3	Outsourcing contractors are to be evaluated and their responsibilities, authorities, and contents are specifically defined in contract document.				
			4	Information is being shared to achieve target performance.				
			5	Trustees have systems to improve their target performance independently.				
		Inspection range	0	Inspection is not conducted.	4.0	5.0	80%	4.0
			1	Inspection is being conducted, but limited.				
			2	Inspections have been carried out in 50% or more of the road extension of the operating route.				
			3	Inspections have been carried out in 75% or more of the road extension of the operating route.				
			4	Inspections have been carried out in 100% or more of the road extension of the operating route.				
		Inspection education	0	Inspectors have no knowledge of civil engineering and have not received an inspection education	2.0	5.0	40%	2.0
			1	Inspectors have knowledge of civil engineering, but have not received inspection education				
			2	Inspectors have no knowledge of civil engineering, but they have received an inspection education.				
			3	Inspectors have knowledge of civil engineering, and have received an inspection education.				
			4	Inspectors are continuously taking inspection education.				
	Daily Inspection content	Existence of Inspection manual	0	Inspection manuals are not developed.	1.0	3.0	33%	1.0
			1	Inspection manuals are partially developed.				
			2	Inspection manuals are developed.				
			3					
			4					
		Use of inspection manual	0	The inspection manuals are not being operated.	1.0	5.0	20%	1.0
			1	The inspection manuals are being operated in some routes.				
			2	Inspection manuals are being used in all routes.				
			3	Inspection manuals are being operates in all routes, but no reviews have been made.				
			4	Inspection manuals are being operates in all routes, and have been reviewed regularly or as needed.				
	Periodic Inspection content	Existence of Inspection manual	0	Inspection manuals are not developed.	1.0	3.0	33%	1.0
			1	Inspection manuals are partially developed.				
			2	Inspection manuals are developed.				
			3					
			4					
		Use of inspection manual	0	The inspection manuals are not being operated.	1.0	5.0	20%	1.0
			1	The inspection manuals are being operated in some routes.				
			2	Inspection manuals are being used in all routes.				
			3	Inspection manuals are being operates in all routes, but no reviews have been made.				
			4	Inspection manuals are being operates in all routes, and have been reviewed regularly or as needed.				
	Pavement inspection equipment		0	Inspection equipment is not well-maintained.	5.0	5.0	100%	5.0
			1	Basic inspection equipment is developed, but not in use.				
			2	Basic inspection equipment is being used.				
			3	Basic inspection equipment is being used. State-of-the-art inspection equipment is maintained, but not in use.				
			4	State-of-the-art inspection equipment is being used.				

Table 4-10 Road AM Evaluation Sheet in Kenya(Part 2)

Bridge inspection	Inspection method	Daily inspection	0	Inspection is not conducted.	2.0	3.0	67%	3.0
			1	Inspection is carried out at random times.				
			2	Inspection is conducted on a regular basis.				
			3					
			4					
		Periodic inspection	0	Inspection is not conducted.	1.0	3.0	33%	1.0
			1	Inspection is carried out at random times.				
			2	Inspection is conducted on a regular basis.				
			3					
			4					
	Inspection system	Outsourcing Situation	0	Person in charge within an organization is absent and inspection is outsourced without evaluating an outsourcing contractor.	N	5.0	N	N
			1	Person in charge within an organization is present and inspection is outsourced without evaluating an outsourcing contractor.				
			2	Outsourcing contractors are to be evaluated and their responsibilities, authorities, and contents are specifically defined.				
			3	Information is being shared to achieve target performance.				
			4	Trustees have systems to improve their target performance independently.				
		Inspection range	0	Inspection is not conducted.	1.0	5.0	20%	1.0
			1	Inspection is being conducted, but limited.				
			2	Inspections have been carried out in 50% or more of the road extension of the operating route.				
			3	Inspections have been carried out in 75% or more of the road extension of the operating route.				
			4	Inspections have been carried out in 100% or more of the road extension of the operating route.				
		Inspection education	0	Inspectors have no knowledge of civil engineering and have not received an inspection education	1.0	5.0	20%	1.0
			1	Inspectors have knowledge of civil engineering, but have not received inspection education				
			2	Inspectors have no knowledge of civil engineering, but they have received an inspection education.				
			3	Inspectors have knowledge of civil engineering, and have received an inspection education.				
			4	Inspectors are continuously taking inspection education.				
	Inspection contents	Existence of Inspection manual	0	Inspection manuals are not developed.	1.0	3.0	33%	1.0
			1	Inspection manuals are partially developed.				
			2	Inspection manuals are developed.				
			3					
			4					
		Use of inspection manual	0	The inspection manuals are not being operated.	1.0	5.0	20%	1.0
			1	The inspection manuals are being operated in some routes.				
			2	Inspection manuals are being used in all routes.				
			3	Inspection manuals are being operates in all routes, but no reviews have been made.				
			4	Inspection manuals are being operates in all routes, and have been reviewed regularly or as needed.				
	Bridge inspection equipment☒		0	Inspection equipment is not well-maintained.	1.0	5.0	20%	1.0
			1	Basic inspection equipment is developed, but not in use.				
			2	Basic inspection equipment is being used.				
			3	Basic inspection equipment is being used. State-of-the-art inspection equipment is maintained, but not in use.				
			4	State-of-the-art inspection equipment is being used.				
Large Item: Inspection					1.9	4.3	47.8%	2.1
Pavement diagnosis	Investigation of cause of damage		0	The investigation of cause of the damage is not carried out.	3.0	5.0	60%	3.0
			1	The investigation of cause of damage is not carried out partially.				
			2	The investigation of cause of an important part is carried out.				
			3	The cause of the damage is systematically investigated.				
			4	The investigation of the cause of damage has been used to improve the overall maintenance.				
	Classification of damage degree		0	There has been no classification of damage	2.0	3.0	67%	2.0
			1	The classification of damage has been done, but there is a large room for improvement.				
			2	The classification of damage has been done with few rooms for improvement.				
			3					
			4					
Bridge diagnosis	Investigation of cause of damage		0	The investigation of cause of the damage is not carried out.	1.0	5.0	20%	1.0
			1	The investigation of cause of damage is not carried out partially.				
			2	The investigation of cause of an important part is carried out.				
			3	The cause of the damage is systematically investigated.				
			4	The investigation of the cause of damage has been used to improve the overall maintenance.				
	Classification of damage degree☒		0	There has been no classification of damage	1.0	3.0	33%	1.0
			1	The classification of damage has been done, but there is a large room for improvement.				
			2	The classification of damage has been done with few rooms for improvement.				
			3					
			4					
Large Item: Diagnostic					1.8	4.2	45.0%	1.8
Pavement repair plan	Manual	Existence of inspection manual	0	Inspection manuals are not developed.	3.0	3.0	100%	3.0
			1	Inspection manuals are partially developed.				
			2	Inspection manuals are developed.				
			3					
			4					
		Use of inspection manual	0	The inspection manuals are not being operated.	2.0	5.0	40%	2.0
			1	The inspection manuals are being operated in some routes.				
			2	Inspection manuals are being used in all routes.				
			3	Inspection manuals are being operates in all routes, but no reviews have been made.				
			4	Inspection manuals are being operates in all routes, and have been reviewed regularly or as needed.				
	Planning	Preventive maintenance	0	Not aware of the need to introduce preventive maintenance	3.0	3.0	100%	3.0
			1	The need to implement preventive maintenance is assessed.				
			2	Preventive maintenance is being operated in regions where its introduction is rated to be necessary.				
			3					
			4					
		Planning	0	Repair plan has not been drafted.	2.0	5.0	40%	2.0
			1	Repair plan for the next year has been drawn up.				
			2	Repair plan of short-term (about two to three years) has been drawn up.				
			3	Repair plan of middle-term (about five years) has been drawn up.				
			4	Repair plan of long-term (over ten years) has been drawn up.				

Table 4-11 Road AM Evaluation Sheet in Kenya (Part 3)

Bridge repair plan	Manual	Existence of inspection manual	0	Inspection manuals are not developed.	1.0	3.0	33%	1.0
			1	Inspection manuals are partially developed.				
			2	Inspection manuals are developed.				
			3					
			4					
		Use of inspection manual	0	The inspection manuals are not being operated.	1.0	5.0	20%	1.0
			1	The inspection manuals are being operated in some routes.				
			2	Inspection manuals are being used in all routes.				
			3	Inspection manuals are being operates in all routes, but no reviews have been made.				
			4	Inspection manuals are being operates in all routes, and have been reviewed regularly or as needed.				
	Planning	Preventive maintenance	0	Not aware of the need to introduce preventive maintenance	1.0	3.0	33%	1.0
			1	The need to implement preventive maintenance is assessed.				
			2	Preventive maintenance is being operated in regions where its introduction is rated to be necessary.				
			3					
			4					
		Repair planning	0	Repair plan has not been drafted.	1.0	5.0	20%	1.0
			1	Repair plan for the next year has been drawn up.				
			2	Repair plan of short-term (about two to three years) has been drawn up.				
			3	Repair plan of middle-term (about five years) has been drawn up.				
			4	Repair plan of long-term (over ten years) has been drawn up.				
Large Item: Repair Plan					1.8	4.0	48.3%	1.8
Maintenance	Cleaning	Pavement	0	Cleaning has not yet been carried out.	2.0	3.0	67%	3.0
			1	Cleaning is being carried out but not regularly.				
			2	Cleaning is performed regularly.				
			3					
			4					
		Waterway	0	Cleaning has not yet been carried out.	2.0	3.0	67%	3.0
			1	Cleaning is being carried out but not regularly.				
			2	Cleaning is performed regularly.				
			3					
			4					
		Signs	0	Cleaning has not yet been carried out.	2.0	3.0	67%	3.0
			1	Cleaning is being carried out but not regularly.				
			2	Cleaning is performed regularly.				
			3					
			4					
	Mowing		0	Mowing has not yet been carried out.	2.0	3.0	67%	3.0
			1	Mowing is being carried out, but not regularly.				
			2	Mowing is performed regularly.				
			3					
			4					
	Minor repair	Pavement	0	Repair has been hardly performed.	2.0	3.0	67%	3.0
			1	The minimum repair work has been done				
			2	The repair works are being performed appropriately.				
			3					
			4					
		Bridge & Culvert	0	Repair has been hardly performed.	1.0	3.0	33%	1.0
			1	The minimum repair work has been done				
			2	The repair works are being performed appropriately.				
			3					
			4					
		Other	0	Repair has been hardly performed.	2.0	3.0	67%	3.0
			1	The minimum repair work has been done				
			2	The repair works are being performed appropriately.				
			3					
			4					
	Maintenance machine		0	Working machine for maintenance is not in place.	3.0	5.0	60%	3.0
			1	Aging working machine for maintenance is in place and not in use.				
			2	Although the working machine for maintenance is in place, it is used partially.				
			3	The working machine for maintenance is in place and in use.				
			4	State-of-the-art working machine for maintenance is in place and in use.				
Large Item: Maintenance					2.0	3.3	62%	2.8
Pavement repair work	Implementation of repair		0	Repair has not been carried out.	2.0	3.0	67%	3.0
			1	Repair has been partially carried out.				
			2	A lot of sites have been repaired.				
			3					
			4					
	The capacity of construction companies		0	No repair works are carried out.	3.0	5.0	60%	3.0
			1	Some repair have been generally carried out, and ability to perform repair works is poor.				
			2	Some general repair have been generally carried out, and ability to perform repair works is average.				
			3	Some general repair have been generally carried out, and ability to perform repair works is high.				
			4	Many advanced repair works have been carried out, and the ability to perform repair works is high.				
	Quality control		0	Quality Control of repair work has not been carried out.	3.0	5.0	60%	3.0
			1	Ability of quality control is low.				
			2	Ability of quality control is average.				
			3	Ability of quality control is high.				
			4	Quality control has been done positively, securing a high quality.				

Table 4-12 Road AM Evaluation Sheet in Kenya (Part 4)

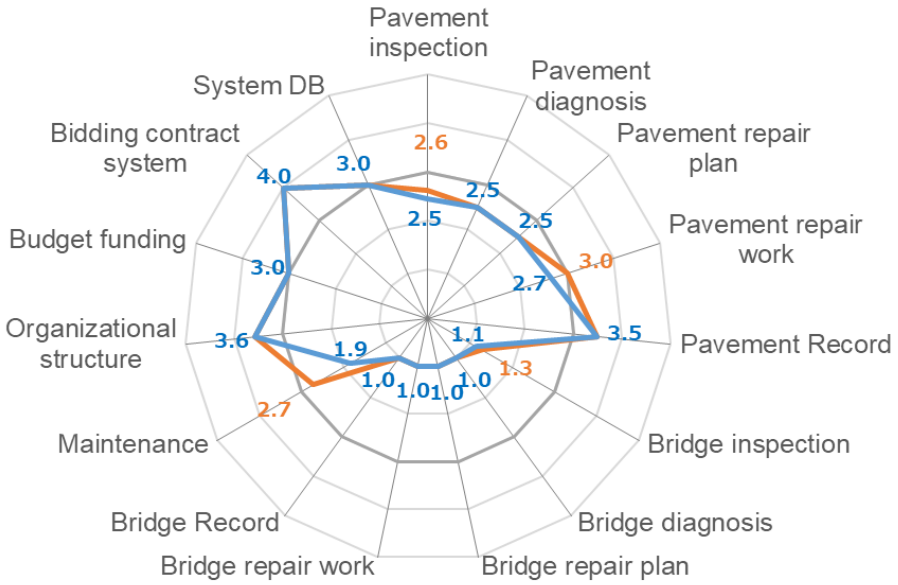
Bridge repair work	Implementation of repair		0	Repair has not yet been carried out.	1.0	3.0	33%	1.0
			1	Repair has been partially carried out.				
			2	A lot of sites have been repaired.				
			3					
			4					
	The capacity of construction companies		0	No repair works are carried out.	1.0	5.0	20%	1.0
			1	Some repair have been generally carried out, and ability to perform repair works is poor.				
			2	Some general repair have been generally carried out, and ability to perform repair works is average.				
			3	Some general repair have been generally carried out, and ability to perform repair works is high.				
			4	Many advanced repair works have been carried out, and the ability to perform repair works is high.				
	Quality control		0	Quality Control of repair work has not been carried out.	1.0	5.0	20%	1.0
			1	Ability of quality control is low.				
			2	Ability of quality control is average.				
			3	Ability of quality control is high.				
			4	Quality control has been done positively, securing a high quality.				
Large Item: Repair work					1.8	4.3	43%	2.0
Pavement Record	Preservation and sharing of inspection records		0	Inspection results have neither been recorded nor preserved.	4.0	5.0	80%	4.0
			1	Inspection results have been partially recorded and preserved.				
			2	Inspection results have been recorded and preserved.				
			3	Inspection results have been recorded, preserved, and shared.				
			4	Inspection results have been recorded, preserved, shared, and updated.				
	Preservation and sharing of repair records		0	Inspection results have neither been recorded nor preserved.	3.0	5.0	60%	3.0
			1	Inspection results have been partially recorded and preserved.				
			2	Inspection results have been recorded and preserved.				
			3	Inspection results have been recorded, preserved, and shared.				
			4	Inspection results have been recorded, preserved, shared, and updated.				
Bridge Record	Preservation and sharing of inspection records		0	Inspection results have neither been recorded nor preserved.	1.0	5.0	20%	1.0
			1	Inspection results have been partially recorded and preserved.				
			2	Inspection results have been recorded and preserved.				
			3	Inspection results have been recorded, preserved, and shared.				
			4	Inspection results have been recorded, preserved, shared, and updated.				
	Preservation and sharing of repair records		0	Inspection results have neither been recorded nor preserved.	1.0	5.0	20%	1.0
			1	Inspection results have been partially recorded and preserved.				
			2	Inspection results have been recorded and preserved.				
			3	Inspection results have been recorded, preserved, and shared.				
			4	Inspection results have been recorded, preserved, shared, and updated.				
Large Item: Record Save					2.3	5.0	45%	2.3
Organization System	Organization	Organization	0	No person in charge of Road AM.	5.0	5.0	100%	5.0
			1	People in charge of Road AM are unclear.				
			2	Staffs in charge of road AM are arranged for other department as well.				
			3	Staffs in charge of road AM are arranged exclusively.				
			4	Road AM department is already established.				
		Personnel	0	Very few people in charge of Road AM	4.0	5.0	80%	4.0
			1	People in charge of Road AM is about 1/3 of the required number				
			2	People in charge of Road AM is about half of the required number				
			3	People in charge of Road AM is about 2/3 of the required number				
			4	People in charge of Road AM is enough in number.				
	System	Leadership of the top	0	The head of the organization is indifferent to the Road AM	3.0	5.0	60%	3.0
			1	The head of the organization is interested in Road AM, but less commitment.				
			2	The head of the organization sometimes makes commitments.				
			3	The head of the organization relatively often makes commitments.				
			4	The head of the organization frequently makes commitments.				
		Influence of this organization	0	Road AM department has a weak influence on other organizations	3.0	5.0	60%	3.0
			1	Road AM department has some influence on other departments				
			2	Road AM department has influence on other departments				
			3	Road AM department is considerable influence on other departments				
			4	Road AM department has strong influence on other organizations				
		Willingness and ability of CP	0	Awareness is low and ability is inadequate.	4.0	5.0	80%	4.0
			1	High awareness, but ability is inadequate.				
			2	Awareness and ability are both moderate.				
			3	Ability is high, but awareness is low.				
			4	Ability and awareness are both high.				
		Training program	0	No training program for human resource development	3.0	3.0	100%	3.0
			1	Training program for human resource is available, but insufficient.				
			2	Training system for human resources development is in place.				
			3					
			4					
		Training facilities	0	No training facility for human resource development	3.0	3.0	100%	3.0
			1	Training facility for human resource is available, but insufficient.				
			2	Training facility for human resources development is in place.				
			3					
			4					
Large Item: Organizational and institutional accounting					3.6	4.4	83%	3.6

Table 4-13 Road AM Evaluation Sheet in Kenya(Part 5)

Budget funding	Budget	Budget enforcement	0	Budget plan has not been drafted.	5.0	5.0	100%	5.0
				Budget plan for the next year has only been drawn up.				
			2	Budget plan of short-term (about two to three years) has been drawn up.				
			3	Budget plan of middle-term (about five years) has been drawn up.				
			4	Budget plan of long-term (over ten years) has been drawn up.				
	Financing	Securing of funds	0	Payment for procurement of materials, machinery and labors are often delayed.	1.0	3.0	33%	1.0
			1	Payment for procurement of materials, machinery and labors are sometimes delayed.				
			2	Payment for procurement of materials, machinery and labors are not delayed.				
			3					
			4					
		Securing financial resources	0	There are no revenue sources focusing for maintenance and management.	3.0	3.0	100%	3.0
			1	There are revenue sources focusing for maintenance and management, but funds are not ready.				
			2	There are revenue sources focusing for maintenance and management, and necessary funds are ready.				
			3					
			4					
Large Item: Budget funding					3.0	3.7	78%	3.0
Bidding contract system	Cost estimation methods		0	Cost estimation standard of procurement of materials, machinery and labors are not established	4.0	5.0	80%	4.0
			1	Cost estimation standard of procurement of materials, machinery and labors are established but not used				
			2	Cost estimation standard of procurement of materials, machinery and labors are established but partially used				
			3	Cost estimation standard of procurement of materials, machinery and labors are established and used				
			4	Cost estimation standard of procurement of materials, machinery and labors are established, used and periodically revised				
	Bidding contract system		0	Bidding contract system of procurement of materials, machinery and labors are not established	4.0	5.0	80%	4.0
			1	Bidding contract system of procurement of materials, machinery and labors are established but not used				
			2	Bidding contract system of procurement of materials, machinery and labors are established but partially used				
			3	Bidding contract system of procurement of materials, machinery and labors are established and used				
			4	Bidding contact system of procurement of materials, machinery and labors are established, used and periodically revised				
Large Item: Bidding contract System					4.0	5.0	80%	4.0
System DB	DB related	Paving assets DB	0	No asset DB	5.0	5.0	100%	5.0
			1	Some of the assets are well-maintained as a paper base.				
			2	Assets are well-maintained as a paper base.				
			3	Assets are well-maintained as an electronic data.				
			4	Assets are well-maintained as an electronic data and can be shared.				
		Bridge assets DB	0	No asset DB	1.0	5.0	20%	1.0
			1	Some of the assets are well-maintained as a paper base.				
			2	Assets are well-maintained as a paper base.				
			3	Assets are well-maintained as an electronic data.				
			4	Assets are well-maintained as an electronic data and can be shared.				
	System related	Communication function	0	There is no plan of communications facility development between headquarters and local offices	5.0	5.0	100%	5.0
			1	There is a plan of communications facility development between headquarters and local offices				
			2	Development of communication facilities between Headquarters and office are now ongoing.				
			3	Communications facility development is well-maintained with no data sharing.				
			4	Communications facility development is well-maintained and data sharing is available.				
		Bridge management system	0	No system has been introduced.	1.0	5.0	20%	1.0
			1	The system has been introduced and partially operational				
			2	The system has been introduced and in operation.				
			3	The system has been operated, but needs updating.				
			4	The system has been operated, and been continuously updated.				
		Pavement management system	0	No system has been introduced.	1.0	5.0	20%	1.0
			1	The system has been introduced and partially operational				
			2	The system has been introduced and in operation.				
			3	The system has been operated, but needs updating.				
			4	The system has been operated, and been continuously updated.				
Large Item: System DB					2.6	5.0	52%	2.6
Total					**2.3**	**4.2**	**56%**	**2.4**
Development into the other region and field	Regional development		0	Road AM development has been remaining in its development in a specific area.	2.0	5.0	40%	4.0
			1	Road AM development has begun to develop to the surrounding area of the specific area.				
			2	Road AM development is being developed outside of a specific area.				
			3	Road AM development has been developed more than half of the regions.				
			4	Road AM development has been developed to all regions				
	Field development		0	Road AM development has been remained in the area where the technical cooperation project was conducted.	1.0	5.0	20%	1.0
			1					
			2	Road AM development has begun to develop to the surrounding area where technical cooperation project was conducted				
			3					
			4	Road AM development is progressing to other areas				

4.5.4 Road AM Evaluation Index (Middle Items)

A summary of the items in the Road AM evaluation material is shown in the following figure.



Note: The Blue line in the figure is current status, and the Orange line is expected achievement of five years after the end of the technical project

Figure 4-8 Road AM Evaluation Index in Kenya (Middle Items)

【Overview】

As shown in Figure 4-8, with respect to the degree of achievement of the Road AM of Kenya, achievement of the bridge relationship has a high degree of achievement while the pavement relationship is quite low. Although the cycle of the implementation of the inspection-repair work on pavement has been established, it has not been carried, and the same for bridge inspections because the cycle is has not come around. In addition, although the introduction of PBC has been enhanced mainly in the advanced inspection and daily maintenance operations, it has only reached about 40% of the KeNHA managed length, maintenance and management work and construction in the conventional method as before. Therefore, it is necessary to keep in mind that the evaluation points in the evaluation score sheet are also graded lower.

In the technical project, support for the improvement of contract supervision and the integration capacity of PBC is performed, and the operational aspects other than the technical aspects such as the organization system, budget fund procurement and the bidding contract system are comparatively substantial.

【Pavement Inspection, Diagnosis and Repair Plan】

Daily and periodic inspections are conducted directly on pavement inspections. The periodic inspection is used in combination with IRI measurement and visual inspection, and pothole and cracking situation of the road damage degree in the minimum unit of the 200m section of the roadway are classified into 5 stages: 1, Very good; 2 Good; 3, Normal; 4, Not good; 5, Poor.

For the above classification, the sections of 4 and 5 will receive orders for rehabilitation work to implement pavement improvement including the overlay. In addition, 1 to 3 are handled by regularly ordering the daily maintenance work and small repair work. Incidentally, in PBC which is being progressively more used in KeNHA, 1 to 5 will receive order for the section of the state as PBC collectively, and 4 will have implementation of the overlay or the like as would a section of 5. Further, daily maintenance by PBC is going to start. For the areas where pavement degradation is progressing, the Inspection Office of the Ministry of Transport, Infrastructure, Housing and Urban Development has

been commissioned to investigate the strength of pavement materials and the roadbed, and the repair plan is formulated.

【Bridge Inspection, Diagnosis and Repair Plan】

For bridges, there were no periodic inspections but daily inspection by contractors are now to adopt the PBC. However, periodic inspections of the bridges have not been conducted, and there is no cycles of inspection, repair planning and repair implementation. Government agencies are also aware of the need for bridge inspections and bridge repairs and have requested JICA to support technical projects for bridge maintenance and management.

【Maintenance, Pavement Repair, Bridge Repair】

The cleaning, weeding, small repair, and pavement repair work were supported by the subcontracting of the regular maintenance operation, but it came to be taken in PBC. Also, for paving repair work, in order to implement pothole repair and overlay or the like in the initial contract period of PBC, contractors carried out continuously from pavement repair work to daily maintenance management. In PBC, maintenance is performed continuously for about three years, and maintenance is done without interruption.

【Recording Systems】

The periodic inspection of the pavement as a format is determined and it is stored as a record in the Excel base so it is possible to share the data. In addition, it is only the record for the payment for the repair record, and the database of the past repair history is not made to be able to be browsed when formulating the repair plan.

In addition, the asset ledger has been made a database of the asset ledger of the whole road corporations in KRB and the information is shared. In KeNHA, there are ten regional offices and a telecommunications network at the headquarters, and a system for sharing information is being developed. The maintenance of PMS and BMS has not been implemented and will become a problem in the future.

【Organization, Budget and Bidding System】

There is a Road AM part of the organization system, and it is not a large capacity shortage but there is vacancy. A certain amount of budget is allocated as a financial resource for road maintenance, but the organization is financially wealthy and has the power to withstand the rapid increase in PBC.

【Assumption After 5 Years】

The evaluation points that assumed five years after the end of the technical project is described by the orange line. With the implementation of this technical project, the PBC length will reach more than 75% of the KeNHA management line in three years. Therefore, maintenance and pavement repair work included in the PBC, bridge inspection (daily inspection), the number of items of the pavement inspection (daily inspection) is assumed to be improved after 5 years. Other items will not be improved because they are not supported by the technical project.

4.6 Extraction of challenges for Road AM Fixation

4.6.1 Challenges on Pavement Maintenance and Management

In KeNHA, the contract by PBC has expanded rapidly, and about 40% of the managed length of 18,000km (7,500km) is carried out in PBC system. On the other hand, in KURA and KeRRA, the implementation of PBC has not progressed as much as KeNHA. Especially, KeRRA is going to adopt PBC after improving the gravel road to the paved road because most of the roads are gravel roads.

The PBC is currently considering how to evaluate the contractor after the end of construction period and how to use the results of the evaluation, although the monthly outsourcer conducts inspections and

evaluates operations. The challenge is whether the PBC system can be used to maintain the local roads managed by 47 Counties (local autonomous bodies).

Damage diagnosis and repair planning, etc. will be planned according to manuals and standards enacted by the Ministry of Transport, Infrastructure, Housing and Urban Development but was created in 2010 by using JICA's support programs “Road Maintenance Manual” and “Standard Specification for Roads and Bridges,” which were created in 1986 and have not been revised for a long time. The content is too old and needs to be revised to conform to the new technology. The construction method in the locale has changed, and it is indispensable to revise the manual in its present state and to improve the technical ability. In addition, PMS is not in service.

In 2006, when the former Road Ministry was divided into the Ministry of Transportation Infrastructure in charge of the administration, and each road corporation was responsible for the implementation of the business, engineers of the former Road Ministry would be dispersed throughout each road corporation and the development of enough engineers after that has not been performed. In addition, engineers in the Ministry of Transportation Infrastructure, Housing and Urban Development are not of the standpoint of creating various manuals and standards are also the main business of administrative adjustment so accumulation of technical know-how is insufficient.

4.6.2 Challenges on Bridge Maintenance and Management

The maintenance and management of the bridge by each road corporation is hardly done. As for the number, type, and health of bridges is not grasped. KeNHA has been doing visual inspections once a year has but been inspected only culvert box with respect to the structure and the evaluation has not been made with respect to the bridge. Note that BMS is not in service. Previously, considering that the inspection and maintenance of the bridge has not been made, it is considered that the damage of the bridge is progressing. It is a situation where the repair cannot be done even if damage is discovered because there is no experience of the repair technology. In addition, the construction of long bridges, including the Mombasa Gate Bridge, is underway in Kenya, and it is necessary to be able to maintain long bridges in the medium term.

4.6.3 Current Situation

As for construction companies in urban areas like Nairobi, leading companies are working on PBC orders. In addition, consultants have little involvement in maintenance operations. Some have received orders from KRB for their operations and maintenance planning. In addition, delay of the contract payment to the contractor from the ordering person is a problem.

4.7 Development of Support Measures for Road AM Fixation

4.7.1 Measures for the Entire AM Road

Measures for not only pavement maintenance (included in PBC) but also the management of the entire road, including bridge maintenance, slope maintenance and human resource development, to support sustainable development.

4.7.2 Support Measures on Pavement Maintenance and Management

The PBC, which was introduced in the technical project, has skyrocketed mainly in KeNHA, and the results of the technical project have been utilized. On the other hand, whether the quality control technology of the repair by overlay or patching or the like is improved is unknown. Road maintenance manuals and design standards have not been revised since, and it is necessary to support improvement of manual revisions and quality control. It is necessary to be able to develop a long-term repair plan by supporting PMS development.

4.7.3 Support Measures for Bridge Maintenance and Management

The maintenance and management of bridges requires early support, as there has been little enforcement in any governmental agency. Technical support by technical projects such as improvement of technician ability and manual maintenance is indispensable. In particular, the maintenance and management of special bridges, such as long bridges, should include early inspection and diagnosis. In addition, it is conceivable that the development support of BMS should also carried out together.

4.7.4 Contents of Research at Japanese Universities

In order to develop human resources into new engineers, an MOU between Japanese universities and the University of Nairobi, and support the approach to Road AM of each road organization, such as joint research on Road AM. In addition, in Kenya, maintenance and management of the bridge is a situation that has hardly been implemented in any government agency and this is a major issue. In addition, since special bridges such as long bridges are constructed, maintenance management becomes important. Therefore, it is necessary to work on the research contents shown below about the bridge engineering and the maintenance management technology at Japanese universities.

Table 4-14 Research Programs at Japanese Universities (Draft)

Challenges	Research Program
Pavement Maintenance and Quality Improvement	Study on effective pavement repair design method considering existing pavement structure and strength
	Study on construction methods of pavement repair considering long-term durability
	Study on long-term durability of pavement materials
	Study on efficient and effective methods of recycling pavement materials
	Study on pavement and embankment structures; Development of diagnostic automation technology
Improvement of Bridge Maintenance and Repair Technology	Study on deterioration diagnosis technology of steel bridges and concrete structures
	Study on utilization and analysis of bridge damage data
	Study on health evaluation of bridges
	Study on preventive maintenance method of bridges considering reliability and risk
	Study on the setting and the standard of the performance level which should be given to the bridge
Road AM Capability Increase	Bridge Maintenance Integrated Database System
	Development of the road infrastructure management cycle and general research aimed at domestic and overseas implementation
	Implementation by ME Network of desired SIP maintenance management methods
	Research and development of social implementation of innovative advanced technology for infrastructure maintenance management
Evaluation and Selection of Contractor	Study on qualification examinations and selection methods of construction companies in construction order
	Study on the evaluation methods of contractors at the end of construction work

Chap. 5 Current Situation, Challenges and Support Measures of Road AM in AACRA

5.1 Background of the Technical Project

Addis Ababa City, the capital of Ethiopia, contains a headquarters of the African Union (AU) and the United Nations Economic Commission for Africa (UNECA) which is the center of politics and diplomacy in Africa. Against a background of favorable economic conditions of the country in recent years, the city of Addis Ababa has grown with fast expanding urbanization and motorization. In addition to the delay of road improvements, public transportation for the middle and large-scale transport is running short, which leads to means of trips by omnibus (mini-bus). This causes serious chronic traffic congestion from trips by omnibus (mini-bus). Factors such as an inappropriate traffic control (no signals, lack of roundabouts with capacity), lack of development in bus terminals and bus stops, poor quality road maintenance, flooding during the rainy season and the accompanying aggravation of road conditions and poor driving manners have become causes that worsen the situation.

They are in a situation in which temporary repairs have been given to the paved roads in the city while the technical level remained low. In "GTP: Growth and Transformation Plan; 2010/11-2014/15)," a national development plan for Ethiopia, the point that the expansion and the maintenance of infrastructure contribute to poverty reduction, including through roads, is cited. Due to the circumstances, the city of Addis Ababa has seen Chinese companies construct the roads, improve roads and signs within the city, however, cooperation for maintenance management of roads within the city has not been conducted.

Japan has upheld "Infrastructure Development" as one of the key areas in country assistance for Ethiopia, and JICA conducted the survey, "Information gathering of the urban transportation in Addis Ababa City and investigations for verification" to contribute to the formation of future technical projects in 2012. The survey pointed out the following five items as problems: "Imbalance of the land use and the transportation facility," "Lack of traffic management in urban areas," "Lack of road maintenance," "Development of Traffic Safety and Traffic Environment," "Development of Public Transportation." As one of the cooperation plans to address them, a Technical Project for road maintenance management is being proposed.

In this kind of situation, they asked the Government of Japan to implement a technical project, Addis Ababa City Roads Authority (hereinafter referred to as "AACRA"), to improve road maintenance capacity in August 2013, which led to the implementation of the project.

5.2 Overview of Road Maintenance and Management in AACRA

5.2.1 AACRA Road Management Extension

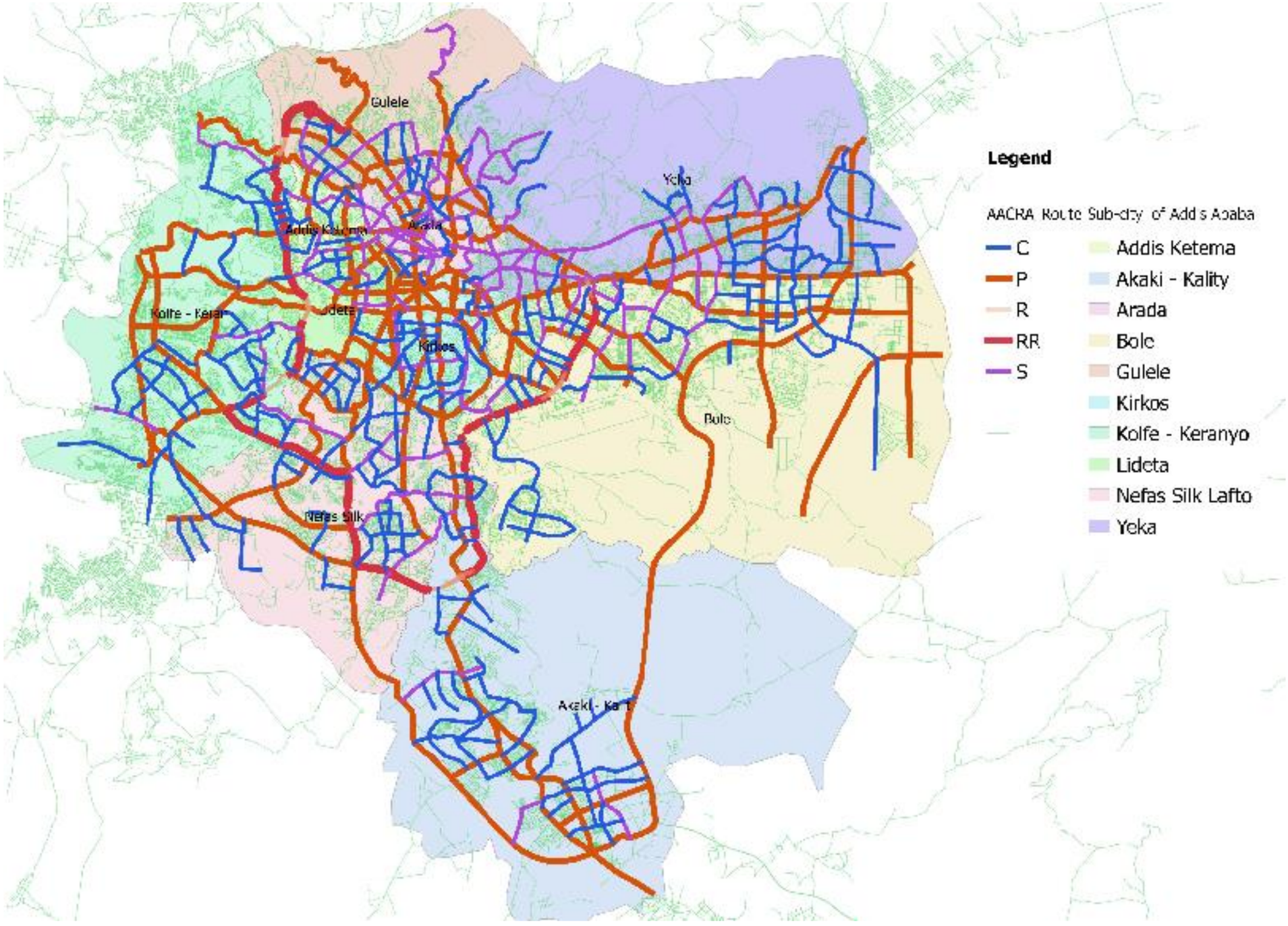
The road extensions to be managed by AACRA is shown in Table 5-1, and the road network is shown in Figure 5-1, respectively. The improvement project for the management ability of road maintenance in Addis Ababa City targets the pavement of major roads (RR, PAS, SAS) out of the 3,761km total of the highway managed by AACRA.

Table 5-1 Road Management Extension of AACRA

Classification of Roads	Extension (km)	Asphalt Pavement		(Reference) 7m Extension of Width Conversion (km)
		Extension (km)	Percentage (%)	
Ring Road (RR)	37	37	100.0	181
Primary Arterial Street (PAS)	290	279	96.2	1,117
Sub Primary Arterial Street (SAS)	164	154	93.9	415
Sub total	492	470	95.5	1,713
Collector Street (CS)	215	135	62.8	438

Classification of Roads	Extension (km)	Asphalt Pavement		(Reference) 7m Extension of Width Conversion (km)
		Extension (km)	Percentage (%)	
Local Street (LS)	3,055	385	12.6	3,302
Grand Total	3,761	990	38.1	5,453

Source: AACRA Road Asset Management & Database Directorate



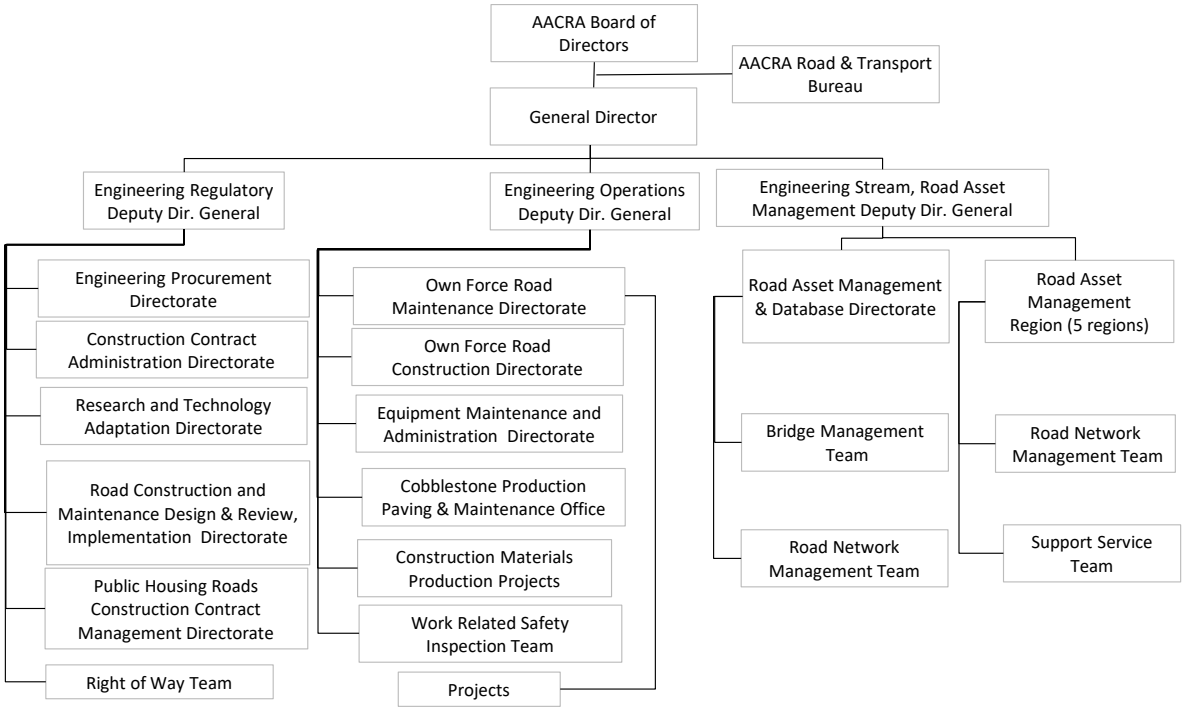
Source: AACRA Road Asset Management & Database Directorate

Figure 5-1 AACRA Road Network

5.2.2 Organizational Structure of AACRA

The department in charge of road maintenance in AACRA is responsible for the following tasks:

- ✓ Engineering Operations (Department of work under direct management)
  Procurement of materials, machinery and equipment, construction work and maintenance management (small repairs, ditch cleaning, etc.) and repair work
- ✓ Engineering Stream Road Asset Management (Road AM Department)
  Periodic inspections, records of inspection results, annual and mid-to-long term planning, decisions on inspections, design and specification of pre-repair work, construction management of repair work to be carried out by department of work under direct management, volume confirmation



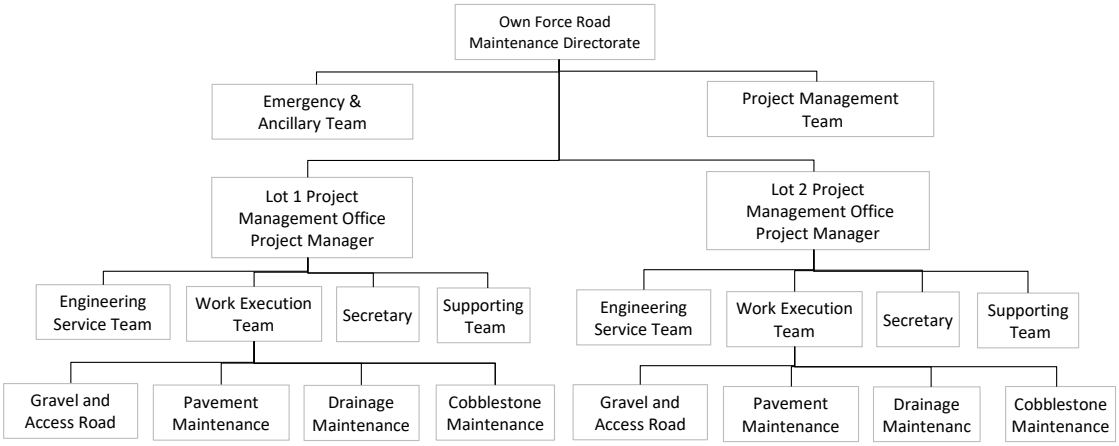
Source: JICA Headquarters

Figure 5-2 Asset Management Related Organization Chart in Addis Ababa City

The procurement and design division includes Road Construction and Maintenance Design & Review, Implementation Directorate (Road Design Checking Department), which implements designs and inspections of road and bridge repair works. Although the Road AM department may ask for difficult designs and investigation of the repair work of bridges, it rarely asks the design and checks the department for road repair work.

It is the Own Force Road Maintenance Directorate (Direct Maintenance Repair Department) that is in charge of the repair work and the maintenance operation, and an organization chart is shown in Figure 5-3. The Direct Maintenance and Repair Department has a total of 2,400 staff members including temporary staff. The department is divided into the Lot1 project office, which is in charge of the central, north and west districts, and the Lot2 project office, which is in charge of the east and south districts, both projects having project managers assume the leadership.

The Road AM department is comprised of Road Asset Management & Database (Road AM and Database Department) and 5 Road Asset Management Region Offices (Road AM Regional Office).



Source: AACRA Own Force Account Maintenance Directorate

Figure 5-3 Organizational Chart of Direct Maintenance and Repair Department

5.2.3 Situation of Construction Equipment Related to Road Constructions and Maintenance of AACRA

The state of the construction equipment possessed by AACRA is shown in Table 5-2. AACRA possesses about 300 construction equipment, most of which are procured by foreign aid. Replacement parts also need to be procured from overseas, but in reality, they have not insured that stock. Vehicles waiting for repairs has amounted to about 20%. This is due to the restriction on the payment in foreign currencies being imposed in Ethiopia, which has fallen into a serious shortage of foreign currency reserves.

As for the plant, they possess one asphalt plant that works at 60 tons/hour, two asphalt plants that work at 30 tons/hour, one crushing plant and one cement plant, but they have not fully operated due to the restriction of material supply and so on, and the shortage has been procured from the city plant. In addition, a large-scale asphalt plant that works at 60 tons/hour, inspected on the spot, was relatively new, procured five years ago from China, but the working rate was poor due to frequent breakdowns. While the plants made in Japan that work at 30 tons/hour, which were procured 20 years ago, have been fully operational, facilities have been aging because they are operating with white smoke diffusing due to the failure of the dust collector.

Table 5-2 Equipment Held by Addis Ababa City

	Total	Available Machines		Spare parts waiting	Overall repair required	Scrap
		Good	Poor			
Roller	23	5	10	4	4	
Wheel Loader	34	8	19	3	3	1
Compressor	8	3	3	1		1
Asphalt Finisher	4				3	1
Bulldozer	11	4	3		2	2
Grader	14	4	6	3		1
Asphalt Kettle	6	2			2	2
Tractor	10	5	1		3	1
Dumper	8	3	1		4	
Excavator	17	6	8	1	1	1
Concrete Mixer	10		5		2	3
Distributor	2				1	1
Water Trunk Truck	0					
Dump Track	104	5	77	7	10	5
Water Sprinkler (Truck)	14	5	6			3
Asphalt Plant	3		1		2	
Fuel Truck	4	2	1			1
Concrete Mixer (Truck)	7	3	3	1		
Earth Carver						
Flood Light	3	3				
Batching Plant	1		1			
Crusher	5		2	1	1	1
Pneumatic Roller	6	3			2	1
合計	294	61	147	21	40	25
	100.0%	20.7%	50.0%	7.1%	13.6%	8.5%

Source: Technical Project Team

5.2.4 Budget for Road Maintenance and Management

The road fund was established based on the Road Sector Development Program (RSDP: 5 Year Plan of Road Maintenance) to ensure the maintenance budget, with the help of the World Bank, for roads which deteriorated in the 1990s. The roads thus far had been devastated while continuing to lose asset value. The source of income for the road fund comes 80% or more from fuel tax (10 cents/L), and the remaining is from other value-added taxes and road occupation charges. The purpose of use is limited to the maintenance of the road, and the construction cost, which is required for the construction of new roads, is separately provided by the Treasury Department.

The budget for the Road Fund in 2018 is 3 billion birr (approx. 75 million USD), and 65% of that is allocated to the Ethiopia Road Authority (hereinafter referred to as “ERA”), 25% allocated to local governments, 5% to AACRA, 5% allocated to local cities and the remaining to traffic safety measures. The budget allocation ratio is determined by road extensions, population and traffic volumes. This allocation ratio is determined by the Board of Directors of the Road Fund with a slight variation every year. The board consists of 15 representatives in each sector. Most of them are part-time directors. All the maintenance costs of ERA are covered by the road fund. On the other hand, having their own financial resources, local governments and local cities can bear the road maintenance cost with a combination of these resources.

The budget for road maintenance and repair of AACRA consists of the road fund and the city finances, and the ratio is one to eight. Table 5-3 shows the budget amount of AACRA for the past five years. The overall budget for AACRA has remained unchanged for almost four years, but the budget for road repair has shown a sharp rise from the budget in 2016/2017, indicating an increase of ten times or more for the past five years. It is said that the President of AACRA recognizes the need for road maintenance and has adjusted with the city agencies to increase the budget for road maintenance. Also, citizens are satisfied with the road state achieved by the increase of the budget, leading to another increase in the budget after the next year as well.

Table 5-3 Changes in AACRA Budget

(Unit：mBirr)

	2014/2015		2015/2016		2016/2017		2017/2018		2018/2019	
	Total	OM/ Repair	Total	OM/ Repair	Total	OM/ Repair	Total	OM/ Repair	Total	OM/ Repair
City budget (Project)	6,098	20	5,470	44	4,749	106	4,802	344	4,487	765
City budget (employee salaries, etc.)	142		171		191		272		369	
Road fund budget	50	50	50	50	50	50	67	67	100	100
Loans overseas, etc	204		254		670		1,213		1,349	
Total	6,495	70	5,945	95	5,661	156	6,355	412	6,305	865
Previous year expenses			0.9	1.3	1.0	1.6	1.1	2.6	1.0	2.1
Rate of increase from 2014/2015			0.9	1.3	0.9	2.2	1.0	5.8	1.0	12.3

Source: AACRA Road Asset Management & Database Directorate

The breakdown of maintenance and repair budget in 2018/2019 is shown in Table 5-4. Road repair accounted for 88% of the total repair amount, about half of which is devoted to asphalt pavement. Only 0.3% is calculated for the repair of the bridges.

Table 5-4 Breakdown of Budget for AACRA Maintenance and Repair (2018/2019)

(Unit：mBirr)

Item	City budget	Road fund budget	Total	Tatio
Road repair	680	82.4	762.4	88.1%
Paving road repair	300	46.8	346.8	40.1%
Gravel road repair	70	5.1	75.1	8.7%
Macadam road repair	50		50	5.8%
Drainage repair	80	23.7	103.7	12.0%
Side walk repair	180	6.8	186.8	21.6%
Street ramp repair	80		80	9.2%
Bridge repair		3	3	0.3%
System development	5		5	0.6%
Emergency response		14.6	14.6	1.7%
	765	100	865	100.0%

Source: AACRA Road Asset Management & Database Directorate

5.3 Overview of the Technical Project

5.3.1 Objective of the Technical Project

The objective of the technical project is to enable the PDCA cycle below from inspection to repair to be implemented efficiently and appropriately.

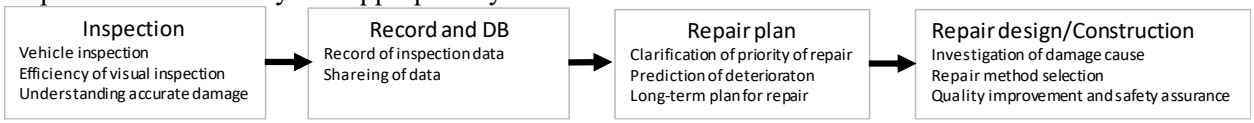


Figure 5-4 Each Step from Inspection to Repair

5.3.2 Overall Goal of the Technical Project

The Overall goal of the Technical Project is "the roads in Addis Ababa City are to be maintained persistently." As an indicator, "road roughness in Addis Ababa City" and "distance of road inspections in Addis Ababa City" are used.

5.3.3 Project Purpose of the Technical Project

The project purpose of the Technical Project is "the roads in Addis Ababa City are to be sustained and maintained persistently." As an indicator, "the average value of the self-evaluation of AACRA staff on the operational management ability of AACRA for road maintenance management," "the implementation of construction work for road maintenance by AACRA based on the PDCA cycle established in the project," and "the average value of AACRA's capacity evaluation to secure the budget of road maintenance" are used.

5.3.4 Expected Effects of the Technical Project

For expected effect (achievement), the following three items are given.

Table 5-5 Expected Effect

Output 1	Improvement of AACRA's implementation system for road maintenance
Output 2	Establishment of the development process for a road maintenance plan
Output 3	Improvement of management skills and knowledge of AACRA technical staff

5.3.5 Activities of the Technical Project

The following are given as the activity contents.

Table 5-6 Activities

Output 1	Implementation system of AACRA for road maintenance is improved.	
	Activity 1	Review the implementation system of AACRA.
	Activity 2	With the involvement of major departments in AACRA, a regular meeting on the implementation system for road maintenance, the allocation of personnel and budget will be held.
	Activity 3	Develop a training plan intended for AACRA staff.
	Activity 4	Plan training intended for AACRA staff on road maintenance, including road inspections, maintenance plans and maintenance management systems.
	Activity 5	Provide information on the road conditions of Addis Ababa City for the road fund and the City Hall of Addis Ababa toward a budget requirement for road maintenance management.

	Activity 6	Conduct PR activities for road maintenance management in Addis Ababa City
Output 2	The process of developing a road maintenance plan is established.	
	Activity 1	Review and update the road maintenance cycle in Addis Ababa City.
	Activity 2	Inspect the roads in the city.
	Activity 3	Maintain and update the city's road inventory, including road conditions, traffic volume and unit price.
	Activity 4	Formulate and update the medium-term road maintenance plan based on the inventory above.
	Activity 5	Develop an annual road maintenance plan.
Output 3	Management skills and knowledge of AACRA technical staff are improved.	
	Activity 1	Select pilot projects for road maintenance and repair from the annual road maintenance plan.
	Activity 2	Share pilot business information within each department at the Road AM Department and departments of work under direct management.
	Activities 3	Examine the pilot business in detail and design specification.
	Activities 4	Support the pilot business conducted by AACRA.
	Activities 5	Provide feedback about the actual results and knowledge of the pilot business to the next annual road maintenance plan.
	Activities 6	Hold workshops and seminars on pilot projects intended for the Ethiopian Road Authority (ERA) and the state and city level road departments.

5.3.6 Manuals Introduced in the Technical Project

The manuals and technical guidelines introduced in this Technical Project are as follows.

(1) Inspection Relation

Table 5-7 Inspection Manuals Introduced

Name of Manual	Overview Introduced
Periodic Manuals for Pavement Inspection	➢ The basic matters are established to conduct inspections, such as the type and method of inspection, inspection frequency and inspection system. ➢ Details are set for conducting visual inspections to describe a draft of inspection plans, a method of photography, and an input method of inspection data. ➢ Set a registration method of the inspection data and a location of responsibility and a reporting method to the person in charge are prescribed in order to avoid misregistration and non-registered data.
Operation Manual for the Inspection System for Paving Vehicles	➢ An installation of the system by smartphone, the initial settings, and the operational details of smartphones are explained.
Implementation Manual for the Inspection System of Paving Vehicles	➢ An inspection method of the vehicles, points to be noted, inspection system, how to plan an inspection schedule, safety measures during the inspection, and how to process the inspection data are explained in detail. ➢ Method for checking periodically (calibration) whether or not a vehicle-mounted device and a system is operating properly is described.

Name of Manual	Overview Introduced
	➢ Method for responding to system failures and how to respond when adding or improving the system is described. ➢ Each component provider of the system (about 10 companies) and system specifications are described

(2) Management System

Table 5-8 Summary of Manuals for the Management System

Name of Manual	Overview
PMS Implementation Manual	➢ Method for operating PMS system to develop a repair plan is described. ➢ The steps to incorporate inspection data and ledger data into the system and method for setting the network system during the service of new roads is described.
PMS Operation Manual	➢ Method for operating PMS system is described. ➢ Methods for displaying inspection data and how to formulate a year plan are explained. ➢ Method for setting the threshold of damage level and various parameters (by road standard, by damage levels, and by damage type) required for the year plan formulation is described.
PMS System Analysis, Deterioration Prediction, Operation Manual of Budget Simulation	➢ Method for operating PMS to develop a medium-to long term repair plan is explained. ➢ Method for capturing the inspection data to generate deterioration curves by segments is explained. Also, constraint conditions of the budget when establishing the mid-to long term plan, how to input future risk tolerance, setting of formulating year (10 to 30 years) and the number of simulations are explained.

(3) Formulation of Repair Plan and Other Information

Table 5-9 Overview of Formulation of Repair Plans and Other Manuals

Name of Manual	Overview
Handbook of Road Maintenance	➢ A handbook summarizing points that AACRA staff can refer to each day to perform their duties. ➢ Each item of inspection, recording, repair planning, repair design, and repair work is fully covered with the points of various manuals explained visually and in a clear way. ➢ Regarding the repair design and the repair work which were not developed as a manual, standard investigation and design methods, as well as the construction method, are outlined with the knowledge obtained through the pilot project.

5.3.7 Technical Level of Various Manuals

The manuals created by the Technical Project are widespread ranging from inspection methods, recording and registration methods of inspection data, operation control of PMS to a repair design and a construction method. Among them, as for the inspection field, visual inspections over the past three years have also been implemented in the technical project. It is thought that the measurement of IRI during the inspection of vehicles and an input of damaged data take a lot of work, but an appropriate operation can be performed by conducting training and establishing an inspection system.

In addition, regarding the plan making of the next year by PMS, it requires trial and error to set up a judging method of the damage degree of the position and the priority of repairs, but it is thought that a proper annual plan can be output if the priority of the repair becomes clear.

Moreover, when formulating the mid-to-long term planning through PMS, it is necessary to create a deterioration model of the damage. Therefore, it is likely to take time to verify the accuracy of the model, and it is expected to take a lot of time for C/P to understand the way of thinking of the deterioration prediction model and use the model efficiently.

As for repair design and construction, knowledge and points to remember obtained in the pilot project are summarized in the handbook.

5.3.8 Achived techical Level in Technical Project

The implementation status and the level of technical attainment of the Technical Project were summarized in Table 5-10.

Table 5-10 Technical Achievement Level

Items	Previous Level of Technical Project	Level Reached in Technical Projects until now	Level to Reach by the End of the Technical Project
Inspection	➢ By Visual inspections ➢ Determine damage by ERA criteria	➢ Measurement of IRI by vehicle inspection ➢ Images taken by vehicle inspections are subjected to screening and visual inspections after grasping major damage. ➢ Record visual inspection data by smartphone. ➢ Create an AACRA damage assessment criterion based on a way of thinking of the ERA.	➢ Visual inspections and vehicle inspections from 2018 to 2019 will be conducted to accumulate data that can be analyzed by PMS.
Record	➢ Paper based records	➢ The main highways (RR, PAS, SAS) incorporate visual inspection results and vehicle inspection results into the PMS system.	➢ Inspection data on the road of CS and LS class, which are outside the scope of this technical project, are being considered to integrate them into PMS.
Development of Repair Plan	➢ Form a repair plan for next year according to pavement damage	➢ For the planning of annual repairs for next year, a system capable of providing places to be repaired on a priority basis, repairing methods, calculation of repair costs by weighing the importance by damage level, contents of the damages, and standards of roads, was established. ➢ When there is a limitation of the budget, a system capable of simulating the potential	➢ New Year budget plan from September 2019 will be formulated by PMS. ➢ Mid-to-long term plan will be formulated by PMS. ➢ The deterioration prediction model will be corrected by the latest inspection result.

Items	Previous Level of Technical Project	Level Reached in Technical Projects until now	Level to Reach by the End of the Technical Project
		levels of all future damages using a deterioration prediction model of the pavement for the formulating of mid-to-long term plan was established.	
Repair Design	➢ Check the roadbed visually, replace it if strength is not enough.	➢ The introduction of DCP machines allowed a pavement design according to the local roadbed strength. ➢ Ground surveys and the design of pavement thickness in the pilot project were conducted.	➢ The standard research and design methods are to be summarized in the handbook.
Repair Work	➢ The construction for preventive maintenance had not been carried out. ➢ Quality control and safety management could not be carried out.	➢ The construction of the crack seal work was made possible as preventive maintenance. ➢ Safety was improved through enhancement of lighting during nighttime working and putting in guards. ➢ Construction control, such as temperature control of asphalt plied timber, was conducted.	➢ The construction management, quality control, and safety management method are to be summarized in the handbook.

5.4 Construction, Maintenance Ability and Technical Level

5.4.1 Current Status of Construction Companies

After conducting an interview with local construction companies and Japanese trading companies on the construction, maintenance and technical levels of local businesses, we found the current conditions and challenges mentioned below. The top 10 major construction companies are shown in Table 5-11. Note that those written in bold letters are local companies that were interviewed.

【New Construction Work of Roads】

Large-scale projects are being dominated by Chinese companies, and local construction companies are participating in the project in the form of joint ventures and subcontracting with Chinese companies. At first, Chinese companies were receiving their orders at low prices, but in recent years, they often bid at a fair price because China has few competitors due to an oligopoly situation. In large-scale construction such as highway construction, the construction history, the number of holding machines and engineers and financial situation are evaluated. So far, we have been undertaking large scale construction working with overseas construction companies, but it has come to the stage where local construction companies can implement the work by themselves since they have enough experience with sufficient track records.

【Road Maintenance Management】

Large local construction companies with technological strength do not show interest because small projects, such as maintenance and repair work, are not profitable. On the other hand, the technological level of small and medium-sized construction companies is not too high and they do not have the technological level enough to entrust repair works to them. The maintenance of roads is being carried out by the departments that work under the direct management of AACRA. On the other hand, we are currently in a period of outsourcing due to the capacity over the departments that work under direct management, and we are considering placing an order for ditch cleaning with small size construction companies to foster them gradually. There is also a movement for returning the regular maintenance and the emergency constructions to ERA although it privatized the departments that work under direct management. The privatized companies focus on paying constructions, which takes a lot of time even in the case of construction requiring an immediate response.

【Securing Talented Individual】

The salary of the government technical staff is low, equivalent to about one third of those of private construction companies and consultants. When young engineers get some experience, they make a career move to private companies. ERA makes technical staff get degrees in college. Though there is a two-year term commitment after taking a degree, they change their jobs after that. There are few mid-level engineers with government experience.

【Securing of Construction Equipment】

Private construction companies secure equipment such as asphalt plants, crushed stone plants, dump trucks, backhoes and bulldozers by themselves, a company that was interviewed, recently purchased a high performance asphalt plant made in Italy for 300 million birr which is almost 5 times more expensive than a plant made in China. Plants made in Japan is one of the options for their purchase. They are not resistant to use second hand construction machines imported from Japan. They are satisfied with just being able to import construction machinery of low cost and good performance as long as there are no regulations from the government.

Table 5-11 Top 10 Construction Companies in Ethiopia

No	Company Name	Location of Headquarters
1	Sunshine Construction	Addis Ababa
2	Sur Construction	Addis Ababa
3	YENCOMAD Construction Plc	Addis Ababa
4	**Rama Construction Plc**	Addis Ababa
5	Diriba Defersa General Contractor	Addis Ababa
6	**ASER Construction Plc**	Addis Ababa
7	**YOTEC Construction Plc**	Addis Ababa
8	ENEYE Construction	Addis Ababa
9	Tekelebehan Ambaye Construction Plc	Addis Ababa
10	TIKS Construction	Addis Ababa

Remarks: Bold letters signify local companies that were interviewed
Source: Itochu Corporation Ethiopia Office

5.4.2 Current Status of AACRA's Departments that Work under Direct Management

We had an interview with a consultant who manages the direct execution department of AACRA about the construction, maintenance, and technical levels of the directly operated construction department and found the following challenges.

【Construction Plan】

Repair parts, repair contents, and repair methods are undecided at a stage before the repair work is carried out. It is the Road AM Department that determines the contents of the repair work, but they only instruct the departments that work under direct management about rough quantity, construction range, and construction method with no proper reflection of the current situation of the damages of the site. Basically, it is necessary to grasp the degree of damage and to indicate concretely the construction method and ranges but these things are not carried out in reality. Also, haphazard and insufficient construction work can be seen due to poor planning of the work before construction.

There are engineers with knowledge at the highest level, but operations chiefs have neither sufficient technical knowledge nor have they received education. They are doing construction work in the dark.

【Construction Ability】

The departments that work under direct management carry out only one work in the same work yard. In general, they carry out the drainage work while doing the pavement work and finish construction early. In addition, the construction equipment often breaks, and the materials are obtained from a plurality of suppliers, which takes time to do a material test. This also is the cause of low ability of construction work. If the number of suppliers is narrowed down to some extent, the frequency of tests can be reduced.

【Safety Management】

The awareness of safety and environmental awareness is low. Nighttime construction work does not provide enough illumination and has poor visibility. Some workers do their work listening to the radio or often leave manholes open. There are some cases where waste wood, which is required to be treated as waste disposal, are being dumped near work sites.

【Quality Control】

In terms of quality control, preparing a quality management plan prior to the construction and assigning a person in charge of the quality control are the common procedure of construction work, but the departments that work under direct management neither prepare the plan nor assign the person in charge, resulting in poor quality control. AACRA officials sometimes visit the spot, but hardly provide direction for the directly managed department.

5.4.3 Current Status of Consultants

We interviewed local consultants and Japanese trading companies on the construction, maintenance, and technical levels and found the following challenges. The top 10 major consultants are shown in Table 5-12. Note that the bold letters signify a local company that was interviewed.

【Excessive Competition】

The number of consulting firms is great and too competitive. Though they seem to have a certain level of technological capacity, it is supposed that the amount of remuneration of construction management is too low.

In most cases, about 10% of the construction cost is secured, but there was information that only about 1% was secured in Ethiopia. As for the number of consultants, only essential personnel are secured, and the fact is that they have not produced sufficient results.

【Volume of Consultant Business】

A maintenance design to be ordered from consultants includes something unclear in task and scope. Unlike new designs, these designs require experience and technical capabilities. In-house training has been provided for technology succession. There is a limit to the amount of work capable to be dealt with because of the limited number of engineers, which prevents them from receiving orders beyond the capacities of their business.

Table 5-12 Top 10 Consulting Companies in Ethiopia

No	Company Name	Location of Headquarters
1	Africa Consult Consulting Architects & Engineering	Addis Ababa
2	Beacon Consulting Architects & Engineers	Addis Ababa
3	Core Consult	Addis Ababa
4	**NET Consulting Engineers & Architects**	Addis Ababa
5	Metaferia Consulting Engineers	Addis Ababa
6	Beza Consulting Engineers	Addis Ababa
7	CWCE Consulting Engineers	Addis Ababa
8	Pure Consult Engineering	Addis Ababa
9	AFRO European Engineering	Addis Ababa
10	BEST Consulting Engineers	Addis Ababa

Remarks: Bold letters signify a local company that was interviewed
Source: Itochu Corporation Ethiopia Office

5.5 Confirmation of Achievement Level on Road AM

5.5.1 Evaluation Index Structure Diagram of Road AM

The structure diagram of the evaluation index of the Road AM is shown in Figure 5-5. This table lists detailed numerical values Achieved through interviews and local confirmation. In addition, the small item describes the average of, the middle item describes the average of the small items, and the large item describes the average of the middle items. The numerical value of other areas is a discrete item.

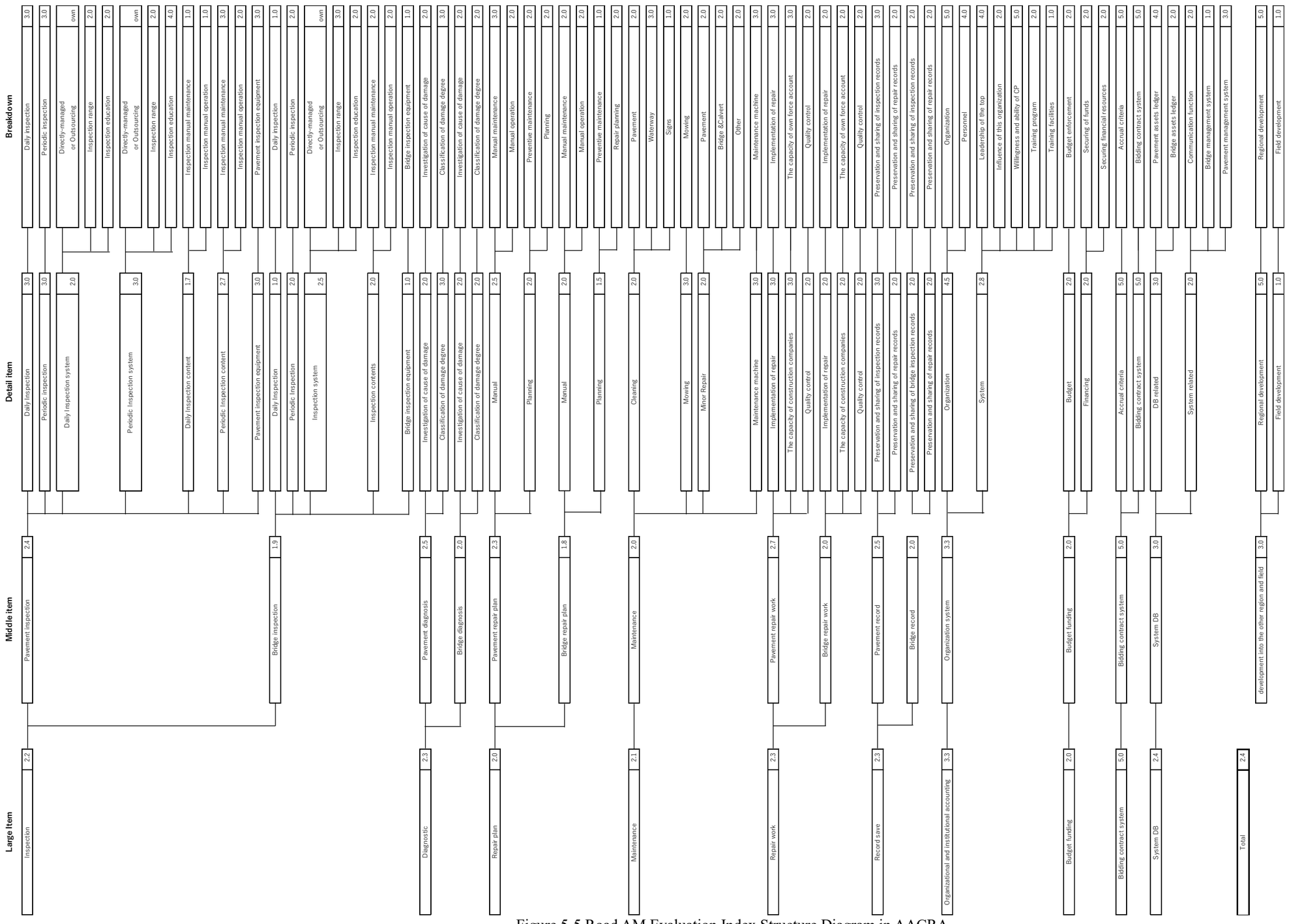


Figure 5-5 Road AM Evaluation Index Structure Diagram in AACRA

5.5.2 Evaluation Index (detail) of Road AM

5.5.2.1 Pavement Inspection

Engineers of the Road AM Regional Office conduct daily visual inspections, and the main purpose is to confirm the illegal occupation of the road and so on. Only inspections of the main highway (18% of the total) are being carried out. Inspectors consist of experienced ones as well as inexperienced ones with a variation in the levels, but they have received education in the field of civil engineering. The goal of these inspections is corrective maintenance. The inspection range and the inspection education score improved from 2.0 to 3.0 because the approach of the technical project continued and progressed, and the daily inspection range was assumed to be a road extension of 50% or more in five years, and the daily inspection education was done.

Middle Item	Small Item	Particulars	Scores
Pavement Inspection	Daily Inspections	-	3.0
	Daily Inspection System	Outsourcing Status	Own force
		Inspection Range	2.0 (3.0)
		Inspection Training	2.0 (3.0)

( ) is expected to be achieved in about five years after the end of the technical project.

The regular pavement inspection is carried out every year (*twice before and after the rainy season) using a road surface inspection vehicle. The range covers about 1,900km which is likely to become the main road in the asphalt pavement. Pictures are taken of the road situation; therefore measurement is to be conducted avoiding Saturday, Sunday and traffic congestion. The regular inspection is conducted using vehicles of the road surface property. The smart phone is used to keep a record of the location of the damage, which records the extent of damage, such as cracks, ruts as well as location information.

This is work to be done separately from the road surface inspection vehicle. The education of the periodic inspection has been continuously provided. There are five engineers who can deal with vehicles for the property of road surface. Currently, engineers from branch offices are receiving training at the headquarters. PMS has 15 master trainers at the headquarters, and it is planning to develop 5 engineers at 5 local offices in the future. Since the efforts of the technical project will continue and progress, and five years later the range of periodic inspections is expected to extend to more than 50% of the road extension, the inspection range score has been improved from 2.0 to 3.0.

Middle Item	Small Item	Breakdown	Scores
Pavement inspection	Periodic Inspections	-	3.0
	Periodic Inspection System	Outsourcing Status	Own force
		Inspection Range	2.0 (3.0)
		Inspection Education	4.0

( ) Is expected to be achieved in about five years after the end of the technical project.

There is no daily inspection manual available. The regular inspection manual is being developed in a technical project and is being implemented in technical projects through training. AACRA has one pavement inspection vehicle for the road surface property, smartphones, and two dynamic penetration cones, which were introduced in the technical project. Since the efforts of the technical project will continue and progress, and the daily inspection manual is maintained in five years at which time it is assumed that the daily inspection manual will have been operated in line, the inspection manual maintenance and the inspection manual operation scores improved from 1.0 to 3.0. In addition, since the periodic inspection manual is assumed to have been operating in line, the inspection manual operation score was improved to 3.0 from 2.0.

Middle Item	Small Item	Breakdown	Scores
Pavement Inspection	Inspection Contents	Inspection Manual Maintenance	1.0 (3.0)
		Inspection Manual Operation	1.0 (3.0)
	Periodic inspection Contents	Inspection Manual Maintenance	3.0
		Inspection Manual Operation	2.0 (3.0)
	Pavement Inspection Equipment	-	3.0

( ) is expected to be achieved in about five years after the end of the technical project.

5.5.2.2 Bridge Inspection

Daily inspection on bridges has not been conducted. Regular inspections are conducted visually every year. The inspection system has just started by direct management, and the range was all bridges (the exact number is unknown, but over one thousand bridges) with the completion of the inspection of less than 600 bridges. The situation is one in which the persons, who experienced the bridge inspection, are adopted as AACRA staff by former ERA staff, and they are carrying out the education concerning the inspection to other staff.

Middle Item	Small Item	Breakdown	Scores
Bridge Inspection	Daily Inspections	-	1.0
	Periodic Inspections	-	2.0
	Inspection System	Outsourcing Status	Own force
		Inspection Range	3.0
		Inspection Education	2.0

Inspection manuals from ERA is being applied. Only cameras and measuring tools are to be inspected.

Middle Item	Small Item	Breakdown	Scores
Bridge Inspection	Contents of Inspection	Manual Maintenance	2.0
		Manual Operation	2.0
	Bridge Inspection Equipment	-	1.0

5.5.2.3 Diagnostic

The cause investigation of the pavement damage is being carried out to the greatest extent possible. Pavement damage is classified. Currently, ERA manuals are being applied, but new manuals are expected to be provided from the technical project. As for the bridge damage, internal injury is not clear with only an appearance check. The ERA manual is applied for damage of bridges. The classification of the bridge damage has been made. The investigation of the cause of damage score improved from 2.0 to 3.0 because it is assumed that the approach of the technical project continued and progressed, and the important parts were investigated in regard to the cause of the pavement damage in five years.

Middle Item	Small Item	Breakdown	Scores
Pavement Diagnosis	Investigation of the Cause of Damage	-	2.0 (3.0)
	Classification of Damage Level	-	3.0

Middle Item	Small Item	Breakdown	Scores
Bridge Diagnosis	Investigation of the Cause of Damage	-	2.0
	Classification of Damage Level	-	2.0

( ) is expected to be achieved in about five years after the end of the technical project.

5.5.2.4 Repair Plan

ERA manuals are being applied for the bridge pavement plan, but new manuals are expected to be provided from the technical project. AASHTO manuals also being referenced to appropriately. Original manuals are kept as materials. In terms of preventive maintenance, the crack seal and drain ditches have been cleaned. We drew up repair plans for the next year, but we are now planning a mid-to-long term plan by PMS, which was introduced in the technical project. Since the efforts of the technical project will continue and progress, and it is assumed that the operation of the manual is performed on all routes in five years, the manual operation score improved from 2.0 to 3.0. In addition, it is assumed that preventive maintenance is carried out in the area where preventive maintenance is required, since the short-term repair plan is assumed to be drafted, so the preventive maintenance and plan development scores will improve to 3.0 from 2.0.

Middle Item	Small Item	Breakdown	Scores
Pavement Repair Plan	Manual	Manual Maintenance	3.0
		Manual Operation	2.0 (3.0)
	Planning	Preventive Maintenance	2.0 (3.0)
		Plan Development	2.0 (3.0)

( ) is expected to be achieved in about five years after the end of the technical project.

ERA manuals are being applied for the bridge pavement plan. In this way, the actual situation is that ERA manuals are basically applied, but it is necessary to customize that according to the road environment of AACRA.

Middle Item	Small Item	Breakdown	Scores
Bridge Repair Plan	Manual	Manual Maintenance	2.0
		Manual Operation	2.0
	Planning	Preventive Maintenance	1.0
		Development of Repair Plan	2.0

5.5.2.5 Maintenance Management

Cleaning has been carried out by other agencies, although randomly. Waterway cleanings are conducted twice a year in consideration of the rainy season (utilizing local SMEs). There is one high-pressure washing machine, but it often malfunctions. No cleaning has been implemented to the signs, but a different institution is doing planting management (flowers) at the interchange. Small repairs include potholes within limited areas.

Middle Item	Small Item	Breakdown	Scores
Maintenance	Cleaning	Pavement	2.0
		Waterway	3.0
		Signs	1.0
	Mowing	-	2.0

Small repairs of bridges are partially supported. Other facilities are available properly. All the maintenance equipment is outdated.

Middle Item	Small Item	Breakdown	Scores
Maintenance Management	Minor Repair	Pavement	2.0
		Bridges/Culverts	2.0
		Other	2.0
	Maintenance Work Machine	-	3.0

5.5.2.6 Repair Work

The pavement repairs have been poorly carried out. Recently, the budget has been gradually divided to the maintenance and the department that works under direct management has been dealing with all types of work, including the cutting overlay, but there are problems of the aging of construction equipment and the shortage of the material supply. The quality is of moderate level. The quality of materials and workers is not good.

As for materials, AACRA also possesses a quarry but purchases crushed stones from private companies because their production capacity is low. Construction equipment is outdated and suffer frequent failures. Pavement plants includes one large-scale unit and two small ones, but they are very old. The shortage has been purchased from a private asphalt plant. We are currently requesting for JICA to update the equipment.

Middle Item	Small Item	Breakdown	Scores
Pavement Repair Work	Implementation of Repairs	-	3.0
	Capacity of the Construction Company	-	3.0
	Quality Control	-	2.0

The repair work of the bridge has been carried out to some extent by the department that works under direct management. The construction company has construction experience, showing no problems in their abilities for the construction work. As for quality control, the ordering company (including consultants) carries it out.

Middle Item	Small Item	Breakdown	Scores
Bridge Repair Work	Implementation of Repairs	-	2.0
	Capacity of the Construction Company	-	2.0
	Quality Control	-	2.0

5.5.2.7 Preservation of Records

Digitization has been available for pavement by PMS. The paper-based inspection ledger is being prepared for pavement, which is controlled by Excel. It was assumed that the efforts of the technical project will continue, and progress and that the pavement repair record will be stored and shared five years later, so the score improved from 2.0 to 3.0.

Middle Item	Small Item	Breakdown	Scores
Pavement Record	Save/share Inspection Records	-	3.0

Middle Item	Small Item	Breakdown	Scores
	Preservation and Sharing of Repair Records	-	2.0 (3.0)
Bridge Record	Save/share Inspection Records	-	2.0
	Preservation and Sharing of Repair Records	-	2.0

( ) is expected to be achieved in about five years after the end of the technical project.

5.5.2.8 System

The system has a Road AM Department. The number of people is about two thirds of the target. There are 19 staff members in the Road AM Department, and we want to have a team of 33 people from now on. Although the top (GM) has the leadership, we recognize their management capacity is not so high including Deputy Director General (hereinafter referred to as "DDG"). Every Friday, we confirm progress situations of the maintenance, challenges, plan of the next week at the meeting with the GM. The Road AM has staff ranging from having high desires and capacities to those who are not. The overall mean is a middle level. Though the organization has a training system for pavement, it does not have training facilities.

Middle Item	Small Item	Breakdown	Scores
Organization	Organization	Organization	5.0
		Personnel	4.0
Organization	System	Leadership of the Top	4.0
		Influence of the Organization	2.0
		C/P Willingness and Ability	5.0
		Training System	2.0
		Training Facilities	1.0

5.5.2.9 Budget Financing

Funds from the city and the road fund have been provided but are insufficient. The proportion of the road fund is 1, whereas that of the city is 9. Consultants for construction management have been employed and they report the progress situation of the work to the road fund. If the work is approved, they receive payment from the road fund, which covers twenty percent of consultancy fees.

Middle Item	Small Item	Breakdown	Scores
Budget Financing	Budget	Budget Enforcement	2.0
	Financing	Securing Funds	2.0
		Securing Financial Resources	2.0

5.5.2.10 Contract System

The accumulation standard and the bidding system are prepared. As for the estimation, the city determines the standard price using unit prices. The contract cost of the Road AM Department and the department that works under direct management includes labor cost, material cost and lease fees for the equipment. The department that works under direct management deducts necessary expenses from the

revenue and is supposed to update the construction machines and the plant facilities, but they have failed to do so due to fund shortage.

Middle Item	Small Item	Breakdown	Scores
Bidding Contract System	Accumulation Criteria	-	5.0
	Bidding Contract System	-	5.0

5.5.2.11 System and DB

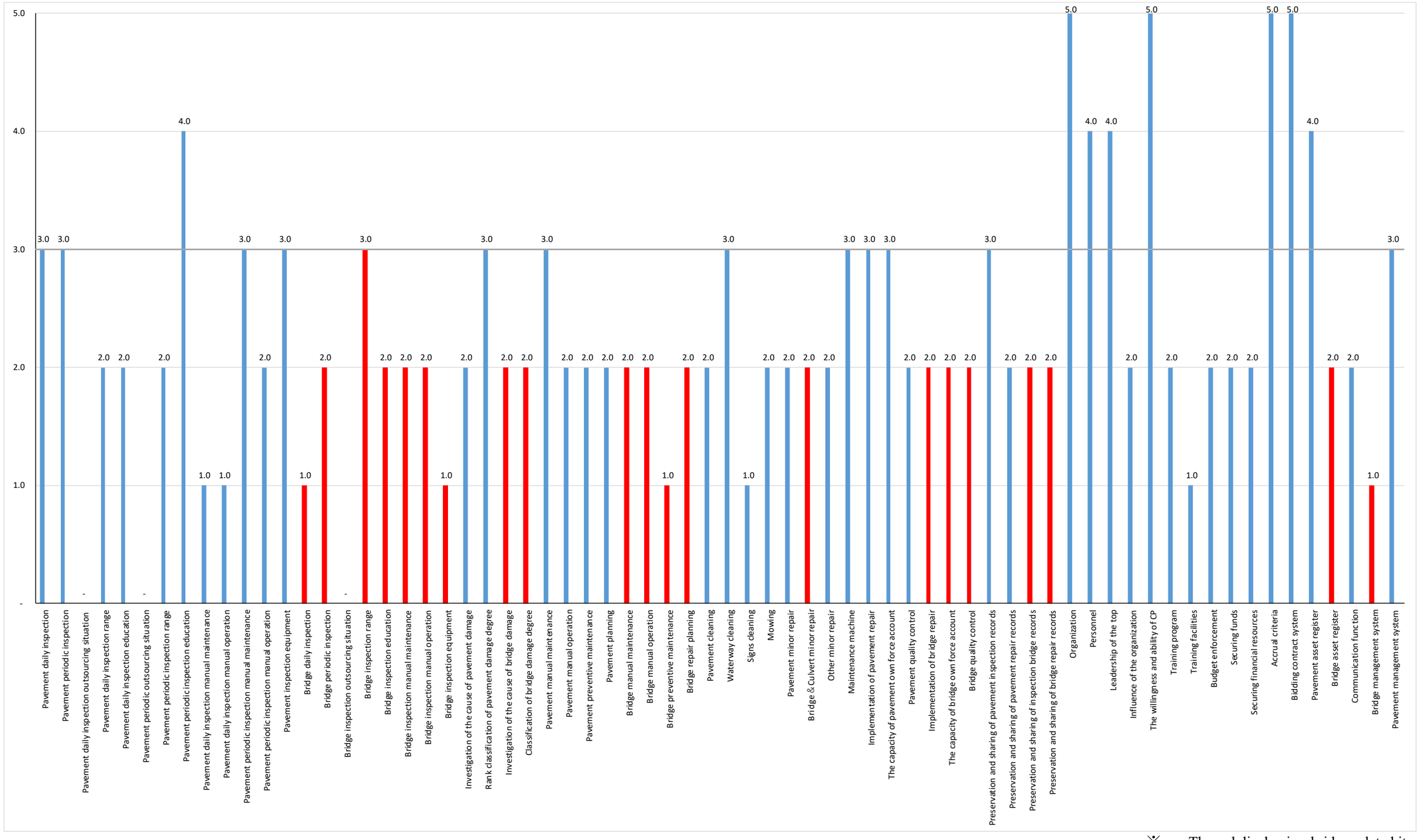
PMS will be introduced in the technical project. There exists a network plan which connects the headquarters and the local office that is in the planning stages. BMS is not currently present but preparation to introduce BMS in ERA is proceeding.

Middle Item	Small Item	Breakdown	Scores
System DB	DB Related	Pavement Asset Ledger	4.0
		Bridge Asset Ledger	2.0
	System Related	Communication Function	2.0
		Bridge Management System	1.0
		Pavement Management System	3.0

5.5.2.12 Deployment to Other Regions

It has been made possible in all offices. As for the region, being unable to deploy bridges becomes a bottleneck.

Middle Item	Small Item	Breakdown	Scores
Deployment to Other Regions	Regional Development	-	5.0
	Fields Unfold	-	1.0



※ The red display is a bridge related item

Figure 5-6 Road AM Evaluation Index of AACRA (Breakdown)

Table 5-13 Road AM Evaluation Sheet of AACRA (Part 1)

Middle item	Small item	Detail item	Scores	Evaluation items	Score Current	Scale	Achieve %	Score 5years later
Pavement inspection	Daily inspection		1	Inspection is not conducted.	3.0	3.0	100%	3.0
			2	Inspection is carried out at random times.				
			3	Inspection is conducted on a regular basis.				
			4					
			5					
	Periodic inspection		1	Inspection is not conducted.	3.0	3.0	100%	3.0
			2	Inspection is carried out at random times.				
			3	Inspection is conducted on a regular basis.				
			4					
			5					
	Daily Inspection system	Outsourcing Situation	0	Person in charge within an organization is absent and daily inspection is outsourced without evaluating an outsourcing contractor.	Own	5.0		Own
			1	Person in charge within an organization is present and daily inspection is outsourced without evaluating an outsourcing contractor.				
			2	Outsourcing contractors are to be evaluated and their responsibilities, authorities, and contents are specifically defined.				
			3	Information is being shared to achieve target performance.				
			4	Trustees have systems to improve their target performance independently.				
		Inspection range	1	Inspection is not conducted.	2.0	5.0	40%	3.0
			2	Inspection is being conducted, but limited.				
			3	Inspections have been carried out in 50% or more of the road extension of the operating route.				
			4	Inspections have been carried out in 75% or more of the road extension of the operating route.				
			5	Inspections have been carried out in 100% or more of the road extension of the operating route.				
		Inspection education	1	Inspectors have no knowledge of civil engineering and have not received an inspection education	2.0	5.0	40%	3.0
			2	Inspectors have knowledge of civil engineering, but have not received inspection education				
			3	Inspectors have no knowledge of civil engineering, but they have received an inspection education.				
			4	Inspectors have knowledge of civil engineering, and have received an inspection education.				
			5	Inspectors are continuously taking inspection education.				
	Periodic Inspection system	Outsourcing Situation	1	Person in charge within an organization is absent and periodic inspection is outsourced without evaluating an outsourcing contractor.	Own	5.0	0.0	Own
			2	Person in charge within an organization is present and periodic inspection is outsourced without evaluating an outsourcing contractor.				
			3	Outsourcing contractors are to be evaluated and their responsibilities, authorities, and contents are specifically defined in contract document.				
			4	Information is being shared to achieve target performance.				
			5	Trustees have systems to improve their target performance independently.				
		Inspection range	0	Inspection is not conducted.	2.0	5.0	40%	3.0
			1	Inspection is being conducted, but limited.				
			2	Inspections have been carried out in 50% or more of the road extension of the operating route.				
			3	Inspections have been carried out in 75% or more of the road extension of the operating route.				
			4	Inspections have been carried out in 100% or more of the road extension of the operating route.				
		Inspection education	0	Inspectors have no knowledge of civil engineering and have not received an inspection education	4.0	5.0	80%	4.0
			1	Inspectors have knowledge of civil engineering, but have not received inspection education				
			2	Inspectors have no knowledge of civil engineering, but they have received an inspection education.				
			3	Inspectors have knowledge of civil engineering, and have received an inspection education.				
			4	Inspectors are continuously taking inspection education.				
	Daily Inspection content	Existence of Inspection manual	0	Inspection manuals are not developed.	1.0	3.0	33%	3.0
			1	Inspection manuals are partially developed.				
			2	Inspection manuals are developed.				
			3					
			4					
		Use of inspection manual	0	The inspection manuals are not being operated.	1.0	5.0	20%	3.0
			1	The inspection manuals are being operated in some routes.				
			2	Inspection manuals are being used in all routes.				
			3	Inspection manuals are being operates in all routes, but no reviews have been made.				
			4	Inspection manuals are being operates in all routes, and have been reviewed regularly or as needed.				
	Periodic Inspection content	Existence of Inspection manual	0	Inspection manuals are not developed.	3.0	3.0	100%	3.0
			1	Inspection manuals are partially developed.				
			2	Inspection manuals are developed.				
			3					
			4					
		Use of inspection manual	0	The inspection manuals are not being operated.	2.0	5.0	40%	3.0
			1	The inspection manuals are being operated in some routes.				
			2	Inspection manuals are being used in all routes.				
			3	Inspection manuals are being operates in all routes, but no reviews have been made.				
			4	Inspection manuals are being operates in all routes, and have been reviewed regularly or as needed.				
	Pavement inspection equipment		0	Inspection equipment is not well-maintained.	3.0	5.0	60%	3.0
			1	Basic inspection equipment is developed, but not in use.				
			2	Basic inspection equipment is being used.				
			3	Basic inspection equipment is being used. State-of-the-art inspection equipment is maintained, but not in use.				
			4	State-of-the-art inspection equipment is being used.				

Table 5-14 Road AM Evaluation Sheet of AACRA (Part 2)

Bridge inspection	Inspection method	Daily inspection	0	Inspection is not conducted.	1.0	3.0	33%	1.0
			1	Inspection is carried out at random times.				
			2	Inspection is conducted on a regular basis.				
			3					
			4					
		Periodic inspection	0	Inspection is not conducted.	2.0	3.0	67%	2.0
			1	Inspection is carried out at random times.				
			2	Inspection is conducted on a regular basis.				
			3					
			4					
	Inspection system	Outsourcing Situation	0	Person in charge within an organization is absent and inspection is outsourced without evaluating an outsourcing contractor.	Own	5.0		Own
			1	Person in charge within an organization is present and inspection is outsourced without evaluating an outsourcing contractor.				
			2	Outsourcing contractors are to be evaluated and their responsibilities, authorities, and contents are specifically defined.				
			3	Information is being shared to achieve target performance.				
			4	Trustees have systems to improve their target performance independently.				
		Inspection range	0	Inspection is not conducted.	3.0	5.0	60%	3.0
			1	Inspection is being conducted, but limited.				
			2	Inspections have been carried out in 50% or more of the road extension of the operating route.				
			3	Inspections have been carried out in 75% or more of the road extension of the operating route.				
			4	Inspections have been carried out in 100% or more of the road extension of the operating route.				
		Inspection education	0	Inspectors have no knowledge of civil engineering and have not received an inspection education	2.0	5.0	40%	2.0
			1	Inspectors have knowledge of civil engineering, but have not received inspection education				
			2	Inspectors have no knowledge of civil engineering, but they have received an inspection education.				
			3	Inspectors have knowledge of civil engineering, and have received an inspection education.				
			4	Inspectors are continuously taking inspection education.				
	Inspection contents	Existence of Inspection manual	0	Inspection manuals are not developed.	2.0	3.0	67%	2.0
			1	Inspection manuals are partially developed.				
			2	Inspection manuals are developed.				
			3					
			4					
		Use of inspection manual	0	The inspection manuals are not being operated.	2.0	5.0	40%	2.0
			1	The inspection manuals are being operated in some routes.				
			2	Inspection manuals are being used in all routes.				
			3	Inspection manuals are being operates in all routes, but no reviews have been made.				
			4	Inspection manuals are being operates in all routes, and have been reviewed regularly or as needed.				
	Bridge inspection equipment☒		0	Inspection equipment is not well-maintained.	1.0	5.0	20%	1.0
			1	Basic inspection equipment is developed, but not in use.				
			2	Basic inspection equipment is being used.				
			3	Basic inspection equipment is being used. State-of-the-art inspection equipment is maintained, but not in use.				
			4	State-of-the-art inspection equipment is being used.				
Large Item: Inspection					2.2	4.3	54.4%	2.6
Pavement diagnosis	Investigation of cause of damage		0	The investigation of cause of the damage is not carried out.	2.0	5.0	40%	3.0
			1	The investigation of cause of damage is not carried out partially.				
			2	The investigation of cause of an important part is carried out.				
			3	The cause of the damage is systematically investigated.				
			4	The investigation of the cause of damage has been used to improve the overall maintenance.				
	Classification of damage degree		0	There has been no classification of damage	3.0	3.0	100%	3.0
			1	The classification of damage has been done, but there is a large room for improvement.				
			2	The classification of damage has been done with few rooms for improvement.				
			3					
			4					
Bridge diagnosis	Investigation of cause of damage		0	The investigation of cause of the damage is not carried out.	2.0	5.0	40%	2.0
			1	The investigation of cause of damage is not carried out partially.				
			2	The investigation of cause of an important part is carried out.				
			3	The cause of the damage is systematically investigated.				
			4	The investigation of the cause of damage has been used to improve the overall maintenance.				
	Classification of damage degree☒		0	There has been no classification of damage	2.0	3.0	67%	2.0
			1	The classification of damage has been done, but there is a large room for improvement.				
			2	The classification of damage has been done with few rooms for improvement.				
			3					
			4					
Large Item: Diagnostic					2.3	4.2	61.7%	2.5
Pavement repair plan	Manual	Existence of inspection manual	0	Inspection manuals are not developed.	3.0	3.0	100%	3.0
			1	Inspection manuals are partially developed.				
			2	Inspection manuals are developed.				
			3					
			4					
		Use of inspection manual	0	The inspection manuals are not being operated.	2.0	5.0	40%	3.0
			1	The inspection manuals are being operated in some routes.				
			2	Inspection manuals are being used in all routes.				
			3	Inspection manuals are being operates in all routes, but no reviews have been made.				
			4	Inspection manuals are being operates in all routes, and have been reviewed regularly or as needed.				
	Planning	Preventive maintenance	0	Not aware of the need to introduce preventive maintenance	2.0	3.0	67%	3.0
			1	The need to implement preventive maintenance is assessed.				
			2	Preventive maintenance is being operated in regions where its introduction is rated to be necessary.				
			3					
			4					
		Planning	0	Repair plan has not been drafted.	2.0	5.0	40%	3.0
			1	Repair plan for the next year has been drawn up.				
			2	Repair plan of short-term (about two to three years) has been drawn up.				
			3	Repair plan of middle-term (about five years) has been drawn up.				
			4	Repair plan of long-term (over ten years) has been drawn up.				

Table 5-15 Road AM Evaluation Sheet of AACRA (Part 3)

Bridge repair plan	Manual	Existence of inspection manual	0	Inspection manuals are not developed.	2.0	3.0	67%	2.0
			1	Inspection manuals are partially developed.				
			2	Inspection manuals are developed.				
			3					
			4					
		Use of inspection manual	0	The inspection manuals are not being operated.	2.0	5.0	40%	2.0
			1	The inspection manuals are being operated in some routes.				
			2	Inspection manuals are being used in all routes.				
			3	Inspection manuals are being operates in all routes, but no reviews have been made.				
			4	Inspection manuals are being operates in all routes, and have been reviewed regularly or as needed.				
	Planning	Preventive maintenance	0	Not aware of the need to introduce preventive maintenance	1.0	3.0	33%	1.0
			1	The need to implement preventive maintenance is assessed.				
			2	Preventive maintenance is being operated in regions where its introduction is rated to be necessary.				
			3					
			4					
		Repair planning	0	Repair plan has not been drafted.	2.0	5.0	40%	2.0
			1	Repair plan for the next year has been drawn up.				
			2	Repair plan of short-term (about two to three years) has been drawn up.				
			3	Repair plan of middle-term (about five years) has been drawn up.				
			4	Repair plan of long-term (over ten years) has been drawn up.				
Large Item: Repair Plan					2.0	4.0	53.3%	2.4
Maintenance	Cleaning	Pavement	0	Cleaning has not yet been carried out.	2.0	3.0	67%	2.0
			1	Cleaning is being carried out but not regularly.				
			2	Cleaning is performed regularly.				
			3					
			4					
		Waterway	0	Cleaning has not yet been carried out.	3.0	3.0	100%	3.0
			1	Cleaning is being carried out but not regularly.				
			2	Cleaning is performed regularly.				
			3					
			4					
		Signs	0	Cleaning has not yet been carried out.	1.0	3.0	33%	1.0
			1	Cleaning is being carried out but not regularly.				
			2	Cleaning is performed regularly.				
			3					
			4					
	Mowing		0	Mowing has not yet been carried out.	2.0	3.0	67%	2.0
			1	Mowing is being carried out, but not regularly.				
			2	Mowing is performed regularly.				
			3					
			4					
	Minor repair	Pavement	0	Repair has been hardly performed.	2.0	3.0	67%	2.0
			1	The minimum repair work has been done				
			2	The repair works are being performed appropriately.				
			3					
			4					
		Bridge & Culvert	0	Repair has been hardly performed.	2.0	3.0	67%	2.0
			1	The minimum repair work has been done				
			2	The repair works are being performed appropriately.				
			3					
			4					
		Other	0	Repair has been hardly performed.	2.0	3.0	67%	2.0
			1	The minimum repair work has been done				
			2	The repair works are being performed appropriately.				
			3					
			4					
	Maintenance machine		0	Working machine for maintenance is not in place.	3.0	5.0	60%	3.0
			1	Aging working machine for maintenance is in place and not in use.				
			2	Although the working machine for maintenance is in place, it is used partially.				
			3	The working machine for maintenance is in place and in use.				
			4	State-of-the-art working machine for maintenance is in place and in use.				
Large Item: Maintenance					2.1	3.3	66%	2.1
Pavement repair work	Implementation of repair		0	Repair has not been carried out.	3.0	3.0	100%	3.0
			1	Repair has been partially carried out.				
			2	A lot of sites have been repaired.				
			3					
			4					
	The capacity of own force account		0	No repair works are carried out.	3.0	5.0	60%	3.0
			1	Some repair have been generally carried out, and ability to perform repair works is poor.				
			2	Some general repair have been generally carried out, and ability to perform repair works is average.				
			3	Some general repair have been generally carried out, and ability to perform repair works is high.				
			4	Many advanced repair works have been carried out, and the ability to perform repair works is high.				
	Quality control		0	Quality Control of repair work has not been carried out.	2.0	5.0	40%	2.0
			1	Ability of quality control is low.				
			2	Ability of quality control is average.				
			3	Ability of quality control is high.				
			4	Quality control has been done positively, securing a high quality.				

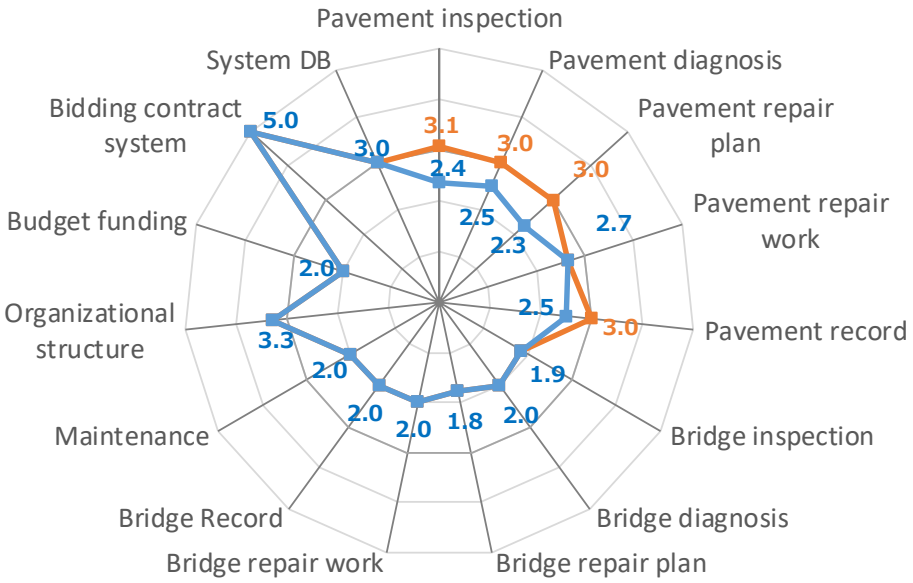
Table 5-16 Road AM Evaluation Sheet of AACRA (Part 4)

Bridge repair work	Implementation of repair		0	Repair has not yet been carried out.	2.0	3.0	67%	2.0
			1	Repair has been partially carried out.				
			2	A lot of sites have been repaired.				
			3					
			4					
	The capacity of own force account		0	No repair works are carried out.	2.0	5.0	40%	2.0
			1	Some repair have been generally carried out, and ability to perform repair works is poor.				
			2	Some general repair have been generally carried out, and ability to perform repair works is average.				
			3	Some general repair have been generally carried out, and ability to perform repair works is high.				
			4	Many advanced repair works have been carried out, and the ability to perform repair works is high.				
	Quality control		0	Quality Control of repair work has not been carried out.	2.0	5.0	40%	2.0
			1	Ability of quality control is low.				
			2	Ability of quality control is average.				
			3	Ability of quality control is high.				
			4	Quality control has been done positively, securing a high quality.				
Large Item: Repair work					2.3	4.3	58%	2.3
Pavement Record	Preservation and sharing of inspection records		0	Inspection results have neither been recorded nor preserved.	3.0	5.0	60%	3.0
			1	Inspection results have been partially recorded and preserved.				
			2	Inspection results have been recorded and preserved.				
			3	Inspection results have been recorded, preserved, and shared.				
			4	Inspection results have been recorded, preserved, shared, and updated.				
	Preservation and sharing of repair records		0	Inspection results have neither been recorded nor preserved.	2.0	5.0	40%	3.0
			1	Inspection results have been partially recorded and preserved.				
			2	Inspection results have been recorded and preserved.				
			3	Inspection results have been recorded, preserved, and shared.				
			4	Inspection results have been recorded, preserved, shared, and updated.				
Bridge Record	Preservation and sharing of inspection records		0	Inspection results have neither been recorded nor preserved.	2.0	5.0	40%	2.0
			1	Inspection results have been partially recorded and preserved.				
			2	Inspection results have been recorded and preserved.				
			3	Inspection results have been recorded, preserved, and shared.				
			4	Inspection results have been recorded, preserved, shared, and updated.				
	Preservation and sharing of repair records		0	Inspection results have neither been recorded nor preserved.	2.0	5.0	40%	2.0
			1	Inspection results have been partially recorded and preserved.				
			2	Inspection results have been recorded and preserved.				
			3	Inspection results have been recorded, preserved, and shared.				
			4	Inspection results have been recorded, preserved, shared, and updated.				
Large Item: Record Save					2.3	5.0	45%	2.5
Organization System	Organization	Organization	0	No person in charge of Road AM.	5.0	5.0	100%	5.0
			1	People in charge of Road AM are unclear.				
			2	Staffs in charge of road AM are arranged for other department as well.				
			3	Staffs in charge of road AM are arranged exclusively.				
			4	Road AM department is already established.				
		Personnel	0	Very few people in charge of Road AM	4.0	5.0	80%	4.0
			1	People in charge of Road AM is about 1/3 of the required number				
			2	People in charge of Road AM is about half of the required number				
			3	People in charge of Road AM is about 2/3 of the required number				
			4	People in charge of Road AM is enough in number.				
	System	Leadership of the top	0	The head of the organization is indifferent to the Road AM	4.0	5.0	80%	4.0
			1	The head of the organization is interested in Road AM, but less commitment.				
			2	The head of the organization sometimes makes commitments.				
			3	The head of the organization relatively often makes commitments.				
			4	The head of the organization frequently makes commitments.				
		Influence of this organization	0	Road AM department has a weak influence on other organizations	2.0	5.0	40%	2.0
			1	Road AM department has some influence on other departments				
			2	Road AM department has influence on other departments				
			3	Road AM department is considerable influence on other departments				
			4	Road AM department has strong influence on other organizations				
		Willingness and ability of CP	0	Awareness is low and ability is inadequate.	5.0	5.0	100%	5.0
			1	High awareness, but ability is inadequate.				
			2	Awareness and ability are both moderate.				
			3	Ability is high, but awareness is low.				
			4	Ability and awareness are both high.				
		Training program	0	No training program for human resource development	2.0	3.0	67%	2.0
			1	Training program for human resource is available, but insufficient.				
			2	Training system for human resources development is in place.				
			3					
			4					
		Training facilities	0	No training facility for human resource development	1.0	3.0	33%	1.0
			1	Training facility for human resource is available, but insufficient.				
			2	Training facility for human resources development is in place.				
			3					
			4					
Large Item: Organizational and institutional accounting					3.3	4.4	71%	3.3

Table 5-17 Road AM Evaluation Sheet of AACRA (Part 5)

Budget funding	Budget	Budget enforcement	0	Budget plan has not been drafted.	2.0	5.0	40%	2.0
				Budget plan for the next year has only been drawn up.				
			2	Budget plan of short-term (about two to three years) has been drawn up.				
			3	Budget plan of middle-term (about five years) has been drawn up.				
			4	Budget plan of long-term (over ten years) has been drawn up.				
	Financing	Securing of funds	0	Payment for procurement of materials, machinery and labors are often delayed.	2.0	3.0	67%	2.0
			1	Payment for procurement of materials, machinery and labors are sometimes delayed.				
			2	Payment for procurement of materials, machinery and labors are not delayed.				
			3					
			4					
		Securing financial resources	0	There are no revenue sources focusing for maintenance and management.	2.0	3.0	67%	2.0
			1	There are revenue sources focusing for maintenance and management, but funds are not ready.				
			2	There are revenue sources focusing for maintenance and management, and necessary funds are ready.				
			3					
			4					
Large Item: Budget funding					2.0	3.7	58%	2.0
Bidding contract system	Cost estimation methods		0	Cost estimation standard of procurement of materials, machinery and labors are not established	5.0	5.0	100%	5.0
			1	Cost estimation standard of procurement of materials, machinery and labors are established but not used				
			2	Cost estimation standard of procurement of materials, machinery and labors are established but partially used				
			3	Cost estimation standard of procurement of materials, machinery and labors are established and used				
			4	Cost estimation standard of procurement of materials, machinery and labors are established, used and periodically revised				
	Bidding contract system		0	Bidding contract system of procurement of materials, machinery and labors are not established	5.0	5.0	100%	5.0
			1	Bidding contract system of procurement of materials, machinery and labors are established but not used				
			2	Bidding contract system of procurement of materials, machinery and labors are established but partially used				
			3	Bidding contract system of procurement of materials, machinery and labors are established and used				
			4	Bidding contact system of procurement of materials, machinery and labors are established, used and periodically revised				
Large Item: Bidding contract System					5.0	5.0	100%	5.0
System DB	DB related	Paving assets DB	0	No asset DB	4.0	5.0	80%	4.0
			1	Some of the assets are well-maintained as a paper base.				
			2	Assets are well-maintained as a paper base.				
			3	Assets are well-maintained as an electronic data.				
			4	Assets are well-maintained as an electronic data and can be shared.				
		Bridge assets DB	0	No asset DB	2.0	5.0	40%	2.0
			1	Some of the assets are well-maintained as a paper base.				
			2	Assets are well-maintained as a paper base.				
			3	Assets are well-maintained as an electronic data.				
			4	Assets are well-maintained as an electronic data and can be shared.				
	System related	Communication function	0	There is no plan of communications facility development between headquarters and local offices	2.0	5.0	40%	2.0
			1	There is a plan of communications facility development between headquarters and local offices				
			2	Development of communication facilities between Headquarters and office are now ongoing.				
			3	Communications facility development is well-maintained with no data sharing.				
			4	Communications facility development is well-maintained and data sharing is available.				
		Bridge management system	0	No system has been introduced.	1.0	5.0	20%	1.0
			1	The system has been introduced and partially operational				
			2	The system has been introduced and in operation.				
			3	The system has been operated, but needs updating.				
			4	The system has been operated, and been continuously updated.				
		Pavement management system	0	No system has been introduced.	3.0	5.0	60%	3.0
			1	The system has been introduced and partially operational				
			2	The system has been introduced and in operation.				
			3	The system has been operated, but needs updating.				
			4	The system has been operated, and been continuously updated.				
Large Item: System DB					2.4	5.0	48%	2.4
Total					**2.4**	**4.2**	**59%**	**2.6**
Development into the other region and field	Regional development		0	Road AM development has been remaining in its development in a specific area.	5.0	5.0	100%	5.0
			1	Road AM development has begun to develop to the surrounding area of the specific area.				
			2	Road AM development is being developed outside of a specific area.				
			3	Road AM development has been developed more than half of the regions.				
			4	Road AM development has been developed to all regions				
	Field development		0	Road AM development has been remained in the area where the technical cooperation project was conducted.	1.0	5.0	20%	1.0
			1					
			2	Road AM development has begun to develop to the surrounding area where technical cooperation project was conducted				
			3					
			4	Road AM development is progressing to other areas				

5.5.3 Road AM Performace Index (Middle Items)



Note: The Blue line in the figure is current status, and the Orange line is expected achievement of five years after the end of the technical project

Figure 5-7 Road AM Evaluation Index for AACRA (Middle Items)

【Inspection, Diagnosis and Repair Plan】

For pavement maintenance and repair supported by technical projects, various manuals are also developed, such as condition survey vehicles, and smartphones are introduced. It has come to the stage of practice and operation of PMS. At present, the technology transfer is aimed at the engineers of AACRA by education and training. Therefore, the score for pavement inspection, diagnosis, and repair planning has exceeded two points.

【Bridge Inspection, Diagnosis and Repair Plan】

In parallel with the maintenance of the inventory, we have just started periodic inspections. The various manuals are applied mutatis mutandis to the one of ERA, and there is intention to create an AACRA original. In order to maintain these bridges, BMS, which is operating in ERA, is proceeding with the introduction of AACRA. Therefore, the score of the inspection, diagnosis, and repair planning of bridges is below two points.

【Pavement Repair, Bridge Repair】

For cleaning, weeding, small repairs and pavement repair work, it is constructed by the directly operated construction department of AACRA and it exceeds two points. On the other hand, repair work of the bridge is less than two points because there is not enough experience.

【Recording Systems】

The inspection records of pavement are updated sequentially to PMS introduced in the technical project. The communication network of the regional office and the headquarters has just begun to consider its introduction. On the other hand, the record of the bridge has just started.

【Organization, Budget and Bidding System】

As for the organizational structure, there is a Road AM Department, and it is about 2/3 of the target size and 19 people are involved in the road. As for the budget, it is ten times more than two years ago, and the maintenance and repair of pavement is positively promoted. There is a top commitment on the

road, and progress reports are being made regularly such as meetings held every Friday. Also, C/P is excellent and actively promotes Road AM.

5.6 Extraction of challenges for Road AM Fixation

5.6.1 Challenges on Pavement Maintenance and Management

The AACRA management road extension is 6,000km. The daily inspection of the pavement is performed by the engineer of the regional office by visual inspection. For periodic inspections, we have performed IRI measurements and photography in the range of the main asphalt paved road (*Ring Road/PAS/SAS about 1, 900km or 18%) in a road inspection vehicle introduced in the technical project every year. In addition, there is a record of the damaged location kept in the smartphone (cracks, ruts, damage range, degree, location information). Pavement diagnosis and repair planning manuals will be provided by the technical project. There must be a medium-to long-term repair plan developed using PMS introduced in the technical project.

It is necessary to take measures in case of trouble in PMS. A troubleshooting handbook is needed to cope with small troubles. Some measures are necessary to cope with big troubles. In addition, it is necessary to prepare spare parts such as those for IRI instrument and cameras in case trouble occurs in the road surface property measurement equipment.

5.6.2 Challenges on Bridge Maintenance and Management

More than 1,000 bridges and culverts are being managed. In December 2017, a direct inspection (visual inspection) of less than 600 bridges began. The inspection manual of ERA has been applied mutatis mutandis, using scales, cameras and GPS. Records of each bridge and culvert are kept on a paper basis and integrated by management in Excel. Education concerning the inspection is carried out to other staff. The manual for repair, diagnosis and repair planning also applies to ERA.

During the procedure to adopt BMS of ERA in AACRA, the repair work of the bridge is carried out by the directly managed department. ERA manuals are intended for bridges in the provinces, and AACRA in urban areas are different depending on traffic conditions and environmental conditions and subsequently various manuals are requested to support the maintenance. In addition, technical assistance is required to implement large-scale and medium-scale repair work.

5.6.3 Challenges of Paving and Bridge Construction

The quality control and the safety management of the directly managed department are not good. AACRA has an asphalt plant and a crushing plant, but because of shortages the production capacity is low and is procured from the private sector. The construction equipment is old and breaks down often. We are currently requesting for JICA to renew its construction equipment. There is a movement to privatize the directly managed construction departments in the future. It is necessary to improve the proper quality, safety, and construction management ability in a narrow construction yard as in Addis Ababa City.

5.6.4 Others

The salary of government staff such as ERA and AACRA personnel is low and young talented engineers change jobs to the high paying private sector. If the engineer who was responsible for system development changed jobs, the technical tradition would be lost.

In the creation and revision of the manual and technical standards, we need the know-how of experienced and talented engineers but there is a shortage of human resources who are responsible for it and subsequently there is a need for measures to reduce the turnover rate, such as improved treatment.

5.7 Development of Support Measures for Road AM Fixation

5.7.1 Support Measures on Pavement Maintenance and Management

To establish a manual for paving inspection, repairs and repair plans introduced in the technical project, review the mid-term plan AACRA after the end of the technical project and update the PMS system. We will continue to support the dispatch of short-term specialists and consultants. It is effective to improve pavement maintenance and understanding of the PMS system through training by OJT education at Japanese universities, Pasco and expressway companies and by training by country.

Purchase of spare parts is encouraged to prepare for the malfunction of the road surface property measuring vehicles (IRI measuring instrument and camera). Moreover, because the specs on the PC which operates the PMS (memory 4GM) is low, the system often goes down and upgrades are necessary. In addition, we will conduct troubleshooting and other problem-solving training.

5.7.2 Support Measures for Bridge Maintenance and Management

In AACRA, an attempt is made to make a routine out of the creation and periodic inspection of the bridge ledger. It is effective to improve bridge maintenance and management capacity by implementing bridge technical projects, such as bridge inspections and repair planning manuals, which are applied mutatis mutandis to the road environment of AACRA, along with support for the introduction of BMS.

It is effective to promote quality control and safety management skills through OJT education, training by subject, and country training by inviting trainees to Japanese expressway administrators. In addition, since there are many improvement points about repairing technology of bridges, it is also effective to implement the repair work of the bridge and to transfer the technology by pilot projects etc.

5.7.3 Support Measures

In order to foster human resources for future technicians and private engineers, we will promote cooperation between Japanese universities and Addis Ababa universities to support Road AM initiatives such as opening joint courses on Road AM. In addition, it is also effective to send C/P and other candidates to Japanese universities as international students. It is necessary to improve the treatment such as guaranteeing the salary at the same level as the private sector, although the salary improvement seems to have been done recently in AACRA so that talented young engineers do not change jobs. In OJT education in Japan, the training facilities of the expressway company and the training curriculum are used to participate in about three to five months of training, aiming at acquisitions in both the field and the classroom. At the end of this training, a simple version of the Inspection and Diagnosis Qualification Test (Inspection and Diagnosis Qualification Test of the expressway) can be taken, and the examination qualification is given to the passing person.

5.7.4 Contents of Research at Japanese Universities

In Ethiopia, maintenance and management of pavement and bridges has progressed to some degree, but in order to continue, further improvements in maintenance capacity and more Road AM efforts are necessary. Therefore, it is considered necessary for Japanese universities to work on the contents of the research shown below.

Table 5-18 Research Programs at Japanese Universities (Draft)

Challenges	Research Program
Pavement Maintenance and Quality Improvement	Study on effective pavement repair design method considering existing pavement structure and strength
	Study on construction methods of pavement repair considering long-term durability
	Study on long-term durability of pavement materials
	Study on efficient and effective methods of recycling pavement materials

Challenges	Research Program
	Study on pavement and embankment structures; Development of diagnostic automation technology
Improvement of Bridge Maintenance and Repair Technology	Study on deterioration diagnosis technology of steel bridges and concrete structures
	Study on utilization and analysis of bridge damage data
	Study on health Performance of bridges
	Study on preventive maintenance method of bridges considering reliability and risk
	Study on the setting and the standard of the performance level which should be given to the bridge
Road AM Capability Increase	Bridge Maintenance Integrated Database System
	Development of the road infrastructure management cycle and general research aimed at domestic and overseas implementation
	Implementation by ME Network of desired SIP maintenance management methods
	Research and development of social implementation of innovative advanced technology for infrastructure maintenance management

Chap. 6 Initiatives on Road Asset Management in Japan

6.1 Subjects of the Survey

This chapter marshals the efforts for the establishment of Road AM by road administrators such as the Ministry of Land, Infrastructure, Transport and Tourism, domestic local governments and expressway companies; overview of exchange of opinions conducted with related parties regarding introduced technologies and the like; and the efforts and technologies that will be helpful in developing countries. In addition, it marshals the current condition of research and development technologies at universities, research institutions and private companies as well as the status of development technologies expected to be used in developing countries through possessed technologies and the like.

6.2 Outline of Results

The outline of the survey results on each of the road administrators, universities, research institutions, private companies and the like is as listed below. The survey results are summarized in a table in this chapter, as well as the outline of each activity, the applicability and useful technology of the local governments and developing countries is described herein.

Table 6-1 List of Survey Results

No.	Institution / Company	Title of Reserch / Outline of Initiatives	Applicability and Effective Technology to Local Governments and Developing Countries	Technology Field(s)					Field(s) Applied				
				Inspection / Diagnosis	Material Repair / Reinforcement	Information Communication	Robots	Road AM	Pavements	Earthwork & Slopes	Concrete Structure	Bridges	Others
	■Cutting-edge initiatives by expressway companies												
1	East Nippon Expressway Company Limited	Advancement of expressway asset management through ICT utilization and mechanization	[Recording efficiency improvement] → Central management of various data such as construction-related documents, inspection and repair history, etc.	○		○		○	○		○	○	
2	Metropolitan Expressway Company Limited	Infrastructure maintenance management and society implementation of disaster prevention system using advanced technology (i-DREAMs)	[Recording efficiency improvement] → Central management of various data such as construction-related documents, inspection and repair history, etc.	○		○		○	○		○	○	
3	Metropolitan Expressway Company Limited	Maintenance management support system using GIS and 3D point cloud data (InfraDoctor)	[Recording efficiency improvement] → Central management of various data such as construction-related documents, inspection and repair history, etc.	○		○		○	○		○	○	
4	Metropolitan Expressway Company Limited	Patrol inspection system using high-performance drive recorder (InfrastructurePatrol)	[Inspection efficiency improvement] → Link with road surface condition grasping, position information by image processing etc.	○		○			○				
5	West Nippon Expressway Engineering Shikoku Company Limited	Road surface survey with a small vehicle adopting a simple system (SmartEagle)	[Inspection efficiency improvement] → Link with road surface condition grasping, position information by image processing etc.	○		○			○				
6	Shutoko Engineering Company Limited	Structural inspection equipment in high places and/or narrow areas	[Inspection efficiency improvement] → Inspection technology using robots and/or drones	○			○				○	○	
7	Shutoko Engineering Company Limited	Lateral-tightening PC grout filling investigation with elastic wave method	[Inspection efficiency improvement] → Inspection technology using robots and/or drones	○			○				○	○	
	■Initiatives on National Roads, Prefectures and Municipalities												
8	Yokohama National Road Office/ Kanto Regional Development Bureau / MLIT	Approach to Road Maintenance Meeting, etc.	[Technical support] → Road Maintenance Meeting with each Regional Development Bureau office, and with Prefectures and Municipalities					○					○
9	Local governments	Summarization of results on questionnaire to local governments	[Questionnaire results] → "Efficiency and Cost Reduction utilizing Systems", "Technical collaboration with Local universities"					○					○
	■Trends in research and development of technologies and systems at universities and research institutes												
10	National Institute for Land and Infrastructure Management / MLIT	Maintenance and utilization of road space data	[Road management] →Road management technology utilizing road space data			○			○				○
11	National Institute for Land and Infrastructure Management / MLIT	Improvement of road management support system using road base map information	[Recording efficiency improvement] →Central management of inspection data using database			○		○	○				○
12	National Institute of Public Works Research Institute	Clinical research using removed bridges	[Inspection diagnosis]→Strength evaluation technology according to the damage situation of the existing bridges	○							○	○	
13	National Institute of Public Works Research Institute	Development and introduction of bridge management system	[Recording efficiency improvement] →Central management of inspection data using database			○		○			○	○	
14	Tokyo University / Associate Prof. Nagai	Approach of Niigata City Bridge Asset Management Review Committee	[Technical support] →Committee activities including academic experts					○					
15	Gifu University / Prof. Kunieda, et al	Infra-Museum as Technical Educator	[Training facilities] → Mechanism of structured objects, and full-scale model that shows the structure(s)					○	○	○	○	○	
16	Gifu University / Prof. Rokugo, et al	Efficiency and advancement of bridge regular inspection by robot technology and greatly shortening traffic regulation	[Inspection efficiency improvement] → Inspection technology using robots and/or drones	○			○	○				○	
17	Tohoku University / Prof. Hisada	Construction of bridge maintenance integrated database system and introduction support to local governments by industry-academia-government collaboration	[Recording efficiency improvement] →Central management of inspection data using database					○					○
	■Development trend of inspection and maintenance technology etc. which are implementable overseas by private companies												
18	TRION Corporation	Road around view information - All Around Aroad View Information (CV-RAVI)	[Recording efficiency improvement] →Central management of inspection data using database			○		○					○
19	TSUTAI	Hammering inspection system (T.T.Car)	[Inspection efficiency improvement] → Inspection technology using robots and/or drones	○					○		○	○	
20	Institute of Systems Planning Co., LTD. / ISP	Crack detection engine with AI / Deep Learning	[Inspection efficiency improvement] → Link with road surface condition grasping, position information by image processing etc.	○							○	○	
21	NIPPON ENGINEERING CONSULTANTS CO.,LTD.	Multicopter for bridge inspection (MARCO)	[Inspection efficiency improvement] → Inspection technology using robots and/or drones	○			○				○	○	
22	Toshiba Infrastracture Systems and Solutions C	Road pavement crack analysis service	[Inspection efficiency improvement] → Link with road surface condition grasping, position information by image processing etc.	○		○			○				
23	KURABO INDUSTRIES LTD.	Road surface inspection compact-unit - PG-4	[Inspection efficiency improvement] → Link with road surface condition grasping, position information by image processing etc.	○		○			○				
24	NICHIREKI Co., Ltd.	*Romencatcher* VPW	[Inspection efficiency improvement] → Link with road surface condition grasping, position information by image processing, accelerometer etc.	○		○			○				
25	Asia Air Survey Co.,Ltd.	Road surface profile measurement system (Road Profiling System)	[Inspection efficiency improvement] → Link with road surface condition grasping, position information by image processing etc.	○		○			○				
26	FUJIFILM Holdings Corporation	Social infrastructure imaging diadnosis service (*HIBIMIKKE*)	[Inspection efficiency improvement] → Inspection technology using image processing etc.	○		○					○	○	
27	JIP Techno Science Corporation	Road surface inspection system using Smartphone（DRiMS）	[Inspection efficiency improvement] → Link with road surface condition grasping, position information by accelerometer and others	○		○		○	○				
28	Sumitomo Mitsui Construction Co., Ltd.	Bridge-inspection robbot camera	[Inspection efficiency improvement] → Inspection technology using robots and/or drones	○		○					○	○	
29	IKEE Co., Ltd.	"Spread and Verification regarding Manufacturing of Cold Patch (Excel) and Daily Road Maintenance Management Operation" (Cambodia)	[Example of overseas development] → Pavement repair with cold patch, other activities to partner countries		○				○				
	■Initiatives on establishment of Road AM by Local Governments and universities												
30	Gifu university	Maintenance Expert System	[Human resource development] → Human resource development and technology certification system closely linked to the areas					○					○
31	Nagasaki university	*Michimori* System	[Human resource development] → Human resource development and technology certification system closely linked to local areas					○					○
32	Tohoku university	Approach to Tohoku Iafrastructure Management Platform	[Technology sharing] → Mechanism to share know-how in collaboration with industry, academia and government					○					○
33	Nihon University	Establishment and Practice of "Bridge self-maintenance; Fukushima Model"	[Inspection efficiency improvement] →Systematization of daily bridge inspection in cooperation with the local governments, residents and students	○					○		○	○	
	■Initiatives on road maintenance and control by private companies												
34	Shiraito Highland Way / GAEART Corporation	Maintenance and operation of toll roads and acquisition of ISO 55001 by road pavement companies	[Asset management] → Maintenance management method according to the service levels					○	○				○
35	Hakone Turnpike / Central Nippon Expressway Company Limited	Maintenance and operation of toll roads by expressway related companies	[Asset management] → Maintenance management method according to the service levels					○	○				○

6.3 Cutting-edge Initiatives by Expressway Companies

The expressway companies have a history of organizationally and systematically having worked on the maintenance of road infrastructure for over 50 years. However, in order to cope with the future aging of road infrastructure as well as the shortage of human resources (engineers) due to the decline of the working age population in Japan, it has been necessary to produce another maintenance system that is more efficient by technological development and the like, thus an integrated maintenance management system is being built by utilizing ICT technology and mechanization.

East Nippon Expressway Co., Ltd. (hereinafter referred to as “NEXCO East”) announced the Smart

Maintenance Highway (SMH) concept in July 2013, and upgraded the project level from "Concept" to "Basic plan" in May 2014, which includes five themes concerning a series of maintenance management operation flow (① Infrastructure monitoring and efficiency of on-site work utilizing ICT; ② Advancement of analysis and Performance by construction of next-generation RIM; ③Advancement of asset management consistent with operation processes; ④Establishment of the SMH operation process by improving the work load on the actual sites; and ⑤Construction technology development and procurement method of renewal and repair work) as well as specific challenges to be solved regarding 11 items related to the themes.

The contents of technological development in the SMH project are roughly divided into (1) Inspection-operation Related Technology and (2) Repair-planning Related Technology. The basic technology of "Next generation RIMS (Road maintenance Information Management System)," which is the key to Repair-planning Related Technology, is in its development under the cross-ministerial Strategic Innovation Program (SIP) promoted by the Cabinet Office. It is premised that the data structures and Application Program Interface (hereinafter referred to as "API") standards are standardized so that the results can be used by other road administrators such as local governments. This technology has not only been deployed to Central Nippon Expressway Co., Ltd. (hereinafter referred to as "NEXCO Central") and West Nippon Expressway Co., Ltd. (hereinafter referred to as "NEXCO West"), but has already been implemented for a bridge DB in Yamagata Prefecture, and further implementation expansion is underway.

i-DREAMS (intelligence-Dynamic Revolution for Asset Management System) of the Metropolitan Expressway Co., Ltd, is a smart infrastructure management system that achieves sustainable infrastructure by improving maintenance productivity. Its vision has been defined and its development and implementation have advanced well so far.

i-DREAMS is a system that enables management of road infrastructure throughout its life cycle from survey and design, construction to maintenance, and management, repair and reinforcement with a digital data management system (InfraDoctor) using GIS as the core. It is utilized for actual road infrastructure maintenance management at each Metropolitan Expressway.

The InfraDoctor, which is the core technology of i-DREAMS, integrates and manages various ledgers (structure ledger, construction-related documents, inspection and repair ledgers and the like) necessary for maintenance management on the GIS platform, and it is a system that greatly improves maintenance productivity by acquiring and using 3D point cloud data with MMS (Mobil Mapping System).

The InfraDoctor has been used by several road administrators such as Fukuoka-Kitakyushu Expressway Public Corporation, Nagoya Expressway Public Corporation, Odawara City and the like. In addition, developments are being promoted abroad, such as measurement and collection of 3D point cloud data being conducted by Thailand Highway Public Corporation in the Kingdom of Thailand and the like.

6.4 National Roads, and Initiatives of Prefectures and Municipalities

6.4.1 National Roads (Yokohama National Road Office / Kanto Regional Development Bureau /MLIT)

(1) Initiatives of Kanagawa Prefecture Road Maintenance Meeting

The Ministry of Land, Infrastructure, Transport and Tourism has established a "Road Maintenance Meeting" on a prefecture-by-prefecture basis and has been maintaining technical standards for maintenance and repair such as periodic inspection guidelines, support systems for the approaches taken by local governments and more.

The Kanagawa Prefecture Road Maintenance Meeting has been held at a pace of one to two times every year since 2014, in which some highway companies, Kanagawa Prefecture, each municipality all meet at once with the Yokohama National Highway Office as a secretary. According to the 2017 data, various efforts have been made to achieve sustainable maintenance with limited budget and limited human resources.

(2) Discussion Meeting

A discussion meeting with the following subjects was held with the Road Management Division 2, which is the department in charge of maintenance in the Yokohama National Highway Office.

The management length is 263.1 km in total including 384 bridges (124 for PC, 74 for RC and 86 for metals), with 163 pedestrian crossings, 25 tunnels and 50.3 km for common ditches and the like.

The budget is 1,740 million yen for maintenance expenses such as patrol and cleaning, and another 2,397 million yen for repair expenses such as inspection and mending. The budget tends to shrink year after year.

Daily maintenance has been implemented based on the Road Maintenance Plan Report.

As specific measures for maintenance, cleaning activities by volunteer support programs and LED lighting of roads are implemented. In addition, the cost of repairs has been reduced by preventive maintenance.

As for the pavement, inspection by pavement inspection cars was carried out before, however, visual inspection by the direct management system is carried out most recently and some cost reduction has been achieved by carrying out more detailed maintenance and repair.

6.4.2 Questionnaires to Local Governments

A questionnaire (see next page) was conducted on the current situation and challenges concerning road maintenance and management. The questionnaire results list is attached at the end of this Report, through the University of Tokyo (Associate Professor Nagai), Tohoku University (Professor Hisada), Gifu University (Emeritus Professor Rokugo) and Nagasaki University (Professor Matsuda), all of which are collaborating with regional governments and local governments.

For [Question 1], answers were received from 25 municipalities. As for [Question 2], the average management length was approximately 1,100 km, and the maximum was approximately 5,700 km in Niigata City. As for [Question 3], there were many opinions such as “budget shortage,” “lack of knowledge and experience regarding bridges” as other written answers. For [Question 4], as preferred case(s); [Cost reduction] direct management inspection on short bridges, comprehensive ordering and outsourcing in the local areas; [Efficiency] use of database and/or tablet terminals; [Human resources development] while receiving supports from the country and/or prefecture, the staff members are searching for the challenges that they can tackle by themselves to take initiative.

Moreover, the checked items for the challenges encountered in [Question 3] are graphed as below;

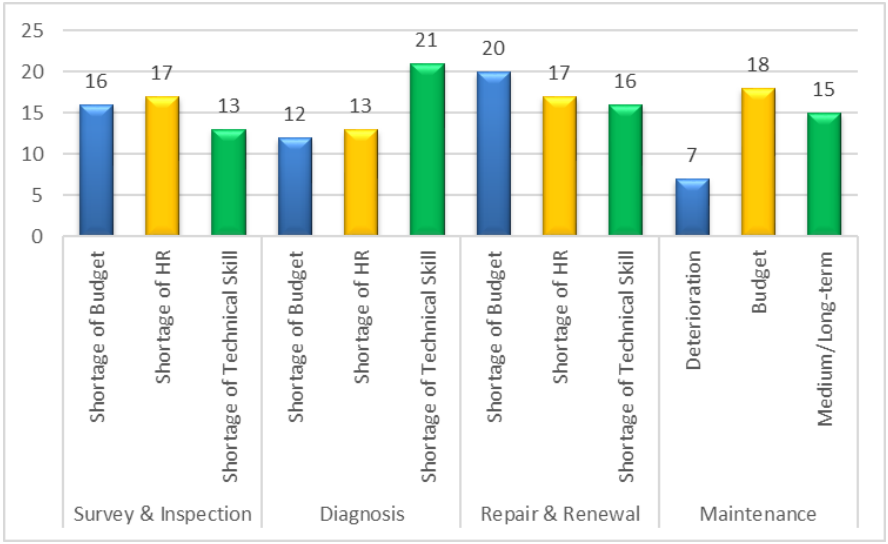


Figure 6-1 Questionnaire Survey; Challenges in [Question 3]

Domestic Trend Survey: Questionnaire on Road Asset Management Technology [*Local Government*]

ENTRY EXAMPLE

【Question 2】Please indicate your objects for maintenance (Total length and/or cardinalities; if possible, as far as they have been aggregated.)

☐Pavements 100 km

☐Bridges Concrete bridges: 20, Steel bridges: 10, Other specialized bridges: 5

☐Culvert Boxes 30 units

☐Tunnels 2 points, X 2km

【Question 3】Please mark check-boxes below, regarding your current challenges in implementation of maintenance and management (Multiple answers allowed).

1）Survey & Inspection Technology; ☐Shortage of budget ☐Shortage of human resources ☑Shortage of Technical skill ☐Others( )

2) Diagnostic Technology; ☐Shortage of budget ☑Shortage of human resources ☑Shortage of Technical skill ☐Others( )

3）Repair & Renewal Technology; ☑Shortage of budget ☑Shortage of human resources ☑Shortage of Technical skill ☐Others( )

4)Maintenance Management(s)

☐Grasping the aging situation ☑Grasping the costs required for maintenance and renewal ☑Formulation of medium/long-term maintenance & repair plans ☐Others( )

5)Others (Any comments concerning 1) – 4) above, or free opinions and the like, if any.)

→ Although there are some supports from the Directly Controlled National Roads, it is often difficult to grasp the budget due to lack of human resources and knowledge about maintenance and management.

【Question 4】Are there any technologies or initiatives that seem to be helping (or seem to help) streamline maintenance and management, among the techniques, methods, and systems related to maintenance and management that are currently applied (or supposed be applied i n the future), such as specific measures under the situation where budgets, human resources and technical skills are lacking, as a reaction to the task answered in【Question 3】?

→ With no budget, we have a medium /long-term maintenance plan, and the operations such as survey and inspection have been actually implemented; The shortage of human resources is supplemented by outsourcing system.

→ We use XXX technology to save labor power or personnel for inspections.

→ We introduce XXX System to plan efficiencyof marshaling and/or utilization of the checked results.

→ Making full use of XXX Technology,we are trying to extend the life of the bridge s.

End.

6.5 Trends in Research and Development on Technology and Systems at Universities and Research Institutions

6.5.1 National Institute for Land and Infrastructure Management / MLIT

The National Institute for Land and Infrastructure Management (hereinafter referred to as "NILIM") of the Ministry of Land, Infrastructure, Transport and Tourism launched the Research Center for Social Infrastructure Management in April 2016. The research target of the center consists of a wide range of fields, focusing on cross-sectoral and common matters, and it mainly conducts researches on the following items:

- ✓ Ideal way for a cross-sectional construction production system for social capital implementation and maintenance
- ✓ Cross-sectional productivity improvement of construction sites for social capital implementation and maintenance
- ✓ Ideal way for an information infrastructure to support social capital implementation and maintenance
- ✓ Advancement of policy and project Performance as well as stock effect performance of the implementation of social capital

As for the research related to road asset management, the Social Capital Information Infrastructure Laboratory of the center continuously conducts research aimed at upgrading and improving the efficiency of maintenance and management, which contributes to an efficient road management operation in both central and local governments.

6.5.2 Public Works Research Institute

The Public Works Research Institute launched, in April 2008, the Center for Advanced Engineering Structural Assessment and Research (hereinafter referred to as "CAESAR"), a comprehensive research organization regarding structural technologies for safety management of the roads and bridges including design and construction of bridges, advancement of maintenance and management technology, prolongation of life, cost reduction, quick recovery from disasters and the like.

CAESAR's activities include ①technical support to governmental agencies, ②research to avoid becoming "Destroyed Japan," ③research intended to prevent Japan from turning into a "Disaster-vulnerable Nation," ④sharing of standardization, normalization and the cases, ⑤management of the relation between information dissemination and technological development and ⑥ international information collection and cooperation, all of which gather various information on structure maintenance and management technology. In particular, a set of exhaustive information on the maintenance of road bridges has been collected in ④sharing of standardization, normalization and the cases, in which a large number of related documents have been released to the public, which will be criteria in time of inspections, surveys, repairs and reinforcement of road bridges that are carried out by Regional Development Bureaus and local governments.

In addition, for the purpose of promoting the development of planned maintenance technology and the development of maintenance technology related to safety management, CAESAR is conducting "clinical research." which is research, or an investigation performed using real bridges. The range of deterioration and damage or deformation of the existing bridges is so diverse that it is important to investigate and do research on the actual bridges. In cooperation with NILIN and in partnership with the Regional Development Bureaus and local governments, observation of the progress of deterioration and damage by sensors installed on each bridge, collection and investigation of removed bridge members or the like are conducted. The latest findings obtained are fed back to technical support for the Regional Development Bureaus and local governments.

Furthermore, as research related to road asset management, research on development and introduction of the Bridge Management System (BMS) is in progress, among which the function of performing fatigue deterioration prediction of floor slabs is utilized especially not only as corrective maintenance but also as preventive maintenance and although there are budget constraints, this research

has contributed to the planned implementations.

6.5.3 The University of Tokyo / Associate Professor Nagai

The activities of the Niigata City Bridge Asset Management Review Committee are focused on the approaches promoted by Associate Professor Nagai and his co-researchers in the University of Tokyo. The objective of the committee is to receive and reflect a wide range of specialized opinions on challenges such as "comprehensive ordering, and securing new personnel," "cost, organization and the system of life-expansion and a repairing plan." Moreover, at the implementation stage as well, they receive opinions on implementation status to provide improvements necessary to them. Summarily, the committee, including academic experts, has been set up with the aim of maintenance with a sharp and flexible strategy and with the support of the Japan Society of Civil Engineers; "Review Working Group on Contracts" and "Review Working Group on Bridge Maintenance Management" have been launched and are functioning as their review operations. Committee meetings have been held five times so far.

6.5.4 Gifu University / Professor Kunieda, et al.

One of the approaches of Professor Kunieda and others of Gifu University is that they have implemented within the University a facility in which actual structures can be seen and touched for training. Gifu University's SIP Implementation Project has adopted the theme "Infrastructure maintenance management, renewal and management technology," and is involved in SIP and the Infrastructure Management Research Center attached to the Faculty of Engineering. "Infra-Museum," in which the mechanism and structure of civil engineering structures can be learned, has been maintained inside the university. Furthermore, the main outcome is that a tunnel cross-section model, a PC bridge model, a steel girder model and an embankment model are organized there, and these models are intended to be utilized as a place of learning linked to the academic curriculum.

6.5.5 Gifu University / Professor Rokugo, et al.

Professor Rokugo of Gifu University and others are carrying out, as their approach, a mounting experiment aimed at the efficiency and advancement of periodic bridge inspections by robot technology. The outline of the project is to incorporate robot technology into periodic inspections of Kakamigahara Bridge, including approaches such as "Creation of a Bridge Inspection Guide (Draft)," "Presentation of Required Performance for Robot Technology and Performance," "Illustration of Optimal Combination of Robot Technology" and the like. As a result, in April 2018 they released "Guideline for Inspecting Bridges with Robot Technology (Draft)," which is for local governments.

6.5.6 Tohoku University / Professor Hisada

The approaches of Professor Hisada and others at Tohoku University is the establishment of an integrated database system for bridge maintenance and supporting activities for local governments. The outline is that the simplified version of the database developed by SIP can be utilized and one customized to Yamagata prefecture specifications can be introduced and operated. As a result, the introduction of a database will make it possible to streamline evaluations and/or diagnoses for future aging measures expected in the future, repair and budget planning can be optimized and more effective systems will be provided to local governments with many managed bridges.

6.6 Trends in Development of Overseas-installable Inspection and Repair Technologies and the like possessed by Private Companies

Various developments in technology development and repair technology that contribute to inspection-efficiency can be mainly found in private companies' initiatives.

Regarding technologies that contribute to the improvement of inspection efficiency, there are various

inspection/diagnostic techniques utilizing technologies such as ICT and image processing, and there are also several techniques that can collect road surface condition data while traveling at normal speeds to record them with position information. Typical technologies such as "DRIMS" (JIP Techno Science Corporation) have already reached quite a few achievements in local governments and overseas (such as Kenya, Cambodia and others). Moreover, regarding inspection technology using robots and drones or the like, there are various technologies that are bound to be implemented overseas such as "Bridge Inspection Robot Camera" (Sumitomo Mitsui Construction Co., Ltd.) that was used in the field test conducted by the SIP Regional Implementation Support Team.

As to repair technology, IKEE Co., Ltd. has expanded cold patches in Cambodia since 2013, which are light and easy to install, installable and durable even in the rainy season and easy to manufacture in local areas as well. Taking advantage of this expansion, the company has developed asphalt plants locally and has also developed technologies for similar pavement repair works and new road construction.

6.7 Initiatives for Fixation of Road AM by Local Governments and Universities

6.7.1 Gifu University

Gifu University has established a system to train maintenance experts who can appropriately diagnose and treat existing infrastructure facilities. The outline is that they have been conducting four-week long qualification courses since 2008, targeting adults who are involved in any maintenance and management of social infrastructure. As a result, the number of successful applicants reached 412 in 2017. The "ME Association," a knowledgeable human network of certified maintenance experts, divides Gifu Prefecture into five regional groups and conducts activities rooted in those regions.

6.7.2 Nagasaki University

At Nagasaki University, they are establishing a system to maintain and manage the infrastructure and foster related human resources in cooperation with Nagasaki Prefecture, local companies, local governments, retirees from each OB and general citizens. The outline is to divide the human resources into four groups: human resources who can maintain and manage the entire road and develop advanced technologies; human resources capable of inspection planning and diagnosis; human resources capable of inspections; and human resource who will be assistants. As a result, monitoring systems and human resources development of "roads and bridges" rooted in each area are carried out by 769 people in total (31 *Michimoris*, 63 designated *Michimoris*, 260 assistant *Michimoris* and 415 sub *Michimoris*) as of February 2018.

6.7.3 Tohoku University

Tohoku University established the "Tohoku Infra-Management Platform" in collaboration with the related public organizations of six prefectures, private companies and universities in Tohoku District. The outline is establishment of platforms, improvement and social implementation of the information basis, social implementation support of results, establishment of framework for human resources and the like. As a result, various programs are conducted such as "Cooperation with 18 Organizations of 6 prefectures," "Introduction of Local-governmental Supporting Database System into Yamagata Prefecture and Miyagi Prefecture," "Demonstration Experiments regarding Bridge Inspection Using Drones," "Study Sessions for Municipalities" and the like.

6.7.4 Nihon University

Nihon University established and practices the "Fukushima Model: Bridge Self-maintenance," led mainly by the Concrete Engineering Laboratory in the Department of Civil Engineering in the Faculty of Engineering. Developed by the collaboration of the residents and students in the towns and villages

of Fukushima Prefecture in regards to road construction, the cleaning of bridges and the implementation of daily inspections among other things, the activity circle has spread not only through Fukushima prefecture but also to local governments and their residents as well as students all over the country. As a result, the "Bridge-inspection Simple Check Sheet" has been created, which is a kind of tool that anyone can report on daily inspections and emergencies and others.

6.8 Approaches in Road Maintenance Management by Private Companies

6.8.1 Approaches on Shiraito Highland Way

Shiraito Highland Way (hereinafter referred to as "this Road") is a 10.0-km-long general expressway (*road stipulation according to the Road Transport Act) located in Karuizawa-machi, Kitasaku-gun of Nagano Prefecture. It is a so-called "Tourism Toll Road," which comprises 2 lanes with a width of 3.5m, registered as Type 3 and Grade 5.

This Road was put into service in 1963 and was operated and managed by a local bus operator, KUSAKARU-KOTSU, Incorporated. In 2011 it was acquired by GAEART Co., Ltd., a road pavement company, and it has been operated and managed by its subsidiary Shiraito Highland Way Co., Ltd.

This Road not only functioned as an access road to "Shiraito Falls" where more than 1 million tourists visit every year, but also as a sightseeing route from the ancient Karuizawa area to the Kusatsu hot spring area and Kita Karuizawa and functions as an essential life road for nearby residents. In fiscal 2017, the annual traffic volume was approximately 277,000 units and the annual toll revenue was approximately 120 million yen.

At the time when GAEART acquired this Road, it had already been 50 years since its service began but it was hardly maintained at that time and even the newest asphalt pavement area on this Road had been in use for already more than 20 years. Apart from the repair history, there were no ledgers organized and there were no procedure documents or maintenance procedures. At first, therefore, they started to organize specifications and procedures, conducted every kind of survey and general inspection and created a ledger to establish a system of patrol and maintenance. Even though it has achieved certain results, they considered that it must be necessary to have a management method for stable operation over a long period of time and to optimize life cycle costs and thus they obtained ISO 55001 Certification, a road maintenance management system suitable for the region.

In order to construct this management system, initially, regional collaborative workshops were held with stakeholders such as Karuizawa-machi, the Tourism Association and nearby residents so that service levels were set and indexed. Goals were thereafter developed from the functional development of needs and risk assessment; the management cycle of the entire organization functioned well enough and further improvement was continued to create an operation image for overall optimization. The following efforts are currently underway to establish the management cycle identified:

1) An inspection qualification is obtained so that employees will be able to carry out periodic inspections themselves; employee education on inspection courses related to legal aspects is also carried out.

→Employees are not necessarily engineers, but if there is any trouble, utilization of experts such as NPOs will be taken into consideration.

2) The contents and distribution of inspection and repair work are visualized and information on target management is shared.

→Inspection/repair data is input from the iPad or similar device (utilizing i-Reporter), and data accumulation is thoroughly implemented; a cycle of seeing trends is established every month (monthly meetings of all employees participating shall be conducted), and the meaning of data acquisition and its usage are disseminated to all employees.

3) Pavement is visualized, and the renewal plan is reflected.

→The repair history of pavement renewal operations, patching of potholes and the like, as well as the

value of performance indexes such as IRI are marshaled by kilo-post; they are reflected in the overall judgment such as the priority of the renewal plan.

4) Crisis management ability is improved.
→Manuals are organized for initial response to nonconforming events such as road surface collapse due to landslides or similar events, so that an early recovery can be achieved through prompt information provision and prompt response in the event of a disaster.

As a result of these efforts, although it is a small-scale organization with 4 employees or less for the head office organization, including the president, and 6 employees (including 3 part-time workers) for cyclic inspection/maintenance and charge collection services, a profit ratio of over 8% was secured in fiscal 2017, and the business is remarkably stable.

6.8.2 Approaches by Hakone Turnpike

Hakone Turnpike (hereinafter referred to as "this Road") is a 15.8-km-long general expressway (*road stipulated on the Road Transport Act) located between Odawara City and Yugawara-machi, Kanagawa Prefecture. It is a so-called "Tourism Toll Road," which comprises 2 lanes with the width of 3.5m, registered as Type 3 and Grade 4.

This road was first constructed by TOKYU CORPORATION. It started being used in 1965 and the road administration itself had been operated and maintained by Tokyu Turnpike Co., Ltd., but the company was in deficit operation for a long time. In March 2004, this Road was thereafter acquired by Macquarie Group, an Australian investment company, and started to be implemented as Hakone Turnpike Co., Ltd. This Road turned began operating at a surplus due to significant cost reductions such as maintenance and management expenses. In April 2014, NEXCO Central Nippon Investment, LCC acquired Hakone Turnpike Co., Ltd., and the road has remained in surplus until today.

This Road possesses a locational strength, which is within 100 km from the center of Metropolitan Tokyo and is a gateway to Hakone and a transit point to the Izu direction at the same time and this Road also serves as a detour to avoid chronic congestion on the coastline. On this Road, the annual traffic volume is approximately 560,000 units and there is almost no large vehicle traffic (approximately 200 units/year). On the other hand, there is quite a high traffic volume for motorcycles (approximately 170,000 units/year). The annual toll revenue of this road is approximately 240 million yen, and annual other revenue is approximately 85 million yen (fiscal 2016); it is characteristic that the ratio of annual other revenue to the annual total revenue is very high, which is equivalent to 26%. The annual other revenue includes Sky Lounge income, event revenue from road occupancy (conducted three to four times a year), the naming right (currently ANEST IWATA Corporation), photography fee income, nighttime use revenue and the like.

97% of the toll income is returned to shareholders, while 3 is the share of Hakone Turnpike. 100% of the income from other income is for the shareholders of Hakone Turnpike Co., Ltd.

Hakone Turnpike Co., Ltd. does not adopt the method of Road AM in accordance with ISO 55001, but is directly connected to some parts preferentially relative to safety and security within the determined budget range based on the experience of its parent company, NEXCO Central. In particular, seismic reinforcement operations are currently underway for the four bridges connected to this Road, and countermeasures for the main bridge will be completed in 2021.

The company is managed with an organization of 14 full-time employees (including one dispatched employee from NEXCO Central) and 14 contract employees. The civil engineering system is controlled only with two people in total: one is the president and the other the dispatched employee from NEXCO Central. As with the case of Shiraito Highland Way mentioned above, training employees to be multi-skilled makes it possible to achieve significant cost reductions by carrying out daily maintenance and management almost directly. As for road inspection, it is outsourced to NEXCO Central Technical Marketing Company Limited once a year. Moreover, cooperation with its parent company, NEXCO Central, can often be found such as the opportunity where this Road is used for calibration of the road surface measurement vehicles of Central Nippon Highway Engineering Tokyo Company Limited.

Furthermore, this road is covered by civil engineering insurance (covering up to 200 million yen) for disaster response such as slope collapse and the like by heavy rains. Therefore, no internal reserves or similar funds have been provided for it. Moreover, because of many trees being alongside the roads, falling branches are often found on this road. However, it will be covered with the insurance also in these such cases on this road.

Chap. 7 Review of Issue-specific Training and Special Program for Long-term Training for Road AM

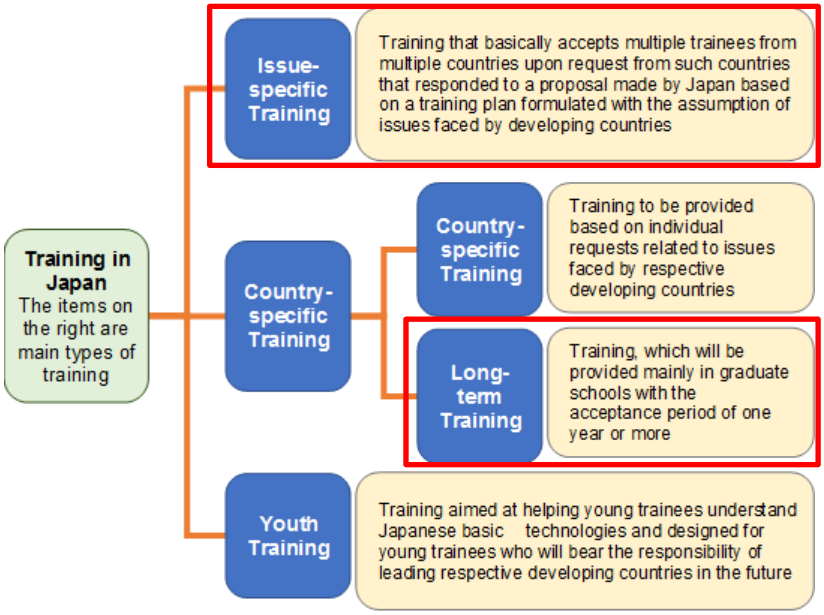
7.1 Survey Contents

Issue-specific Training is designed to be carried out as a continuous human resources development method in any country in the world (including the target countries) from Fiscal Year 2019. Countries in which more than one training course is planned to be carried out have been grouped based on the request survey results in consideration of the technology level of each country. Setting the training duration for about three to four weeks, JICA reviewed the training curriculum for improving the knowledge and skills on how to use the inspection data.

7.2 Trainee Acceptance Project and the Position of the Review Program

7.2.1 Outline of the Trainee Acceptance Project

The Trainee Acceptance Project is mainly held at work sites in Japan and is one of the technical projects of Japan that helps developing countries solve various challenges. The project has been developed with support from various levels within Japan since its inception as the first project of Japan's official development assistance in 1954, with the annual participation of about 10,000 leaders who will play a role in nation building efforts in their developing countries. Main types of training include **Issue-specific Training** that is carried out with the participation of multiple countries, and **Country-specific Training** that is provided to a specific country. Issue-specific Training is what will be proposed to developing countries based on the formulation of a training plan corresponding to the issues in those countries on the Japanese side. The target countries for each training program will be selected from the developing countries that made a request in response to the proposal from Japan. On the other hand, the Country-specific Training is that for which, as it were, a "tailored" training plan will be formulated and implemented based on the individual and specific request of the relevant developing country. There is also **Youth Training**, designed for youth trainees who will bear the responsibility of leading respective developing countries in the future, which offers them basic training to understand Japanese technologies and knowledge in various sectors.



Source: JICA Study Team Prepared from the JICA Website

Figure 7-1 Diagram of the Training Programs in Japan

7.2.2 Outline of Issue-specific Training

For Issue-specific Training, over 400 programs are planned and carried out annually which cover a broad range of sectors. There is almost no other project comparable to the practical trainee acceptance project of this size, which characterizes Japan's international cooperation.

JICA assesses and reviews the implementation periods of the respective Issue-specific Training programs every fiscal year and determines every three years whether a given program should be continued, renewed or abolished. If it is deemed necessary to renew the program the program can and will be renewed. For programs that will be renewed or newly launched, JICA reviews the program in the year two fiscal years prior to the year of its implementation, and, for programs that implementation is deemed valid, JICA determines whether it will be implemented after hearing from the side of the relevant developing country in the fiscal year prior to the year of implementation whether the country wishes to have the project.

7.2.3 Outline of Country-specific Training

Different from Issue-specific Training, for which the lineup of training programs will be proposed by Japan in advance, the Country-specific Training is a tailor-made training course that will be carried out upon individual and specific requests from the relevant developing country. For Country-specific Training, over 700 programs are planned and carried out annually, which cover a broad range of sectors in the same manner as Issue-specific Training.

Most of the Country-specific Training programs are those that will be carried out for administrators and engineers of the counterpart countries (hereinafter referred to as the "counterparts") as the subjects of technology transfer in the technical projects implemented by JICA at the relevant sites of developing countries. Country-specific Training is characterized by its role in supplementing technology transfer at the work sites of developing countries in order to transfer technology more accurately by allowing the participants to see and know the work sites in Japan in which technology is used.

As part of the Country-specific Training program, JICA offers Long-term Training programs for trainees to attend master's or doctoral programs at Japanese universities for at least one year.

Also, the Special Program aims at further enhancing the effects of training projects through special instructions related to the courses and research projects of respective trainees or through the trainees' practical research projects by taking into account the needs (e.g., development challenges) of their home countries, in addition to the existing curriculum (e.g., instructions given at classes or research laboratories) of the universities that accept trainees.

Specifically, the Special Program aims for the following two objectives:

(1) The trainees will acquire practical knowledge and experience that suits the reality of their home countries by gaining a solid understanding of the contents of courses taken by them and by doing research and study on specific cases related to their research projects; and
(2) The trainees will establish networks with researchers and relevant institutions in Japan that will be helpful to their future activities.

7.2.4 Outline of Youth Training

Youth Training is designed for youth trainees who will bear the responsibility of leading respective developing countries and aimed at improving trainees' knowledge and awareness conducive to the efforts to solve challenges in their respective countries through the provision of basic training courses that help those trainees gain experience and understand technologies in various areas of expertise in Japan.

For Youth Training, over 70 programs are planned and carried out annually which cover a broad range of training areas (e.g., public administration, education, agriculture, social welfare, economy, health care, environment and information communication) and are basically designed around JICA's priority areas or programs for respective target countries.

7.2.5 Position of the Review Program

In the Review Program, as shown in the Diagram of the training system in Japan (**Table 7-1**), JICA reviewed the training contents of the Road AM course under **Issue-specific Training** that will start in FY 2019 and the **Special Program for Long-term Training** for understanding the state of Japan's efforts in Road AM.

7.3 Lineup of Issue-specific Training Courses for the Transport Sector and the Future Direction at the Review Meeting for the Transport Sector

7.3.1 Lineup of Issue-specific Training Courses for the Transport Sector

Under Issue-specific Training, there are 331 issue-specific courses in 17 sectors as shown in Table 7-1. For the transport sector, there are 26 issued-specific courses under 5 sub-categories: (i) transportation administration (10 courses), (ii) international transportation (4 courses), (iii) national transportation (3 courses), (iv) urban transportation (3 courses) and other transportation (6 courses) as shown in Table 7-2.

Table 7-1 Outline of JICA Knowledge Co-Creation Program 2018

NO.	Main field	Number of courses by assignment	rate
①	Education	28	8%
②	Health	33	10%
③	Water Resources /Disaster Management	31	9%
④	Governance	27	8%
⑤	Peace-Building	3	1%
⑥	Social Security	9	3%
⑦	**Transportation**	**26**	**8%**
⑧	Information and Communication Technology	8	2%
⑨	Natural Resources and Energy	20	6%
⑩	Economic Policy	11	3%
⑪	Private Sector Development	23	7%
⑫	Agricultural Rural Development	43	13%
⑬	Nature Conservation	15	5%
⑭	Fisheries	8	2%
⑮	Gender and Development	5	2%
⑯	Urban Regional Development	16	5%
⑰	Environmental Management	25	8%
Total		**331**	100%

Source: JICA Study Team Prepared from the JICA Website

Table 7-3 shows 10 Issue-specific Training courses for Road AM and Table 7-4 through 7-13 show the details thereof. In FY 2018, a new issue-specific course, the Infrastructure Management System for Road Administration, was added to the lineup as shown in Table 7-13.

Table 7-2 Issue-specific Courses in the Transport Sector

Transportation		
Capacity Development for Transport Sector		
1	1884543	Maritime Safety and Security Policy Program
2	1884544	Maritime Law Enforcement
3	1884545	Practical Technology on Intelligent Transport System (ITS)
4	1884546	The total planning of airport construction, management and maintenance
5	1884547	Comprehensive Bridge Engineering
6	1884548	Road Administration
7	1884549	Ship Safety
8	1884550	Improvement of Port Cargo Transport Efficiency for African Countries
9	1884895	Civil Aviation Safety Oversight
10	1884997	Traffic Police Administration
International/Inter-regional Transportation		
11	1884551	Seminar on Aviation Security
12	1884552	Hydrography for Charting and Disaster Management (Internationally Accredited Category B)
13	1884553	PBN Instrument Flight Procedure Design
14	1884554	Capacity Development for Port Facility Security
National Transportation		
15	1884538	Road Maintenance
16	1884555	Bridge Maintenance
17	1884557	Comprehensive Expressway Engineering
Urban Transportation		
18	1884558	Development of Urban Road Network
19	1884560	Environmentally Sustainable Urban Transport Planning
20	1884561	Urban Railways Management
Other Transportation Issues		
21	1884563	Project Management in Infrastructure Development for Civil Engineers
22	1884565	Maritime Search and Rescue, Maritime Disaster Prevention, and Marine Environment Protection for Coast Guard Officials
23	1884566	Sustainable Port Development and Planning (for Port Engineer)
24	1884567	Strategic Port Administration and Management (for port manager)
25	1884568	Development of the sustainable and reliable logistics system in Asian region
26	1884788	Infrastructure Management System for Road Administration

Source: JICA Study Team Prepared from the JICA Website

Table 7-3 Issue-specific Training Courses Related to Road AM

Global Issues Sector / Sub-sector	Program Title	course No.	JICA Center	Language	Target Organization / Group
Transportation / Capacity Development for Transport Sector	Practical Technology on Intelligent Transport System (ITS)	J1804124	JICA Tokyo (Economy & Env.)	English	Target Organization Administrative organization Target Group 1. The government officials are in charge of actual work to introduce ITS. 2. At least 5 years of experience in the field of road and transportation 3. University (Engineering or Science) graduate or have an equivalent educational background 4. Have a good command of English in speaking and writing 5. To be expected to work on the same assignment in the similar field for ten years after the participation of the program.
Transportation / Capacity Development for Transport Sector	Comprehensive Bridge Engineering	J1804317	JICA Kansai (I	English	Target Organization Competent government agencies or governmental organizations responsible for bridge engineering (design, construction, maintenance, repair of bridges) Target Group Engineer currently engaged in bridge engineering (design, construction / construction supervision, maintenance and repair of bridges). Preferably with 5 – 15 years of work experience (3 years or more in bridge engineering desirable).
Transportation / Capacity Development for Transport Sector	Road Administration	J1804322	JICA Tokyo (Economy & Env.)	English	Target Organization National or local governments' road administration bureau. Target Group University graduate with civil engineering degree or equivalent Mid-level officer in charge of road planning in government or government-related organization and expected to be assigned to a leading position in the future
Transportation / National Transportation	Road Maintenance	(A)J1804167 / (B)J1804168 / (C)J1804100 / (D)J1804222 / (E)J1804152	(A)JICA Hokkaido (Sapporo) (B)JICA Hokkaido (Sapporo) (C)JICA Okinawa (D)JICA Chugoku (E)JICA Hokkaido (Sapporo)	(A)Russian / (B)English / (C)English / (D)English / (E)French	Target Organization Organization responsible for road management, operation and maintenance. Target Group Engineer or administrator engaged road maintenance. More than 5 years' experience in road maintenance and will be in same occupation more than 2 years after this training. A graduate or equivalent academic background in the field of civil engineer
Transportation / National Transportation	Bridge Maintenance	J1804440	Under Planning	English	Target Organization Competent government agencies or governmental organizations responsible for bridge engineering (design, construction, maintenance, repair of bridges) Target Group Engineer currently engaged in bridge engineering (design, construction / construction supervision, maintenance and repair of bridges). Preferably with 5 – 15 years of work experience (3 years or more in bridge engineering desirable).
Transportation / National Transportation	Comprehensive Expressway Engineering	J1804323	JICA Tokyo (Economy & Env.)	English	Target Organization 1) Government department in charge of expressway 2) Expressway company or concessionaires Target Group 1. Engineer or Administrator in charge of planning, O /M of the expressway. 2. In the relevant field, over 5years of working experience and over 2years of career in the same organizations planned after this Program. 3. University graduate or equivalent in civil, mechanical, or electrical engineering
Transportation / Urban Transportation	Development of Urban Road Network	(A)J1804237 / (B)J1804238	(A)JICA Kansai (I (B)JICA Kansai (I	(A)English / (B)English	Target Organization Organization (Central / local government or municipality) in charge of urban road development in the metropolitan area. Target Group Engineering officials in charge of urban road development (It is desirable to have civil engineering expertise equivalent to university graduate level with more than 5 years of working experience in the relevant field)
Transportation / Urban Transportation	Environmentally Sustainable Urban Transport Planning	J1804293	JICA Chubu	English	Target Organization Department in charge of urban transport or urban development in the central or local government Target Group 1. Officer in charge of planning and implementing urban transport (mainly public transport) or urban development in the central or local government 2. At least 5 years' experience in the relevant field
Transportation / Other Transportation Issues	Project Management in Infrastructure Development for Civil Engineers	J1804409	JICA Yokohama	English	Target Organization Organizations for executing infrastructure development Target Group (Title) Executive officers in charge of infrastructure development in central government, etc. (Experience) 8 years of experience in management on infrastructure project (Others) University graduate or equivalent in the field of civil engineering
Transportation / Other Transportation Issues	Infrastructure Management System for Road Administration	J1804192	JICA Hokkaido (Sapporo)	English	Target Organization National or local governments' road administration. Target Group 1. Mid-level officer in charge of road administration in Central / Regional Government, and expected to be assigned to a leading position in the future. 2. More than 5 years of experience in road administration. 3. University graduate with civil engineering degree or equivalent

Table 7-4 Practical Technology on Intelligent Transport System (ITS)

Practical Technology on Intelligent Transport System (ITS) ITS(高度道路交通システム)実務	Continuing Innovative Program
Target Countries :	
Course No. : J1804124	**No. :** 1884545
Sector : Transportation/Capacity Development for Transport Sector	
Sub-Sector :	
Language : English	

Outline

Traffic demand in the developing countries is rapidly increasing, and it is necessary to expand road capacity and enhance safety. ITS assists to enhance the efficiency and safety of existing road network using real-time information. This program is aimed to enhances the action plan and the practical capacity to introduce ITS in each country.

Objective/Outcome	**Target Organization / Group**
【Objective】 To disseminate the knowledge and the action plan to introduce the ITS in each country through acquiring the practical knowledge and technique after returning in each country. 【Outcome】 1. To understand the outline and related technology of ITS 2. To understand the role of the governments to introduce the ITS 3. To propose the action plan through specifying the applicable Japanese ITS technology in each country 4. To disseminate the action plan to related officials in each country	【Target Organization】 Administrative organization 【Target Group】 1. The government officials are in charge of actual work to introduce ITS. 2. At least 5 years of experience in the field of road and transportatiton 3. University (Engineering or Science) graduate or have an equivalent educational background 4. Have a good command of English in speaking and writing 5. To be expected to work on the same assignment in the similar field for ten years after the participation of the program. 6. Be at age 50 years or younger

Contents		
1. ・Lecture on outline and Idea of ITS ・Lecture and site visit on related technology of ITS(An example and the future prospects of Traffic signal control, ETC, VICS, AHS, Road facility control system, Safety driving support, Road management, etc.) 2. ・Technical lecture on ITS administration in Japan (The role and cooperatiton among related governmental organization, the roles and cooperation among the private sector, academic institute and government) 3. ・To make the action plan (the participant should pick up a few applicble technology or knowledge) under the instruction from Japanese expert (, the roles and cooperation among the private sector, academic institute) 4. ・To disseminate the action plan and learned knowledge / technology through this program to related officials in each country	**Course Period**	2018/6/24～2018/7/21
	Department in Charge	Infrastructure and Peacebuilding Department
	JICA Center	JICA Tokyo(Economy&Env.)
	Cooperation Period	2016～2018

Implementing Partner	Tokyo university some consultants are placed
Remarks and Website	Scene of the program (Japanese only) https://www.youtube.com/watch?v=9UTZvB99nXM&list=PL5xfaPiPaaOxOZZe6QzwZ5dFYmfiTaR4M&index=4

Table 7-5 Comprehensive Bridge Engineering

Comprehensive Bridge Engineering 橋梁総合			Continuing
Target Countries : Whole area			
Course No. : J1804317	**No. :** 1884547		
Sector : Transportation/Capacity Development for Transport Sector			
Sub-Sector :			
Language : English			
Outline			
This course will provide comprehensive bridge engineering such as design of bridges, construction/construction supervision and maintenance/repair of various types of bridges through case study and site visit in Japan.			
Objective/Outcome		**Target Organization / Group**	
【Objective】 To formalate action plans about construction or maintenance work for birdges. 【Outcome】 1. Design of bridges (acquisition of design technique using software is NOT included in the course objectives) 2. Construction and construction supervision of various types of bridges (RC, PC and steel bridges) 3. Maintenance and repair of various types of bridges		【Target Organization】 Competent government agencies or governmental organizations responsible for bridge engineering (design, construction, maintenance, repair of bridges) 【Target Group】 Engineer currently engaged in bridge engineering (design, construction/construction supervision, maintenance and repair of bridges). Preferably with 5 - 15 years of work experience (3 years or more in bridge engineering desirable).	
Contents		**Course Period**	2018/9～2018/10
[Preliminary Phase in Participants' home countries] Formulation and submission of Country Report Collection of data and preparation for report presentation [Core Phase in Japan]Lectures, practices, site visits and discussion on the following subjects 1. Bridge Planning in Japan 2. Design and Construction of Substructures 3. Design and Construction of Concrete Bridges (PC and RC Bridges) 4. Design and Construction of Steel Bridges 5. Bridge Accessories 6. Bridge Maintenance and Repair 7. Preparation and presentation of Training Reports		**Department in Charge**	Infrastructure and Peacebuilding Department
		JICA Center	JICA Kansai (I)
		Cooperation Period	2017～2019
Implementing Partner	Honshu-Shikoku Bridge Expressway Company Limited		
Remarks and Website			

Table 7-6 Road Administration

Road Administration 道路行政			Continuing
Target Countries : Low-Income and Lower Middle-Income Developing Country			
Course No. : J1804322		**No. :** 1884548	
Sector : Transportation/Capacity Development for Transport Sector			
Sub-Sector :			
Language : English			
Outline			
Road development has considerable social and economic impacts in developing countries with insufficient social infrastructure. This Knowledge Co-Creation Program aims to develop the capacity of road administration for the related government officials.			
Objective/Outcome		**Target Organization / Group**	
【Objective】 Capacity development of officers in charge of road administration in the field of road planning, improvement and maintenance 【Outcome】 (1) Understand the process of road planning and points to consider thereof (2) Understand the effects of road development, the way to grasp them and the evaluation method of the project (3) Understand the process of road structure planning (including pavement and bridges) and points to consider thereof, and (4) Propose an improvement plan of road administration in respective countries		【Target Organization】 National or local governments' road administration bureau. 【Target Group】 University graduate with civil engineering degree or equivalent Mid-level officer in charge of road planning in government or government-related organization and expected to be assigned to a leading position in the future	
Contents		**Course Period**	Under Planning
[Exercise] Road Network Planning [Lecture] Road Administration in Japan, Highway Economic Effects and Project Appraisal, Road Traffic Demand Forecast, Road Structure Ordinance, Road Design, Disaster Prevention, Public Involvement・EIA [Lecture & Site Visits] Traffic Safety, Road Structure (Bridge, Tunnel, Pavement), Road Construction, Road Facilities・ITS, Road Maintenance		**Department in Charge**	Infrastructure and Peacebuilding Department
		JICA Center	JICA Tokyo(Economy&Env.)
		Cooperation Period	2016～2018
Implementing Partner	Infrastructure Development Institute		
Remarks and Website			

Table 7-7 Road Maintenance

Road Maintenance 道路維持管理	Continuing
Target Countries :	
Course No. : (A) J1804167/ (B) J1804168/ (C) J1804100/ (D) J1804222/ (E) J1804152	**No. :** (A) 1884538/ (B) 1884539/ (C) 1884540/ (D) 1884542/ (E) 1884556
Sector : Transportation/National Transportation	
Sub-Sector :	
Language : (A) Russian/ (B) English/ (C) English/ (D) English/ (E) French	

Outline

This course mainly targets engineers who are engaged in road maintenance. It contributes to improve their knowledge, experience and technique for appropriate road maintenance, especially planning skills (including asset management) through lecture, site visit and discussion etc.
They are expected to identify the issues and formulate feasible action plan for the solution.

Objective/Outcome	**Target Organization / Group**
【Objective】 To identify the issues for road maintenance and formulate countermeasure and improvement plan for the appropriate and efficient road M/M through the acquisition of applicable knowledge and technique. 【Outcome】 1. Main issues of respective country/organization are identified. 2. Through the experience of Japan and local government on road maintenance planning and framework (including road asset management system), applicable knowledge and technique are reconsidered. 3. Through understanding necessary skills, procedure of appropriate road management and maintenance (especially road M/M planning) is reconsidered.	【Target Organization】 Organization responsible for road management, operation and maintenance. 【Target Group】 Engineer or administrator engaged road maintenance. More than 5 years' experience in road maintenance and will be in same occupation more than 2 years after this training. A graduate or equivalent academic background in the field of civil engineer

Contents		
【Pre-training】 1. Preparation of Inception Report to analyze the issues regarding road M/M in respective organization and country. 【Training in Japan】 1. Presentation and discussion of Inception Report. 2. Lectures, site visit, workshop and discussions of following matters. 1) The concept of "road M/M cycle (Inspection, evaluation, planning implementation and monitoring etc." 2) Road M/M plan, history, implementation system in Japan and local areas. 3) Preventive and effective road M/M planning 4) Road M/M works (Inspection, evaluation etc.) in Japan and local areas. 5) Implementation of road M/M works and countermeasure works against disaster, etc. 6) Road construction plan to achive the effective road maintenance and management after operation 3. Formulation, discussion and presentation of the action plan for the efficient and effective road M/M 【Post-training】 1. Presentation and discussion of the draft action plan among the stakeholders in respective country 2. Submission of the progress report	**Course Period**	(A) 2018/10/31～2018/12/15 (B) 2018/8/29～2018/10/6 (C) 2018/10/10～2018/11/23 (D) 2018/10/24～2018/12/11 (E) 2018/4/18～2018/5/24
	Department in Charge	Infrastructure and Peacebuilding Department
	JICA Center	(A) JICA Hokkaido (Sapporo) (B) JICA Hokkaido (Sapporo) (C) JICA Okinawa (D) JICA Chugoku (E) JICA Hokkaido (Sapporo)
	Cooperation Period	2017～2019

Implementing Partner	(A) Hokkaido Development Engineering Center/ (B) Under Planning/ (C) Green Earth/ (D) Hiroshima International Center/ (E) Under Planning
Remarks and Website	If there are more requests than the upper limit of paticipants, it is possible to implement more than once.

Table 7-8 Bridge Maintenance

Bridge Maintenance 橋梁維持管理	Updated Innovative Program
Target Countries : Countries that JICA bridges project have been implemented, on going or planning.	
Course No. : J1804440	**No. :** 1884555
Sector : Transportation/National Transportation	
Sub-Sector :	
Language : English	

Outline

This course is added to monitoring activities after a series of program in Japan. Participants will understand the bridge maintenance system carried out in Japan and, the bridge maintenance skills of will be improve by means of the practical training program for inspection, evaluation, and repair of various types of bridges. The monitoring activities and feedback system after the training will improve the quality of the training program.

Objective/Outcome	**Target Organization / Group**
【Objective】 Action plans for bridge maintenance management will be formulated and implemented by the organization which trainees belong to. 【Outcome】 1. To be able to acquire and explain the essential points of Bridge Maintenance Management and make plans for Bridge Maintenance Management. 2. To be able to explain the basic work and concept of inspection, evaluation of various types of bridges (concrete bridges and steel bridges). 3. To be able to explain the basic work and concept of maintenance reinforcement/repair of various types of bridges (concrete bridges and steel bridges). 4. To make an action plan for Bridge Maintenance Management in participants' countries.	【Target Organization】 Competent government agencies or governmental organizations responsible for bridge engineering (design, construction, maintenance, repair of bridges) 【Target Group】 Engineer currently engaged in bridge engineering (design, construction /construction supervision, maintenance and repair of bridges). Preferably with 5 - 15 years of work experience (3 years or more in bridge engineering desirable).

Contents		
【Preliminary Phase in Participants' home countries】 Formulation and submission of First Country Report about the situation of bridge maintenance and the belonged organization. The accepted participants should revise and edit the first one and that will be the Second Country Report. 【Core Phase in Japan】 Lectures, practices, site visits and discussion on the following subjects 1. Introduction to Bridge Maintenance Management in Japan 2. Maintenance and Management of Steel Bridges 3. Maintenance and Management of Concrete Bridges 4. Maintenance and Management of Bridge Deck Pavement / Floor Slab Waterproof System 5. Maintenance and Management of Bridge Accessories 6. Bridge Inspection and Evaluation 7. Bridge Maintenance Reinforcement/Repair 8. Bridge Management System (BMS) 9. Preparation and presentation of Training Reports 【Finalization phase in a participant's home country】 Participants and their organizations revise and implement the action plan for bridge maintenance. Three months after after returning country, the participants submit a review report about the situation of action plan implementation and the horizontal expansion. Two participants will be selected among the participants who submitted a review report, and the local monitoring investigation, workshop at their countries will be carried out.	**Course Period**	Under Planning
	Department in Charge	Infrastructure and Peacebuilding Department
	JICA Center	Under Planning
	Cooperation Period	2018～2020

Implementing Partner	Under Planning
Remarks and Website	

Table 7-9 Comprehensive Expressway Engineering

Comprehensive Expressway Engineering 高速道路総合			Updated
Target Countries : Countries which have expressway(s) under planning, construction and/or operating			
Course No. : J1804323	**No. :** 1884557		
Sector : Transportation/National Transportation			
Sub-Sector : Transportation/Other Transportation Issues			
Language : English			
Outline			
To improve the network of distribution, expressway management has been implemented in the developing countries with remarkable economic development and JICA also has been supporting their development. In this field, appropriate planning, construction and effective management, maintenance are required. This Knowledege Co-Creation Program on comprehensive expressway engineering is based on Japan's experience for more than 50 years in Japan.			
Objective/Outcome		**Target Organization / Group**	
【Objective】 To identify the issues for expressway planning, construction, management and operation/maintenance, to solve the issues and to develop the action plan through the acquisition of knowledge and technique. 【Outcome】 1. To identify the status and issues regarding planning, construction, management and operation / maintenance of expressway(s) in respective country. 2. To consider the applicable knowledge and technique through understanding Japanese expressway (toll road) system, expressway development plan, construction technology, and management, operation / maintenance strategy. 3. To propose the solutions and action plan of expressway planning, construction, management, and operation / maintenance.		【Target Organization】 1) Government department in charge of expressway 2) Expressway company or concessionaires 【Target Group】 1. Engineer or Administrator in charge of planning, O/M of the expressway. 2. In the relevant field, over 5years of working experience and over 2years of career in the same organizations planned after this Program. 3. University graduate or equivalent in civil, mechanical, or electrical engineering	
Contents		**Course Period**	2018/9/2～2018/9/15
【Preliminary Phase】 Preparation of Country Reports about the status, issues and plans of expressway in respective countries. 【Core Phase in Japan】Lectures, site visits, workshops and discussions as following; ・Japanese Road administration (road planning, expressway system, PPP system, etc.) ・Expressway development plan in Japan (comprehensive plan, implementation structure, history etc.) ・Expressway construction technology ・Expressway management (toll collection system, traffic management system, traffic congestion countermeasures, etc.) ・Expressway maintenance (maintenance, inspection, risk management, disaster countermeasures etc.) ・Technical services (surface inspection vehicles, regulation material etc.) in Expressways ・Action plan presentation and discussion to implement for solving the issues including expressway planning, operation, management and maintenance.		**Department in Charge**	Infrastructure and Peacebuilding Department
		JICA Center	JICA Tokyo(Economy&Env.)
		Cooperation Period	2018～2020
Implementing Partner	Under Planning		
Remarks and Website			

Table 7-10 Development of Urban Road Networks

Development of Urban Road Network 都市内道路整備	Updated
Target Countries : All countries	
Course No. : (A)J1804237/(B)J1804238	**No. :** (A)1884558/(B)1884459
Sector : Transportation/Urban Transportation	
Sub-Sector :	
Language : (A)English/(B)English	

Outline

This program is designed for technical officers in charge of urban roads in metropolitan area. The aim of this program is to improve the capacity of effective and efficient urban road development through Japanese experience particular to urban road development such as engineering techniques, the measures of traffic congestion relief, road safety and surrounding environment protection.

Objective/Outcome	**Target Organization / Group**
【Objective】 The capacity of effective and efficient urban road development is to be improved. 【Outcome】 1. To be able to explain and share the basics about the urban road development to the parent organization. 2. To be able to explain and share the various challenges and measures for the issues characteristic to urban road development to the parent organization. 3. To be able to explain and share the various constraints and the countermeasures on the process of planning / construction of urban road to the parent organization. 4. To be able to explain and share the Action Plan to the parent organization.	【Target Organization】 Organization (Central/local government or municipality) in charge of urban road development in the metropolitan area. 【Target Group】 Engineering officials in charge of urban road development (It is desirable to have civil engineering expertise equivalent to university graduate level with more than 5 years of working experience in the relevant field)

Contents		
[Preliminary Phase] Preparation of Job Report [Core Phase in Japan] lectures/ observations/ discussions on 1. Classification and role of urban road (as transportation, lifeline (Electricity, gas, water), living environment, disaster reduction, etc), history of road development in Japan 2. (1) Traffic congestion relief (systematic development of road network, resolution of bottleneck of traffic flow, TDM (Traffic Demand Management), ITS (Intelligent Transport Systems), Multi-Modal) (2) Road safety (road safety measures, cooperation with police, traffic control) (3) Environmental measures (reduction of vehicle emission, vibration, noise, greenbelt, etc) (4) Lifecycle cost, preventive maintenance 3. Execution scheme, construction technology (rapid or neighboring construction) 4. Preparation and presentation of Action Plan [Finalization Phase] Implementation of Action Plan and inform the degree of its implementation to JICA.	**Course Period**	(A)2018/7/16～2018/8/25 (B)2018/9/10～2018/10/25
	Department in Charge	Infrastructure and Peacebuilding Department
	JICA Center	(A)JICA Kansai (I) (B)JICA Kansai (I)
	Cooperation Period	2018～2020

Implementing Partner	(A)Construction Services in Kinki Region/(B)Construction Services in Kinki Region
Remarks and Website	Priority may be given to the counterpart organization of JICA projects

Table 7-11 Environmentally Sustainable Urban Transport Planning

Environmentally Sustainable Urban Transport Planning 環境的に持続可能な都市交通計画			Updated
Target Countries :			
Course No. : J1804293		**No. :** 1884560	
Sector : Transportation/Urban Transportation			
Sub-Sector : Urban/Regional Development/Urban Development			
Language : English			
Outline			
This program is designed for mid-level central and local government officers to bring awareness and encourage introducing environmentally sustainable urban transport (EST) system and urban development based on the concept of "Green Economy" (economic activities aiming at the environmental conservation and the economic development).			
Objective/Outcome		**Target Organization / Group**	
【Objective】 To be able to identify and propose measures necessary in consideration of current circumstances of each country, by acquiring the practical knowledge to promote Environmentally Sustainable Urban Transport System and Urban development. 【Outcome】 1. To understand and analyze the current situation and problems of EST in area of responsibility. 2. To understand EST policy/system and its history/experiences in Japan. 3. To understand actual approaches and measures for EST, and to consider the possibility of adaptation to each country. 4. To summarize and make a proposal of what and how to strengthen or improve EST system and Urban development in respective countries by applying the knowledge gained by the program.		【Target Organization】 Department in charge of urban transport or urban development in the central or local government 【Target Group】 1. Officer in charge of planning and implementing urban transport (mainly public transport) or urban development in the central or local government 2. At least 5 years' experience in the relevant field	
Contents			
【Preliminary Phase】Preparation of Inception report 【Core Phase】 1. Presentation of Inception report, Discussion 2. Lectures/ Field visits (Example) (1)EST Administration in Japan, City planning, Land utilization, Environment assessment (2)Financial measures to promote EST, Transport strategy for urban city, Electric bus, Guide-way bus system, TDM, NMT, LRT, ITS 3. Matrix, Planning method, Case study, Discussion 4. Preparation and presentation of proposal		**Course Period**	2018/11/7～2018/12/15
		Department in Charge	Infrastructure and Peacebuilding Department
		JICA Center	JICA Chubu
		Cooperation Period	2018～2020
Implementing Partner	Under Planning		
Remarks and Website			

Table 7-12 Project Management in Infrastructure Development for Civil Engineers

Project Management in Infrastructure Development for Civil Engineers 社会基盤整備における事業管理			Continuing
Target Countries : Countries with infrastructure development plan on national and legional policy			
Course No. : J1804409	**No. :** 1884563		
Sector : Transportation/Other Transportation Issues			
Sub-Sector : Urban/Regional Development/Other Urban and Regional Development Issues			
Language : English			
Outline			
In late years, the procedures for public works in developing countries become more complicate due to the intermingling of ODA projects and their own national systems. This course is offered for executive officers in charge of project management in central government and so on. Each participant reviews the own situation and problems and summarizes Action Plan utilizing the knowledge and technology learned.			
Objective/Outcome		**Target Organization / Group**	
【Objective】 This course brings on executive officers and candidates who belong to central government and governmental body in making policy and systems for project management of infrastructure development. 【Outcome】 1) To improve knowledge of the project management on infrastructure development 2) To improve knowledge of contract and evaluation system s on infrastructure development 3) To exercise accountability of the project on infrastructure development 4) To obtain site management methods 5) To consider the application and possibility in order to establish their own standard and system utilizing the technology learned through this course, and made a Action Plan.		【Target Organization】 Organizations for executing infrastructure development 【Target Group】 (Title) Executive officers in charge of infrastructure development in central government, etc. (Experience)8 years of experience in management on infrastructure project (Others) University graduate or equivalent in the field of civil engineering	
Contents		**Course Period**	2018/10/11～2018/12/8
1) To understand the characteristics and condition of infrastructure development in Japan and obtain project management skills such as ensuring quality of public works, utilizing information technology, construction waste recycling, land acquition etc. 2) To obtain the contract system in Japan, supervision/inspection system, standard specification, role of consultants and project eveluation methods at each step of infrastructure development 3) To learn the process to obtain the support and agreement of citizens through accountability in infrastructure development 4) To study the updated site management, including quality, schedule and safety control 5) To draw up their Action Plan comparing their situation/problems and the technology acquiring through this course, and hold the presentation and discussion for deep understanding		**Department in Charge**	Infrastructure and Peacebuilding Department
		JICA Center	JICA Yokohama
		Cooperation Period	2017～2019
Implementing Partner	Infrastructure Development Institute - Japan		
Remarks and Website			

Table 7-13 Infrastructure Management System for Road Administration (New Lineup)

Infrastructure Management System for Road Administration 道路行政のインフラマネジメントシステム			New
Target Countries :			
Course No. : J1804192		**No. :** 1884788	
Sector : Transportation/Other Transportation Issues			
Sub-Sector : Transportation/Other Transportation Issues			
Language : English			
Outline			
This training course is targeted at national and local governments that are behind in road construction and aiming to establish a real Infrastructure Management system immediately. For that reason, this course has practical training contents for administrative engineers. These are as follows: ①Management System to proceed road construction efficiently and steadily, ②Management System to cooperate between national government and local government and between the government and the private section, ③Management System to ensure the quality of infrastructures. In addition, this course includes following subjects that developing countries have concerned in road administration, such as environmental issues, traffic congestion, rapid urbanization, natural disaster, and the participants in this course will be able to improve the overall ability of administrative management.			
Objective/Outcome		**Target Organization / Group**	
【Objective】 The participants learn the general road administration and the proceeding system that construct roads steadily. Through these learning, they develop a sense of responsibility as an administrative engineer, and improve their ability of works. 【Outcome】 1.″Why was that infrastructure development possible in Hokkaido(a local government) in a short period(about 100 years)?″ The participants look into the reasons in the viewpoint of the systems of road administration and integrate their thoughts into a report. 2.″Why were these infrastructures in Hokkaido ensured in high quality and uniformity in spite of hard natural conditions?″ The participants look into the reason in the viewpoint of the road engineering technology and integrate their thoughts and methods into a report. 3.″What is the necessary management system for national and local governments to ensure the quality of infrastructures like road ?″ The participants look into the mechanism of the system and integrate their thoughts into a report. 4.″How have issues of the road administration been resolved until now, such as environmental issues, urbanization and disaster prevention ?″ The participants learn the viewpoints and the direction of resolution and integrate their thoughts and methods into a report. 5. The trainees should make reports on the issue analysis, the direction of the solution and their measures regarding ″administrative issue that their own country or organization belongs to″ while receiving advice by the experts		【Target Organization】 National or local governments' road administration . 【Target Group】 1. Mid-level officer in charge of road administration in Central/Regional Government, and expected to be assigned to a leading position in the future. 2. More than 5 years of experience in road administration. 3. University graduate with civil engineering degree or equivalent.	
Contents		**Course Period**	2018/8/25～2018/10/6
<Preliminary Phase> Preparation of Inception Report to analyze the issues regarding road administration in respective organizations and countries. <Core Phase> 1. Lectures about legal basis and procedure regarding infrastructure development, road project planning, project execution system, project evaluation system, project audit systems and etc. (lectures) 2. Lectures about infrastructure development procedure through planning, design, construction and maintenance on road development, and about priority for investment , technical standards, reliability of infrastructure, ways of design inspection, construction specifications, maintenance management and etc. (lectures and field training) 3. Lectures about work before tendering for construction, such as field survey and design, land acquisition and compensation of project site and etc., about way of construction management for quality control, about checkpoints for supervision and inspection, and about occupational safety management of construction and etc. (lectures and field training) 4. Lectures about way of environmental measures on road administration, urbanization measures such as traffic congestion, urban redevelopment and etc., disaster prevention measures and etc. (lectures and field training) 5. Consideration of the solution and countermeasures to the issues regarding road administration that are daily challenges in respective organization and country. Formulation of an action plan after they go back to their home country (exercises, discussion, field training) <Post Training> Presentation and sharing of action plan among belonging organizations, and submission to them that action plan should be executed. Report on implementation tion status of action plan		**Department in Charge**	Infrastructure and Peacebuilding Department
		JICA Center	JICA Hokkaido (Sapporo)
		Cooperation Period	2018～2020
Implementing Partner	Hokkaido Government		
Remarks and Website			

7.3.2 Future Direction Suggested by the Review Meeting for the Transport Sector

At the Review Meeting for the transport sector (October 2018), the following points were stated with respect to the direction of training to be given in Japan:

7.3.2.1 Direction of Cooperation in the Transport Sector; Priority Areas

With respect to cooperation in the road sector, JICA has not only been engaged in road construction and development, but also has promoted cooperation toward the entrenchment of Road AM (e.g., enhancement of the operation and maintenance capacity and optimal budget allocations in the future).

Also, in response to the Japanese government's policy (i.e., the Export Strategy for Infrastructure System revised in June 2018), JICA has aided in the areas at which Japanese companies excel, such as expressway construction, operation and maintenance, practical technology on ITS (intelligent transport systems) and development of urban road networks (grade separation and rapid construction).

In the issue-specific guidelines for the transport sector, the following sub-targets for the road sector are set out in the intermediate target "3-1. Improvement of Road Transport," and JICA will aim at aiding in accordance therewith.

1) Development of arterial roads
2) Strengthening of traffic management
3) Strengthening of maintenance
4) Strengthening of capacity to respond to road hazards
5) Normalization and standardization
6) Improvement of road transport services

7.3.2.2 Overview of Current Cooperation

Roads are prioritized in transportation infrastructure in developing countries because they provide an essential basis for daily lives and economic activities. Based on these backgrounds, JICA provides grant aid and loan assistance for roads, bridges, machines for the purpose of construction and maintenance, and ITS while also carrying out technical projects, dispatching experts and providing training, etc., for the purpose of maintenance.

In recent years, it has become known that enough inspections and repairs have not been carried out on roads and bridges that were developed in the past. JICA provides necessary assistance such as the introduction of PMS and BMS through technical projects, formulation of management plans for maintenance funds based on inspection results and response to measures (e.g., repairs) taken based on those plans. In addition to the implementation of these technical projects, JICA established the Road Asset Management Platform in October 2017 in order to respond flexibly to issues in developing countries by covering from the most advanced efforts to efforts made by local municipalities in Japan in a unified manner. Through the Platform, JICA will effectively and efficiently provide not only technical projects but also comprehensive assistance with the combination of Issue-specific Training, Country-specific Training and overseas study programs (the Long-term Training).

The overseas study programs to be carried out under the concept of JICA Development Studies Program are aimed at strategic education at graduate schools in Japan for key personnel responsible for the entrenchment of Road AM, and are carried out in time to coincide with the end of the relevant technical projects (Sub-target 3). The cooperation conducive to improving the living environment (e.g., traffic congestion and road safety) is required as an effort against urban transport issues. JICA is now making efforts to address new issues through programs such as ITS assistance and road safety assistance as measures to address traffic congestion in urbanized areas (Sub-target 2) and assistance related to road hazards (Sub-target 4).

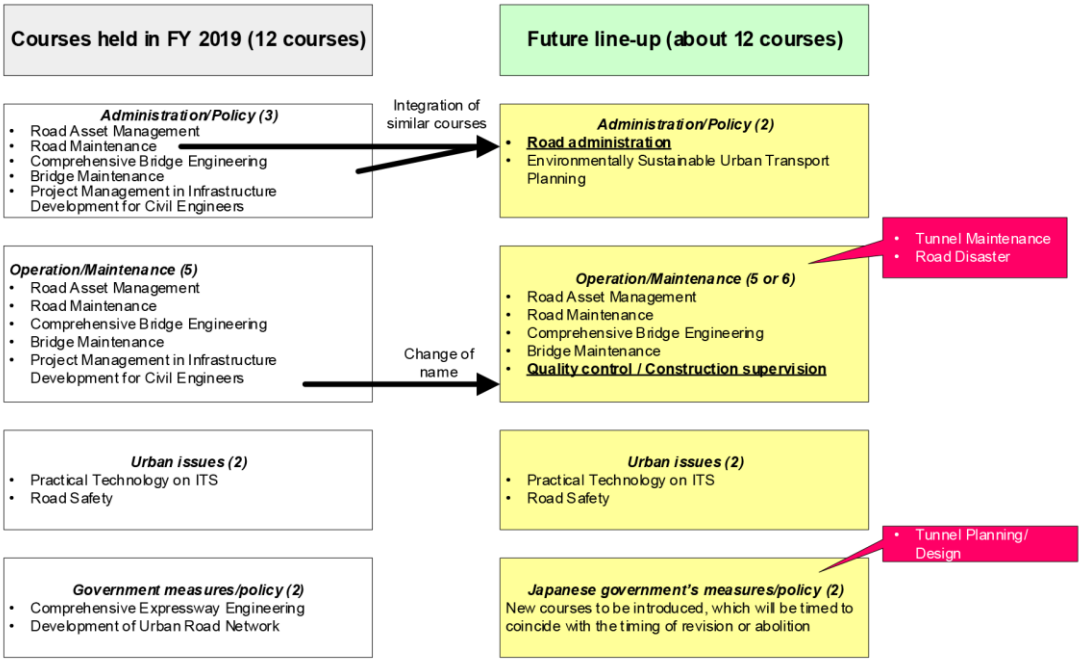
Furthermore, in the Road Asset Management Platform, JICA incorporates Japan's state-of-the-art research and development technologies and technologies held by small and medium sized enterprises (SMEs) in technical projects, and provides assistance aiming at disseminating and developing technologies to be utilized after the technical projects finish, as well as the collaboration with the SIP

infrastructure and the forum on expansion to overseas markets under the Japan Congress for Infrastructure Management (under the auspices of the Ministry of Land, Infrastructure, Transport and Tourism of Japan). JICA focuses on holding technology introduction seminars for consultants for the purpose of encouraging technology utilization and proposals in the Technical Projects and on collaborating with the Technical Project and SME assistance projects, and the like.

7.3.2.3 Future Direction of Training in Japan

(1) Restructuring of the Road Sector

Among all 12 courses in the road sector to be provided in FY 2019, JICA has designated certain courses as key courses and will endeavor to enhance the quality of training courses as medium to long-term courses. In total, 9 courses are designated as key courses: the training courses toward the entrenchment of Road AM (Road Asset Management, Road Administration, Road Maintenance, Bridge Maintenance, Comprehensive Bridge Engineering, and Project Management in Infrastructure Development for Civil Engineers) , and those based on the Sub-targets under the issue-specific guidelines (Practical Technology on ITS, Road Safety, and Environmentally Sustainable Urban Transport Planning). Similar courses (Infrastructure Management System for Road Administration) will be incorporated into the key courses at the timing of their revision or abolition.



Source: Provided by JICA

Figure 7-2 Restructuring of Issue-specific Training Courses for the Road Sector

(2) Training Courses Conducive to the Infrastructure System Export Strategy

As part of training courses conducive to the Japanese government's Infrastructure System Export Strategy, training courses where Japanese companies have advantages (e.g. highway construction and operational management, and development of urban road networks (e.g., fly-over), Comprehensive Expressway Engineering, Development of Urban Road Networks) are provided. In the future, tunnel construction projects (loan assistance) will be carried out in South East and South Asia; therefore, it is expected that there will be an increase in training needs related to tunnel construction and maintenance.

(3) Efforts to Improve the Quality of the Training

JICA has made efforts to improve the quality of training for the courses of "Bridge Maintenance" and "Practical Technology on ITS (intelligent transport systems)" by, for example, providing follow-up after trainees return home. JICA is making efforts to formulate projects based on the follow-up of

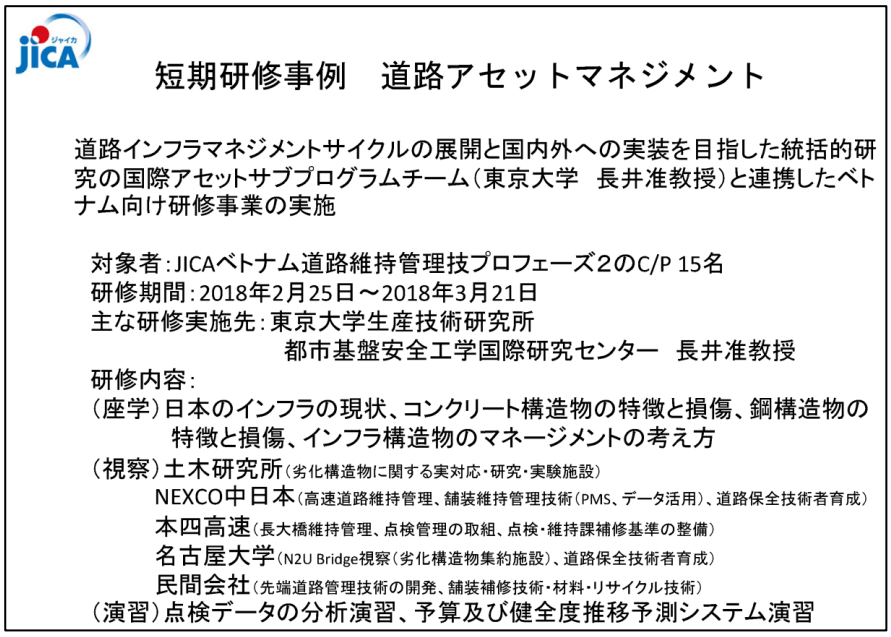
trainees after their return home and on the understanding of detailed local needs by selecting one or two countries every fiscal year and holding local surveys and seminars as a follow-up to training.

The Road Asset Management course to be started in FY 2019 is intended to help trainees acquire methods of utilizing the inspection data accumulated in the technical projects. JICA categorizes this training as an innovative and high-quality program and aims at further development of knowledge and skills that were consolidated in the technical projects through the follow-up after trainees return home.

(4) Dissemination and Deployment of Japanese Technology

JICA will promote the excellence of Japanese technology utilizing training in Japan and provide support leading to the overseas expansion of Japanese companies' business. In the courses of "Practical Technology on ITS" and "Road Asset Management," JICA will make efforts to help overseas expansion of Japanese companies' business through the seminars in counterpart countries with respect to the introduction of Japanese companies' latest technologies and quality improvement.

7.3.2.4 An Example of Short-term Training: [Road Asset Management]



Source: Provided by JICA

7.3.2.5 Summary Sheet of the Request Survey Results for Issue-specific Training in FY 2018

Table 7-14 Summary Sheet of the Request Survey Results for Issue-specific Training in FY 2018

NO.	Course No.	Program Title	Classification	Global Issues Sector	Global Issues Sub-sector	Assignment task section	JICA Center	Requested number	Requesting country
102	1984547	Comprehensive Bridge Engineering	Continuation	Transportation	Capacity Development for Transport Sector	Social infrastructure / Peace-Building section	JICA Kansai (I)	17	Indonesia, Uganda, Kenya, Republic of the Congo, Zambia, Zimbabwe, Sudan, Tanzania, Togo, Nepal, Papua New Guinea, Philippines, Myanmar, Moçambique, Lao, Liberia, Rwanda
103	1984563	Project Management in Infrastructure Development for Civil Engineers	Continuation	Transportation	Capacity Development for Transport Sector	Social infrastructure / Peace-Building section	JICA Yokohama	10	Afghanistan, Ghana, Cambodia, Kyrgyz Republic, Côte d'Ivoire, Samoa, Georgia, Fiji, Mauritius, Moçambique
106	1984545	Practical Technology on Intelligent Transport System (ITS)	Update	Transportation	Capacity Development for Transport Sector	Social infrastructure / Peace-Building section	JICA Tokyo (Economy&Env.)	8	Uganda, Egypt, Ghana, Kenya, Thai, Nigeria, Pakistan, Philippines
107	1984548	Road Administration	Update	Transportation	Capacity Development for Transport Sector	Social infrastructure / Peace-Building section	JICA Tokyo (Economy&Env.)	15	Kyrgyz Republic, Côte d'Ivoire, Democratic Republic of the Congo, Tajikistan, Philippines, Vietnam, Benin, Malawi, Myanmar, Mauritania, Moçambique, Lao, Rwanda, East Timor, South Sudan
110	1984564	Construction machine construction management (Utilization of i-Construction)	Update	Transportation	Capacity Development for Transport Sector	Social infrastructure / Peace-Building section	JICA Yokohama	3	Uganda, Nigeria, Lao
112	1984788	Infrastructure Management System for Road Administration	Continuation	Transportation	Capacity Development for Transport Sector	Social infrastructure / Peace-Building section	JICA Hokkaido (Sapporo)	10	Afghanistan, Ethiopia, Tonga, Nigeria, Philippines, Moçambique, Liberia, Rwanda, East Timor, South Sudan
115	1984905	Traffic safety	New	Transportation	Capacity Development for Transport Sector	Social infrastructure / Peace-Building section	JICA Kansai (I)	21	Uzbekistan, Egypt, Cambodia, Samoa, Solomon, Thai, Tonga, Nepal, Pakistan, Palau, Fiji, Burkina Faso, Vietnam, Malaysia, Morocco, Mongol, Jordan, Liberia, Rwanda, East Timor
116	1984918	Road Asset Management	New	Transportation	Capacity Development for Transport Sector	Social infrastructure / Peace-Building section	JICA Tokyo (Economy&Env.)	24	Ethiopia, Ghana, Cambodia, Kiribati, Cook Islands, Zambia, Djibouti, Solomon, Tajikistan, Nigeria, Namibia, Niue, Papua New Guinea, Bangladesh, Philippines, Bolivia, Madagascar, Myanmar, Moçambique, Lao, Rwanda, East Timor(1+2)
123	1984538	Road Maintenance	Continuation	Transportation	National Transportation	Social infrastructure / Peace-Building section	JICA Hokkaido (Sapporo)	39	Afghanistan, Angola, Ukraine, Uzbekistan, Egypt, El Salvador, Ghana, Kazakhstan, Cameroon, Kyrgyz Republic, Democratic Republic of the Congo, Samoa, Djibouti, Georgia, Zimbabwe, Sudan, Sri Lanka, Senegal, Saint Lucia, Thai, Tajikistan, Tanzania, Turkmenistan, Tonga, Pakistan, Papua New Guinea, Palau, Fiji, Philippines, Burundi, Benin, Madagascar, Micronesia, Myanmar, Moldova, Mongol, Lao, East Timor
124	1984557	Comprehensive Expressway Engineering	Continuation	Transportation	National Transportation	Social infrastructure / Peace-Building section	JICA Tokyo (Economy&Env.)	11	India, Kenya, Georgia, Pakistan, Philippines, Vietnam, Malaysia, Myanmar
125	1984555	Bridge Maintenance	Continuation	Transportation	National Transportation	Social infrastructure / Peace-Building section	JICA Kyushu	19	Iraq, Indonesia, Uganda, Ukraine, Egypt, Ghana, Guinea, Democratic Republic of the Congo, Zambia, Sri Lanka, Saint Lucia, Tanzania, Nicaragua, Philippines, Bhutan, Vietnam, Myanmar, Lao, South Sudan
127	1984558	Development of Urban Road Network	Continuation	Transportation	Urban Transportation	Social infrastructure / Peace-Building section	JICA Kansai (I)	17	Afghanistan, Yemen, Iraq, Uganda, Egypt, Ethiopia, Gambia, Democratic Republic of the Congo, Zambia, Zimbabwe, Tanzania, Nigeria, Nepal, Vietnam, Benin, Moçambique, East Timor
128	1984560	Environmentally Sustainable Urban Transport Planning	Continuation	Transportation	Urban Transportation	Social infrastructure / Peace-Building section	JICA Chubu	10	Iran, Egypt, Côte d'Ivoire, Sri Lanka, Tanzania, Nigeria, Bosnia, Herzegovina, Moçambique, Lao, Rwanda

Source: Provided by JICA

7.4 Planning of Training Contents of the Road AM Course Under the Issue-specific Training

7.4.1 Basic Concepts

- ✓ The primary level training is intended for road administrators who are less-experienced in road and bridge maintenance. The intermediate level training is intended for road administrators who, to some extent, have experience in maintenance and are aware of issues in further entrenchment of Road AM in their country. The primary, intermediate and advanced level trainings will have different contents, periods and participants.
- ✓ The primary level training should be deemed as standard training to be conducted in Japan (i.e., Trainers Training Programs: programs aiming at the dissemination of knowledge and skills that will be significant if learned by many people).
- ✓ The intermediate and advanced level training should be deemed as Solution Creation Programs (i.e., programs aiming at accelerating the solution of problems for an organization or society that go beyond the capacity building of individuals such as: work improvement, policy formation and system building).
- ✓ The primary level training is intended for new road administrators who are less-experienced in road and bridge maintenance.
- ✓ The intermediate level training is intended for new and mid-level road administrators who, to some extent, have experience in road and bridge maintenance and are aware of issues in further entrenchment of the Road AM in their country.
- ✓ The advanced level training is intended for mid-level road administrators who are well experienced in road and bridge maintenance and have experience in maintenance planning.

Table 7-15 Planned Course Contents for Issue-specific Training: Road Asset Management

Course	Primary Level	Intermediate Level	Advanced Level
Training Duration	3 weeks	4 weeks	4 weeks
Target Persons	3 to 5 years of experience	5 or more years of experience	10 or more years of experience
	New road maintenance administrators engaged in road maintenance duties	New and mid-level road administrators who have engaged in road maintenance duties for many years and, specifically those who oversee planning and formulating maintenance plans	Mid-level road administrators who are well experienced in road and bridge maintenance duties and have experience in planning and formulating maintenance plans
Goals	➢ Understanding the concept of road asset management ➢ Understanding the skills and knowledge required for each maintenance cycle item (inspection, assessment, analysis, repair, etc.)	➢ Being able to understand budget management techniques for carrying out appropriate maintenance ➢ Being able to formulate medium to long-term maintenance plans	➢ Being able to understand the skills and knowledge required for each maintenance cycle item (inspection, assessment, analysis, repair, etc.) for slopes and tunnels ➢ Being able to understand budget management techniques for carrying out maintenance on all construction

Main Training Contents	➢ Road and bridge inspection skills ➢ Damage to road pavement and slopes, and the cause thereof ➢ Repair techniques ➢ Types and causes of bridge damage ➢ Maintenance cycles ➢ Lectures on preventive maintenance	➢ Understanding and learning about the formulation of budget plans and the prediction of changes in soundness, utilizing maintenance systems (PMS, BMS, RMS) and inspection data	➢ Slope and tunnel inspection technology ➢ Damage to slopes and tunnels and the causes thereof, and formulation of a repair plans therefor ➢ Formulation of plans for the maintenance of all roads under the jurisdiction, and the management of budget thereof
Participating Countries	Countries where no technical project for maintenance has been carried out 1)Papua New Guinea, 2) Niue, 3) Solomon Islands, 4) Cook Islands, 5) Kiribati, 6) Rwanda, 7) Madagascar, 8) Namibia, 9) Nigeria, 10) Djibouti (Total 10-countries, 10-people)	Countries where any maintenance technology cooperation project has been carried out 1)Bangladesh, 2) Laos, 3) Myanmar, 4) Philippines, 5) Timor-Leste (+2), 6) Cambodia, 7) Tajikistan, 8) Bolivia, 9) Mozambique, 10) Zambia, 11) Ghana, 12) Ethiopia (Total 12-countries, 14-people)	➢ Applications for the advanced level Issue-specific Training course will be received, and the contents of the training will be reviewed and carried out

Source: JICA Study Team

7.4.2 Grouping of Course Contents (primary and intermediate levels) Based on Request Survey Results for Issue-specific Training in FY 2019

Table 7-16 List of Grouped Course Contents (primary and intermediate levels) (1)

NO.	Region	Requesting country	Program Title												Implementation status of technical cooperation project																	
			2E+06 Comprehensive Bridge Engineering	2E+06 Project Management in Infrastructure Development for Civil Engineers	2E+06 Transportation / Capacity Development for Transport Sector	2E+06 Road Administration	2E+06 Construction machine construction management (Utilization of i-Construction)	2E+06 Infrastructure Management System for Road Administration	2E+06 Traffic safety	1984918 Road Asset Management	2E+06 Road Maintenance	2E+06 Comprehensive Expressway Engineering	2E+06 Bridge Maintenance	2E+06 Development of Urban Road Network	2E+06 Environmentally Sustainable Urban Transport Planning	◎Technical cooperation project		◎Technical cooperation project		◎Technical cooperation project		◎Technical cooperation project		◎Technical cooperation project		◎Technical cooperation project		◎Technical cooperation project		◎Technical cooperation project	
			Continuation 17	Continuation 10	Update 8	Update 15	Update 3	Continuation 10	New 21	New 24	Continuation 39	Continuation 11	Continuation 19	Continuation 17	Continuation 10	Transportation project name	Cooperation period Start	Cooperation period End	Transportation project name	Cooperation period Start	Cooperation period End	Transportation project name	Cooperation period Start	Cooperation period End	Transportation project name	Cooperation period Start	Cooperation period End	Transportation project name	Cooperation period Start	Cooperation period End	Transportation project name	Cooperation period Start	Cooperation period End
1	South Asia	Bhutan											○			Technical Cooperation Project For Capacity Development in Construction and Maintenance of Bridges	2016/9/9	2019/10/31														
2	South Asia	Bangladesh								○Intermediate						Bridge Management Capacity Development Project	2015/7/10	2018/3/2														
3	South Asia	Pakistan			○				○		○	○																				
4	South Asia	Nepal	○						○					○		Bridge Management Capacity Development Project	2018/1/1	2019/12/31	The Project for the Development of a Spare Parts Management Center and En-route Radar Control Services	2014/2/2	2017/12/31	The Project for the Operation and Maintenance of Sindhuli Road	2011/12/1	2016/1/1								
5	South Asia	Sri Lanka									○		○		○	The Project for Capacity Development on Bridge Management	2015/2/6	2018/2/23														
6	South Asia	India										○				The Capacity Development Project on Highways in Mountainous Regions	2016/4/1	2021/3/31														
7	South Asia	Afghanistan		○				○			○			○		The Project for Capacity Development for Management of Kabul City Road Improvement	2016/9/23	2019/9/30	Capacity Development and Establishment of Road Maintenance Management System Project	2008/3/24	2011/3/23										
8	Southeast Asia	Laos	○			○	○			○Intermediate	○		○		○	The Project to enhance the Capacity of Vientiane Capital Bus Enterprise (Phase II)	2016/8/15	2019/8/14	Project to Enhance the Capacity of Vientiane Capital State Bus Enterprise	2012/1/11	2014/12/26	Project for Improvement of the Road Management Capability	2011/9/22	2017/9/1								
9	Southeast Asia	Myanmar	○			○				○Intermediate	○	○	○			The Project on Improvement of Railway Service and Rolling Stock Maintenance	2017/7/31	2021/6/30	The Project for Capacity Development on CNS/ATM Systems	2014/9/1	2018/8/31	Project on Improvement of Service and Safety of Railway	2013/5/31	2015/5/30	Project for Improvement of Road Technology in Disaster Affected Area	2012/7/26	2015/6/30	Project for Capacity Development of Road and Bridge Technology	2016/4/1	2019/6/30				
10	Southeast Asia	Malaysia							○			○				Project for Capacity Building in Maritime Safety and Security	2009/6/2	2011/6/1														
11	Southeast Asia	Viet Nam				○			○			○	○	○		Project for Capacity Enhancement in Road Maintenance Phase II	2015/2/9	2018/4/25	The Project for Improving Public Transportation Hanoi	2011/7/1	2015/6/30	Project for Strengthening the Traffic Police Training in Various Police Colleges of Vietnam	2010/6/1	2013/6/1	Project for Capacity Enhancement in Construction Quality Assurance	2010/5/16	2013/3/21	The Project on the Improvement of the Port Management System in the Socialist republic of Vietnam	2005/2/1	2008/11/30				
12	Southeast Asia	Philippines	○		○	○		○		○Intermediate	○	○	○			Improvement of Quality Management for Highway and Bridge Construction and Maintenance Phase 3	2016/2/16	2019/2/28	The Project for Capacity Development on Transportation Planning and Database Management in the Republic of the Philippines	2011/9/27	2014/9/19	Improvement of Quality Management for Highway and Bridge Construction and Maintenance, Phase II	2011/10/1	2014/9/30	Capacity Development Project for Improvement of Safety and Efficiency for Air Navigation System	2009/2/25	2014/2/24	Improvement of Quality Management for Highway and Bridge Construction and Maintenance Project	2007/2/17	2010/2/16				
13	Southeast Asia	Timor-Leste				○		○	○	○Intermediate+2	○			○		The Project for the Capacity Development of Road Services in the Democratic Republic of Timor-Leste	2016/2/15	2019/2/14	The Project for the Capacity Development of Road Works in Timor Leste	2010/6/15	2013/3/31										
14	Southeast Asia	Thailand			○				○		○																					
15	Southeast Asia	Cambodia		○					○	○Intermediate						The Project for Capacity Enhancement on Environmental Social Considerations in Implementing Agency in Road Sector in Cambodia	2017/1/17	2020/1/16	The Project for Modernization of Vehicles Registration and Inspection Administration System	2016/9/12	2019/9/11	The Project for Strengthening Capacity for Maintenance of Roads and Bridges	2015/4/7	2018/3/16	Project on Capacity Enhancement of Environmental and Social Considerations for Resettlement	2010/4/1	2012/3/31	The Strengthening of Construction Quality Control Project	2009/5/11	2012/10/31	Project for Establishment of National Port Policy and Administration System	2009/3/14	2011/11/13	The Project for Traffic Improvement in Phnom Penh City in the Kingdom of Cambodia	2007/3/1	2010/3/31
16	Southeast Asia	Indonesia	○										○			JABODETABEK Urban Transportation Policy Integration	2009/7/5	2011/10/4	The Project on BAKORKAMLA (Indonesian Maritime Security Coordination Body) Structural	2008/5/21	2011/5/21										
17	East Asia	Mongolia							○		○																					
18	Central Asia	Turkmenistan									○																					
19	Central Asia	Tadjhikistan				○				○Intermediate	○					The Project for Improvement of Road Maintenance	2013/10/1	2016/6/1	The Project for Capacity Development for Road Disaster Management in the Republic of Tajikistan	2017/4/11	2020/8/10										
20	Central Asia	Georgia		○							○	○																				
21	Central Asia	Kyrgyz		○		○					○					The Project for the capacity building of road maintenance in the Kyrgyz Republic	2008/3/15	2011/9/30																
22	Central Asia	Kazakhstan									○																					
23	Central Asia	Uzbekistan							○		○																					
24	North America / Latin America	Bolivia								○Intermediate						The Project for Capacity Development of Road Disaster Prevention and Police Management and	2009/3/2	2012/3/30																
25	North America / Latin America	Nicaragua											○			The Project for the study of National Transport Plan in the Republic of Nicaragua	2012/12/1	2014/2/28																
26	North America / Latin America	St. Lucia									○		○																			
27	North America / Latin America	El Salvador									○					The Project for Capacity Development of the Department of Climate Change Adaptation and Strategic Risk Management for Strengthening of Public Infrastructure, Phase 2	2016/8/9	2021/8/8																
28	Middle East	Jordan							○																							
29	Middle East	Morocco							○																							
30	Middle East	Egypt			○				○		○		○	○	○	The Project for Improvement of the Bridge Management Capacity in Egypt	2012/3/20	2015/3/19																
31	Middle East	Iran													○																	
32	Middle East	Iraq											○	○																		
33	Middle East	Yemen												○																		
34	Oceania	Micronesia									○																					
35	Oceania	Fiji		○					○		○																					
36	Oceania	Palau							○		○																					

Beginner
1)Papua New Guinea, 2)Niue, 3)Solomon Islands, 4)Cook Islands, 5)Kiribati, 6)Rwanda, 7) Madagascar, 8) Namibia, 9) Nigeria, 10) Djibouti
(Total 10 countries, 10 people)

Intermediate
1) Bangladesh, 2) Laos, 3) Myanmar, 4) Philippines, 5) Timor-Leste (+2), 6) Cambodia, 7) Tajikistan, 8) Bolivia, 9) Mozambique, 10) Zambia, 11) Ghana, 12)Ethiopia
(Total 12 countries, 14 people)

Source: JICA Study Team

Table 7-17 List of Grouped Course Contents (primary and intermediate levels) (2)

NO.	Region	Requesting country	Program Title													Implementation status of technical cooperation project																			
			2E+06	2E+06	2E+06	2E+06	2E+06	2E+06	2E+06	1984918	2E+06	2E+06	2E+06	2E+06	2E+06	①Technical cooperation project			②Technical cooperation project			③Technical cooperation project			④Technical cooperation project			⑤Technical cooperation project			⑥Technical cooperation project			⑦Technical cooperation project		
			Comprehensive Bridge Engineering	Project Management in Infrastructure Development for Civil Engineers	Transportation / Capacity Development for Transport Sector	Road Administration	Construction machine construction management (Utilization of i-Construction)	Infrastructure Management System for Road Administration	Traffic safety	Road Asset Management	Road Maintenance	Comprehensive Expressway Engineering	Bridge Maintenance	Development of Urban Road Network	Environmentally Sustainable Urban Transport Planning	Transportation project name	Cooperation period		Transportation project name	Cooperation period		Transportation project name	Cooperation period		Transportation project name	Cooperation period		Transportation project name	Cooperation period		Transportation project name	Cooperation period		Transportation project name	Cooperation period	
			Continuation	Continuation	Update	Update	Update	Continuation	New	New	Continuation	Continuation	Continuation	Continuation	Continuation		Start	End		Start	End		Start	End		Start	End		Start	End		Start	End		Start	End
			17	10	8	15	3	10	21	24	39	11	19	17	10																				
37	Oceania	Papua New Guinea	○							○Beginner	○																								
38	Oceania	Niue								○Beginner																									
39	Oceania	Tonga						○	○		○																								
40	Oceania	Solomon Islands							○	○Beginner																									
41	Oceania	Independent State Of Samoa		○					○		○																								
42	Oceania	Cook Islands								○Beginner																									
43	Oceania	Kiribati								○Beginner																									
44	Europe	Moldova									○																								
45	Europe	Bosnia													○																				
46	Europe	Hercegovina													○																				
47	Europe	Ukraine									○		○																						
48	Africa	Rwanda	○			○		○	○	○Beginner					○																				
49	Africa	Liberia	○					○	○																										
50	Africa	Mozambique	○	○		○		○		○Intermediate				○	○	The Project for the Capacity Development of road maintenance in the Republic of Mozambique	2011/8/1	2014/7/31																			
51	Africa	Mauritania				○																													
52	Africa	Mauritius		○																															
53	Africa	South Sudan				○		○					○			The Project for Capacity Development on Sustainable Road Maintenance and Management in Juba, South Sudan	2011/9/1	2014/3/31	The Project for Enhancement of Operation and Management of Inland Waterway in Southern Sudan	2011/3/1	2015/6/30	Juba Urban Transport Infrastructure and Capacity Development Study		2008/8/1	2010/2/28											
54	Africa	Malawi				○																													
55	Africa	Madagascar								○Beginner	○																								
56	Africa	Benin				○					○			○																					
57	Africa	Burundi									○					Projet de Réhabilitation du Transport Public	2009/4/18	2012/3/31																		
58	Africa	Burkina Faso							○																										
59	Africa	Namibia								○Beginner																									
60	Africa	Nigeria			○		○	○		○Beginner				○	○																				
61	Africa	Togo	○																																
62	Africa	Tanzania	○								○		○	○	○	Rural Road Maintenance System Development Project (RMSD)	2012/2/24	2016/3/25	The Project for Capacity Strengthening of LBT Training at ATTI	2006/6/22	2011/2/28																
63	Africa	Senegal									○																								
64	Africa	Sudan	○								○																								
65	Africa	Zimbabwe	○								○			○																					
66	Africa	Djibouti								○Beginner	○																								
67	Africa	Zambia	○							○Intermediate			○	○		Bridge Maintenance Capacity Building Project	2015/2/1	2017/8/31																		
68	Africa	Dem. Rep. Of Congo				○					○		○	○		The Project for Capacity Development of Road Maintenance Management	2016/2/24	2019/5/31																		
69	Africa	Congo	○																																
70	Africa	Cote D'Ivoire		○		○									○																				
71	Africa	Kenya	○			○						○				The Project for the Strengthening of Capacity on Roads Maintenance Management through Contracting, Phase 3	2016/12/1	2019/11/30	The Project for the Strengthening of Capacity on Roads Maintenance Management through Contracting, Phase II	2013/11/3	2015/11/2														
72	Africa	Guinea											○																						
73	Africa	Gambia												○																					
74	Africa	Cameroon									○																								
75	Africa	Ghana		○	○					○Intermediate	○		○			Project for Developing Labour Based Bituminous Surfacing Technology	2016/1/18	2019/6/30																		
76	Africa	Ethiopia						○		○Intermediate				○		The Project for Development of Road Maintenance Capacity of Addis Ababa City	2015/6/1	2019/7/27																		
77	Africa	Uganda	○		○		○						○	○																					
78	Africa	Angola									○																								

Beginner
1)Papua New Guinea, 2) Niue, 3) Solomon Islands, 4) Cook Islands, 5) Kiribati, 6) Rwanda, 7) Madagascar, 8) Namibia, 9) Nigeria, 10) Djibouti
(Total 10 countries, 10 people)

Intermediate
1) Bangladesh, 2) Laos, 3) Myanmar, 4) Philippines, 5) Timor-Leste (+2), 6) Cambodia, 7) Tajikistan, 8) Bolivia, 9) Mozambique, 10) Zambia, 11) Ghana, 12) Ethiopia
(Total 12 countries, 14 people)

Source: JICA Study Team

7.4.3 Concept Papers for Issue-specific Training

道路アセットマネジメント Road Asset Management	1984918 Innovative Program New No Fixed Allocation 1 Persons/Country Desir
Target Countries:	15 participants
Previous Course Name:	
Sector: Transportation/Capacity Development for Transport Sector	
Sub-Sector:	
Language: English	

Outline

"Road Asset Management" is to implement a maintenance plan, which is minimized the life cycle cost of road assets, such as pavements, bridges, tunnels and other road structures, by grasping the current conditions of those assets appropriately, predicting deterioration and damage of them individually, and achieving an extension of life span of those assets due to repair and reinforce those appropriately. The purpose of this training is to enhance skills for implementing Road Asset Management by acquiring necessary knowledge and techniques for appropriate maintenance works and maintenance plan of road assets in each target country.

Objective/Outcome	Target Organization / Group
【Objective】 To formulate Action Plan for establishment of Road Asset Management in each country, by understanding the efforts and related research & development toward establishing Road Asset Management System in Japan, the method of planning budget plan based on the inspection result of road assets, and the method of prediction soundness. 【Outcome】 1. To understand the current situation and maintenance methods of road assets in Japan. 2. To acquire skills that can be introduced in each target country by understanding efforts, related research & development, and human resource development toward establishing Road Asset Management System in Japan. 3. To understand the characteristics and damage of concrete / steel structures so as to acquire the concept of an infrastructure management by utilizing the inspection data. 4. To compile the Action Plan for establishing Road Asset Management in each target country.	【Target Organization】 Organizations that have jurisdiction over maintenance of road assets of the country 【Target Group】 Junior or Mid-level administrators who formulate road assets operation and maintenance plan. Fluent in English,

Contents		
[Preliminary Phase] To prepare a report on the current situation of the maintenance of road assets. [Core Activities] 1. Lectures on the current situation of the maintenance of road assets in Japan, the characteristics and damages of concrete / steel structures, and the concept of management of road infrastructures by utilizing the inspection data. 2. Study Tours; (1) Advanced Technology (ex. highway maintenance technology, pavement maintenance system, long span bridge maintenance system, bridge facility inspection, maintenance / repair technical standards and manuals, human resource development) (2) Research and Development by Universities (ex. model facility of concrete deterioration and aging structure, bridge inspection assisted with robot technology, infrastructures lifetime-extending maintenance technology) (3) Efforts by local governments (ex. shift to preventive maintenance, human resource development) (4) Advanced Technology by private companies (ex. inspection robot technology, monitoring technology, pavement repair material, recycle technology) 3. Exercise on inspection data (analysis of the trend of bridge deterioration, development of prediction soundness curve for bridge deterioration, data mapping for bridge locations, data processing and analysis, etc.) 4. To make an action plan for establishing Road Asset Management by understanding the current situation and issues of road assets in each target country. [Finalization Phase] 1. To discuss on and revise the action plan in the target organization. 2. To implement measures to maintain road assets according to the action plan. 3. Twelve months after returning country, the participants submit a review report about the situation of implementing the action plan.	Course Period	Under Planning Under Planning
	Implementing Partner	Organizations with technical knowledge and practical experience on road asset management
	Department in Charge	Infrastructure and Peacebuilding Department Transportation and ICT Group
	JICA Center	JICA Tokyo (Economy & Env.)
	Cooperation Period	2019～2021
Remarks and website		

7.4.4 Comparative Summary of the Primary and Intermediate Courses of the Road Asset Management under JICA Issue-specific Training

		Primary Level	Intermediate Level
1. Basic information of the Training	(1) Name of Training	(Japanese) 道路アセットマネジメント（新機軸・高品質プログラム） (English) Road Asset Management	
	(2) Training Duration (planned)	January 17, 2020 (Friday) to February 8, 2020 (Saturday) [Technical training duration: January 20, 2020 (Monday) to February 7, 2020 (Friday)	Feb. 20 (Thu.), 2020 to Mar. 20 (Fri.), 2020 [Technical training period: Feb. 21 (Fri.), 2020 to Mar. 19 (Thu.), 2020]
	(3) Number of Trainees	10	14
	(4) Participating Countries	Countries where no Technical Project for maintenance has been carried out: 1) Papua New Guinea, 2) Niue, 3) Solomon Islands, 4) Cook Islands, 5) Kiribati, 6) Rwanda, 7) Madagascar, 8) Namibia, 9) Nigeria, 10) Djibouti (Total 10 countries, 10 people)	Those implementing a maintenance technology cooperation project: 1) Bangladesh, 2) Laos, 3) Myanmar, 4) Philippines, 5) Timor-Leste (+2), 6) Cambodia, 7) Tajikistan, 8) Bolivia, 9) Mozambique, 10) Zambia, 11) Ghana, 12) Ethiopia (Total 12 countries, 14 people)
	(5) Target Persons	1) New road administrators engaged in road and bridge maintenance duties 2) Those who have 3 to 5 years of experience in such sector (1 to 2 years of experience in inspection and diagnosis duties) 3) Those who have an undergraduate degree or equivalent educational qualification 4) Those having the linguistic capability to communicate smoothly in English training. 5) Those both mentally and physically healthy.	1) New and mid-level road administration officials engaged in maintenance operations of roads and bridges, particularly maintenance planning and formulation. 2) Those having 5 years or more experience in the said field. (Those having 1 to 2 years of experience in inspections and audit operations and 1 to 3 years of experience in maintenance planning operations.) 3) University graduates or those having an equivalent educational background. 4) Those having the linguistic capability to communicate smoothly in English training. 5) Those both mentally and physically healthy.
	(6) Training Agency	Tokyo International Center, Japan International Cooperation Agency (“JICA Tokyo”)	
	(7) Course Language	English	
2. Background of the Training		There is high demand for infrastructure development in developing countries, the amount of which is expected to be about 26 trillion dollars in the Asia-Pacific region by 2030. Also, the infrastructure that have been built with Japan’s assistance since the 1970s are almost 50 years old and considering demands for new construction projects, it is essential to reduce costs for such projects by introducing the concept of preventive maintenance and optimizing maintenance. Therefore, it is important to acquire the idea of asset management that, based on the understanding of the current condition of road assets (e.g., bridges), allows to predict the deterioration (aging) of and damage to respective assets, extend their service lives by conducting timely repairs and reinforcements, and realize maintenance plans with minimum life-cycle cost. This training is intended to provide training for trainees to acquire necessary knowledge and skills toward securing funding sources for the road asset maintenance work carried out in developing countries and for carrying out such work over a medium to long-term period.	
3. Goals of the Training		This training aims at helping trainees understand the necessity of road asset management through the understanding of the state of efforts, research and development toward the entrenchment of road asset management in Japan, and also through the acquisition of the knowledge and skills related to each maintenance cycle item (inspection, assessment, analysis, repair, etc.). After undergoing Training, trainees are expected to: 1） Be able to understand the state of Japan’s road assets and the management methods thereof; 2） Be able to understand the state of Japan’s efforts related to road asset management, its human resource development methods and the state of its research and development, and to have acquired the skills and knowledge that can be adopted in their own countries; 3） Be able to understand Japan’s national and local road asset management plans and implementation system thereof, and to understand, acquire and consider the skills and knowledge that can be applied to their own countries; and 4） Be able to acquire the basic knowledge and skills on road and bridge maintenance, design and construction, damage and measures against it, and the like.	To clarify the issues on each participant country’s own road maintenance and formulate responsive measures and improvement measures for a solution of the issues and rooting of future efficient road asset management through an understanding of approaches and R&D for the rooting of domestic road asset management in Japan as well as understanding and learning about budgeting based on the inspection data and an integrity transition estimation method. After undergoing Training, trainees are expected to: 1） Be able to clarify issues on road maintenance in each country and parent organization. 2） Understand road asset status and road maintenance methods in Japan. 3） Understand approaches to road asset management, human resource development methods and R&D status in Japan; learn about technologies and knowledge introducible to your own country. 4） Understand the features of and damage on the concrete and steel structures; learn about the management concept of the infrastructural structures by utilizing inspection data. 5） Consider measures for formulating a proper road maintenance plan through gaining knowledge and understanding of technologies required for road asset management. 6） Formulate responsive measures and improvement measures required for the rooting of road asset management back home.
4. Contents of the Training		The training items shown below will apply, mutatis mutandis, to the curriculum structure of these courses. The participating trainees must clarify the current status, issues and problems of the maintenance of road assets in their home countries through the preparation of the Job and Country Report as preliminary activities. On that basis, trainees will consider how to solve the issues and problems by utilizing the knowledge acquired through the training. Moreover, this training aims at having trainees prepare action plans so that they can disseminate in their home countries the skills and knowledge they acquired in the training. After returning home, trainees will conduct efforts in the maintenance of road assets in accordance with the action plans formulated by all the trainees from all the participating countries, they will submit the review reports on the status of implementation about 12 months after they return home. JICA will also consider visiting the relevant countries to give advice or hold workshops, as applicable, as follow-up for trainees.	
		<Training items> (1) Lectures will be given on Japan’s current status of infrastructure, on the characteristics of and damage to concrete and steel structures and on the idea of infrastructure management. (2) Visits will be made for the following purposes:	<Training items> (1) Lectures on the status quo of the Japanese infrastructure, features of and damage on the concrete and steel structures, and management concept of the infrastructural structures. (2) Following inspections.

	1） State-of-the-art efforts: expressway maintenance, repair technology, efforts for inspection and management, development of inspection and maintenance standards, development of engineers; and 2） Efforts by universities: deteriorated structure accumulation facilities, research and development of advanced road maintenance technology, and development of engineers; (1) Analysis exercise of road asset inspection data; (2) Formulation of preventive and effective maintenance plans in Japan; (3) Activities based on maintenance plans in Japan (inspection, assessment, planning, etc.); (4) Lectures, visits and practice related to actual maintenance work, disaster prevention, etc.; and (5) Sharing of the maintenance status and issues of road assets in respective countries, and preparation of, presentation of and discussion on action plans toward the entrenchment of road asset management methods after returning home.	1） State-of-the-art efforts: maintenance of the expressways, repair technology, maintenance of the long and large bridges, approaches to inspection, improvement of the inspection and maintenance and repair standards, and development of engineers. 2） Efforts by universities: deteriorated structure accumulation facilities, research and development of advanced road maintenance technology, and development of engineers. (1) Efforts by private companies: development of advanced road management technology, bridge repair technology, materials, and recycling technology. (2) Analytical practice of road asset inspection data and practice of budgeting and the integrity transition estimation system. (3) Preparation, publication and discussion of the action programs for sharing road asset maintenance status and the issues of each country as well as the rooting of asset management methods after going back.
5. Training Methods	(1) Lectures: texts, summaries, etc., will be prepared, and audio-visual materials will be used, if necessary, in order to enhance the understanding by trainees. (2) On-site visits and training trips: these opportunities are intended to be conducive to their practice after returning home, giving weight to the connection with the lectures, and arranging such opportunities to allow trainees to review the contents they learned at the lectures with reference to the textbooks and to nurture their applied skills. (3) Preparation and presentation of action plans: each trainee is required to prepare and present his or her action plan and will receive comments and advice from lecturers. The trainee will revise the action plan based on those comments and submit the final plan. For the purpose of the trainee's presentation of his or her country's action plan, JICA will consider deepening the mutual understanding between the trainee and Japanese stakeholders and endeavor to enhance his or her problem-solving ability after returning home. (4) For the review reports (e.g., the implementation status of the action plans of each relevant country, the status of horizontal dissemination of training content acquired) to be made by trainees of all the participating countries, JICA assumes that the reports will be made by, for example, using JICA's teleconference system that connects responsible offices and agencies with overseas offices. The results will be shared by all the trainees from all the participating countries via email or the like. Also, regarding the problems and issues acknowledged in the review, JICA will conduct follow-up activities by holding consultations with trainees and their superiors or holding workshops in their country.	
6. Input	(1) Input by Japanese side ・Project cost necessary for training, such as expenses for the dispatch of Japanese lecturers, and travel and lodging expenses and per diem allowances of participating trainees from counterpart countries. (2) Input by counterpart countries ・Cost for preparation and distribution of General Information brochures (GI) ・Cost for recruitment and selection of participants and notification of selection results through diplomatic channels	

7. Schedule and Training Curriculum (Draft)

Date		Type	Training contents (Draft)	Name of lecturer(s) (Draft)	Affiliation and title
Jan 17	Fri		Arrival in Japan		
Jan 18	Sat		Day off		
Jan 19	Sun		Day off		
Jan 20	Mon	Other review meeting	Opening Ceremony, briefing, program orientation, job/country report presentation meeting	JICA course leader	JICA Tokyo
Jan 21	Tue	Lecture	Current infrastructure in Japan	Kouhei Nagai	Institute of Industrial Science (IIS), University of Tokyo
Jan 22	Wed	Lecture	Idea of infrastructure management	Kouhei Nagai	IIS, University of Tokyo
Jan 23	Thu	Lecture	Analysis exercise of inspection data	Kouhei Nagai, Koji Matsumoto	IIS, University of Tokyo
Jan 24	Fri	Lecture	Analysis exercise of inspection data	Kouhei Nagai, Koji Matsumoto	IIS, University of Tokyo
Jan 25	Sat		Day off		
Jan 26	Sun	Travel	Day off Travel from Haneda Airport to Nagasaki Airport		
Jan 27	Mon	Lecture	Introduction to bridges; transition of technology	Hiroshi Matsuda	Nagasaki University Infrastructures Lifetime-Extending Maintenance Research Center
		Lecture	Basics and inspection procedures of slopes	Satoshi Sugimoto	
		Lecture	Basics and inspection procedures of paving	Takafumi Nishikawa	
		Lecture	Design and construction technology of concrete bridges	Toshihiro Okumatsu	
		Lecture	Causes and cases of concrete structure deterioration	Toshihiro Okumatsu	
		Lecture	Inspection of concrete structures	Kenji Sasaki	
Jan 28	Tue	Lecture	Focus points and inspection technology in concrete bridge inspection	Kenji Sasaki	
		Lecture	Characteristics and deformation of steel structural ferrous materials	Educational video	
		Lecture	Causes and cases of steel structure deterioration	Kohei Yamaguchi	
		Lecture	Degradation phenomenon of steel structure	Kohei Yamaguchi	
		Lecture	Focus points and inspection technology in steel bridge inspection	Educational video	
Jan 29	Wed	Lecture/exercises	Inspection exercises for steel structures		
		Lecture/exercises	Inspection exercises for concrete structures		
Jan 30	Thu	Field training	Inspection practical trainings for concrete and steel bridge inspections		
Jan 31	Fri	Field training	Practical inspection training for slopes		
Feb 1	Sat	Travel	Day off Travel from Nagasaki Airport to Itami Airport		
Feb 2	Sun		Day off		
Feb 3	Mon	Lecture	Outline explanation of expressway asset management	Tsuyoshi Takeno	Ibaraki Technical Training Center, West Nippon Expressway Company
		Lecture	Outline explanation of expressway renewal projects	Kazuhiro Ito	
		Study Tour	Site inspection of expressway repair work (planned to visit a repair work site)		
Feb 4	Tue	Travel	Travel from Kyoto to Nagoya		
		Study tour	Study tour to N2U-Bridge (deteriorated structure accumulation facility)	Hikaru Nakamura	Bridge Life Extension Promotion Office, Nagoya University
Feb 5	Wed	Course	Regular inspection of Kakamigahara Bridge utilizing robot technology	Keitetsu Rokugo	Center for Infrastructure Asset Management Technology and Research
		Travel	Travel from Nagoya to Tokyo		
Feb 6	Thu	Exercises	Preparation of action plans	JICA course leader	JICA Tokyo
Feb 7	Fri	Review meeting	Presentation of action plans, evaluation meeting, closing ceremony	JICA course leader	JICA Tokyo
Feb 8	Sat		Departure from Japan		

Date		Style	Description (Draft)	Lecturer (Draft)	Place of employment and position
Feb 20	Thu.		Arrival in Japan		
Feb 21	Fri.	Others	Opening ceremony, briefing, program orientation	JICA	JICA Tokyo
Feb 22	Sat.		Holiday		
Feb 23	Sun.		Holiday		
Feb 24	Mon.	Review meeting	Job and country report publication meeting	JICA course leader	JICA Tokyo
Feb 25	Tue.	Lecture	Status quo of Japanese infrastructure	Kouhei Nagai	University of Tokyo, Institute of Industrial Science
Feb 26	Wed.	Lecture	Features of and damage on the steel structures	Kouhei Nagai, Tsukasa Mizutani	University of Tokyo, Institute of Industrial Science
Feb 27	Thu.	Lecture	Management concept of the infrastructural structures	Kouhei Nagai	University of Tokyo, Institute of Industrial Science
Feb 28	Fri.	Lecture	Analytical practice of the inspection data	Kouhei Nagai, Koji Matsumoto	University of Tokyo, Institute of Industrial Science
Feb 29	Sat.		Holiday		
Mar 1	Sun.		Holiday		
Mar 2	Mon.	Lecture	Analytical practice of the inspection data	Kouhei Nagai, Koji Matsumoto	University of Tokyo, Institute of Industrial Science
Mar 3	Tue.	Lecture	Analytical practice of the inspection data	Kouhei Nagai, Koji Matsumoto	University of Tokyo, Institute of Industrial Science
Mar 4	Wed.	Lecture	Introduction of the bridge repair materials	Naoki Yamashita	Taiheiyo Materials
		Lecture/field trip	Bridge repair material test, field trip to the bridge repair site	Fabinia Romero	Alpha Kogyo
		Move	From Tokyo to Nagoya		
Mar 5	Thu.	Field trip	Field trip to N2U-Bridge (Deteriorated structures consolidation facility)	Hikaru Nakamura	Nagoya University, Long Bridge Life Promotion Office
		Workshop	Periodic inspection of the Kakamigahara Bridge by utilizing robot technology	Keitetsu Rokugo	Gifu University, Center for Infrastructure Asset Management Technology and Research
		Move	From Gifu Hajima to Kyoto		
Mar 6	Fri.	Lecture	Overview of expressway asset management	Takeshi Takeno	NEXCO West Nippon, Ibaraki Technical Training Center
		Lecture	Overview of the expressway renewal project	Kazuhiro Ito	
		Field trip	Inspection of the expressway repair work site (Repair work site scheduled)		
Mar 7	Sat.		Holiday		
Mar 8	Sun.		Holiday		
Mar 9	Mon.	Lecture	Maintenance of the long and large bridges, approaches to inspection and management, and improvement of inspection, maintenance and repair standards	Naoki Toyama	Honshu-Shikoku Bridge Expressway
		Field trip	Field trip to an exhibition of construction technologies		Bridge Exhibition Center
		Field trip	Field trip to the Akashi Kaikyo Bridge		Akashi Kaikyo Bridge
		Move	From Kobe to Tokyo		
Mar 10	Tue.	Lecture	Development of advanced road management technologies by private organizations	Kazuya Aoki, Chikakuni Maeda	
Mar 11	Wed.	Lecture	Practice of budgeting and the integrity transition estimation system	Kouhei Nagai, Koji Matsumoto	University of Tokyo, Institute of Industrial Science
Mar 12	Thu.	Lecture	Practice of budgeting and the integrity transition estimation system	Kouhei Nagai, Koji Matsumoto	University of Tokyo, Institute of Industrial Science
Mar 13	Fri.	Lecture	Practice of budgeting and the integrity transition estimation system	Kouhei Nagai, Koji Matsumoto	University of Tokyo, Institute of Industrial Science
Mar 14	Sat.		Holiday		
Mar 15	Sun.		Holiday		
Mar 16	Mon.	Lecture	Status quo and maintenance of the road bridges	Yoshinobu Oshima	Public Works Research Institute
		Field trip	Field trip to a yard for removed members, wheel load running tester, and 3,000-ton loading tester	—	
		Field trip	Field trip to a shaking table	—	
Mar 17	Tue.	Practice	Preparation of an action plan	JICA course leader	JICA Tokyo
Mar 18	Wed.	Review meeting	Action plan publication meeting, social gathering	JICA course leader	JICA Tokyo
Mar 19	Thu.	Others	Evaluation meeting, closing ceremony, and debrief meeting	JICA	JICA Tokyo
Mar 20	Fri.		Holiday (Vernal Equinox Day) Departure from Japan		

7.4.5 Outline of FY 2019 JICA Issue-specific Trainng "Road Asset Management (Primary level)"

7.4.5.1 Basic Information of the Training

(1) Name of Training
Road Asset Management

(2) Training duration (planned)
January 17, 2020 (Friday) to February 8, 2020 (Saturday)
[Technical training duration: January 20, 2020 (Monday) to February 7, 2020 (Friday)

(3) Number of Trainees
10 people

(4) Participating Countries
Countries where no Technical Project for maintenance has been carried out
1) Papua New Guinea, 2) Niue, 3) Solomon Islands, 4) Cook Islands, 5) Kiribati,
6) Rwanda, 7) Madagascar, 8) Namibia, 9) Nigeria, 10) Djibouti
(Total 10 countries, 10 people)

(5) Target Persons
1) New road administrators engaged in road and bridge maintenance duties
2) Those who have 3 to 5 years of experience in such sector (1 to 2 years of experience in inspection and diagnosis duties)
3) Those who have an undergraduate degree or equivalent educational qualification
4) Those having the linguistic capability to communicate smoothly in English training.
5) Those both mentally and physically healthy.

(6) Training Agency: Tokyo International Center, Japan International Cooperation Agency ("JICA Tokyo")

(7) Course Language: English

7.4.5.2 Background of the Training

There is high demand for infrastructure development in developing countries, the amount of which is expected to be about 26 trillion dollars in the Asia-Pacific region by 2030. Also, the infrastructure that have been built with Japan's assistance since the 1970s are almost 50 years old and considering demands for new construction projects, it is essential to reduce costs for such projects by introducing the concept of preventive maintenance and optimizing maintenance. Therefore, it is important to acquire the idea of asset management that, based on the understanding of the current condition of road assets (e.g., bridges), allows to predict the deterioration (aging) of and damage to respective assets, extend their service lives by conducting timely repairs and reinforcements, and realize maintenance plans with minimum life-cycle cost. This training is intended to provide training for trainees to acquire necessary knowledge and skills toward securing funding sources for the road asset maintenance work carried out in developing countries and for carrying out such work over a medium to long-term period.

7.4.5.3 Goals of the Training

This training aims at helping trainees understand the necessity of road asset management through the understanding of the state of efforts, research and development toward the entrenchment of road asset management in Japan, and also through the acquisition of the knowledge and skills related to each maintenance cycle item (inspection, assessment, analysis, repair, etc.).

After undergoing training, trainees are expected to:
1) Be able to understand the state of Japan's road assets and the management methods thereof;
2) Be able to understand the state of Japan's efforts related to road asset management, its human resource development methods and the state of its research and development, and to have acquired the skills and knowledge that can be adopted in their own countries;
3) Be able to understand Japan's national and local road asset management plans and implementation system thereof, and to understand, acquire and consider the skills and knowledge that can be applied to their own countries; and
4) Be able to acquire the basic knowledge and skills on road and bridge maintenance, design and construction, damage and measures against it, and the like.

7.4.5.4 Contents of the Training

The training items shown below will apply, mutatis mutandis, to the curriculum structure of these courses. The participating trainees must clarify the current status, issues and problems of the maintenance of road assets in their home countries through the preparation of the Job and Country Report as preliminary activities. On that basis, trainees will consider how to solve the issues and problems by utilizing the knowledge acquired through the training. Moreover, this training aims at having trainees prepare action plans so that they can disseminate in their home countries the skills and knowledge they acquired in the training. After returning home, trainees will conduct efforts in the maintenance of road assets in accordance with the action plans formulated by all the trainees from all the participating countries, they will submit the review reports on the status of implementation about 12 months after they return home. JICA will also consider visiting the relevant countries to give advice or hold workshops, as applicable, as follow-up for trainees.

< Training items >
1) Lectures will be given on Japan's current status of infrastructure, on the characteristics of and damage to concrete and steel structures and on the idea of infrastructure management.
2) Visits will be made for the following purposes:
   (1) State-of-the-art efforts: expressway maintenance, repair technology, efforts for inspection and management, development of inspection and maintenance standards, development of engineers; and
   (2) Efforts by universities: deteriorated structure accumulation facilities, research and development of advanced road maintenance technology, and development of engineers;
      (a) Analysis exercise of road asset inspection data;
      (b) Formulation of preventive and effective maintenance plans in Japan;
      (c) Activities based on maintenance plans in Japan (inspection, assessment, planning, etc.);
      (d) Lectures, visits and practice related to actual maintenance work, disaster prevention, etc.; and
      (e) Sharing of the maintenance status and issues of road assets in respective countries, and preparation of, presentation of and discussion on action plans toward the entrenchment of road asset management methods after returning home.

7.4.5.5 Training methods

(1) Lectures: texts, summaries, etc., will be prepared, and audio-visual materials will be used, if necessary, in order to enhance the understanding by trainees.
(2) On-site visits and training trips: these opportunities are intended to be conducive to their practice after returning home, giving weight to the connection with the lectures, and arranging such opportunities to allow trainees to review the contents they learned at the lectures with reference to the textbooks and to nurture their applied skills.
(3) Preparation and presentation of action plans: each trainee is required to prepare and present his or her action plan and will receive comments and advice from lecturers. The trainee will revise the action plan based on those comments and submit the final plan. For the purpose of the trainee's

presentation of his or her country's action plan, JICA will consider deepening the mutual understanding between the trainee and Japanese stakeholders and endeavor to enhance his or her problem-solving ability after returning home.

(4) For the review reports (e.g., the implementation status of the action plans of each relevant country, the status of horizontal dissemination of training content acquired) to be made by trainees of all the participating countries, JICA assumes that the reports will be made by, for example, using JICA's teleconference system that connects responsible offices and agencies with overseas offices. The results will be shared by all the trainees from all the participating countries via email or the like. Also, regarding the problems and issues acknowledged in the review, JICA will conduct follow-up activities by holding consultations with trainees and their superiors or holding workshops in their country.

7.4.5.6 Input

(1) Input by Japanese side

- Project cost necessary for training, such as expenses for the dispatch of Japanese lecturers, and travel and lodging expenses and per diem allowances of participating trainees from counterpart countries.

(2) Input by counterpart countries

- Cost for preparation and distribution of General Information brochures (GI)
- Cost for recruitment and selection of participants and notification of selection results through diplomatic channels

7.4.5.7 Schedule and Training Curriculum (Draft)

Table 7-18 Schedule and Curriculum for Road Asset Management (Primary level) (Draft)

Date		Type	Training Contents (Draft)	Name of Lecturer(s) (Draft)	Affiliation and Title
Jan 17	Fri		Arrival in Japan		
Jan 18	Sat		Day off		
Jan 19	Sun		Day off		
Jan 20	Mon	Other Review Meeting	Opening ceremony, briefing, program orientation, job and country report presentation meeting	JICA course leader	JICA Tokyo
Jan 21	Tue	Lecture	Current infrastructure in Japan	Kouhei Nagai	Institute of Industrial Science (IIS), the University of Tokyo
Jan 22	Wed	Lecture	Idea of infrastructure management	Kouhei Nagai	IIS, the University of Tokyo
Jan 23	Thu	Lecture	Analysis exercise of inspection data	Kouhei Nagai, Koji Matsumoto	IIS, the University of Tokyo
Jan 24	Fri	Lecture	Analysis exercise of inspection data	Kouhei Nagai, Koji Matsumoto	IIS, the University of Tokyo
Jan 25	Sat		Day off		

Jan 26	Sun	Travel	Day off Travel from Haneda Airport to Nagasaki Airport		
Jan 27	Mon	Lecture	Introduction to bridges; transition of technology	Hiroshi Matsuda	Infrastructures Lifetime-Extending Maintenance Research Center, Nagasaki University
		Lecture	Basics and inspection procedures of slopes	Satoshi Sugimoto	
		Lecture	Basics and inspection procedures of paving	Takafumi Nishikawa	
		Lecture	Design and construction technology of concrete bridges	Toshihiro Okumatsu	
		Lecture	Causes and cases of concrete structure deterioration	Toshihiro Okumatsu	
		Lecture	Inspection of concrete structures	Kenji Sasaki	
Jan 28	Tue	Lecture	Focus points and inspection technology in concrete bridge inspection	Kenji Sasaki	
		Lecture	Characteristics and deformation of steel structural ferrous materials	Educational video	
		Lecture	Causes and cases of steel structure deterioration	Kohei Yamaguchi	
		Lecture	Degradation phenomenon of steel structure	Kohei Yamaguchi	
		Lecture	Focus points and inspection technology in steel bridge inspection	Educational video	
Jan 29	Wed	Lecture and exercises	Inspection exercises for steel structures		
		Lecture and exercises	Inspection exercises for concrete structures		
Jan 30	Thu	Field training	Practical training for concrete and steel bridge inspections		
Jan 31	Fri	Field training	Practical inspection training for slopes		
Feb 1	Sat	Travel	Day off Travel from Nagasaki Airport to Itami Airport		
Feb 2	Sun		Day off		
Feb 3	Mon	Lecture	Outline explanation of expressway asset management	Tsuyoshi Takeno	Ibaraki Technical Training Center, West Nippon Expressway Company
		Lecture	Outline explanation of expressway renewal projects	Kazuhiro Ito	
		Study Tour	Site inspection of expressway repair work (planned to visit a repair work site)		
Feb	Tue	Travel	Travel from Kyoto to Nagoya		

4		Study tour	Study tour to N2U-Bridge (deteriorated structure accumulation facility)	Hikaru Nakamura	Bridge Life Extension Promotion Office, Nagoya University
Feb 5	Wed	Course	Regular inspection of Kakamigahara Bridge utilizing robot technology	Keitetsu Rokugo	Center for Infrastructure Asset Management Technology and Research
		Travel	Travel from Nagoya to Tokyo		
Feb 6	Thu	Exercises	Preparation of action plans	JICA course leader	JICA Tokyo
Feb 7	Fri	Review meeting	Presentation of action plans, evaluation meeting, closing ceremony	JICA course leader	JICA Tokyo
Feb 8	Sat		Departure from Japan		

Source: JICA Study Team

7.4.5.8 Schedule and Training Curriculum (Draft)

(1) [Jan. 21 (Tue.)] Institute of Industrial Science, the University of Tokyo

Date and time	Jan. 21, 10:00 to 17:00
Training title	Status Quo of Japanese Infrastructure
Lecturer (Job title)	Kouhei Nagai
Purpose of lecture	▪To deepen knowledge through a general overview of the bridge-related technologies and the status quo of bridge maintenance in Japan.

(2) [Jan. 22 (Wed.)] Institute of Industrial Science, the University of Tokyo

Date and time	Jan. 22, 10:00 to 17:00
Training title	Concept of Management of Infrastructural Structures
Lecturer (Job title)	Kouhei Nagai
Purpose of lecture	▪To learn the basic concept of infrastructure management and utilization of the database.

(3) [Jan. 23 (Thu.), Jan. 24 (Fri.)] Institute of Industrial Science, the University of Tokyo

Date and time	Jan. 23, 10:00 to 17:00, Jan. 24, 10:00 to 17:00
Training title	Analytical Practice of Inspection Data
Lecturers (Job titles)	Kouhei Nagai, Koji Matsumoto
Purpose of lecture	▪To practice a case analysis of the bridge inspection data. ▪To learn the classification and organization methods, using the inspection data.

(4) [Jan. 27 (Mon.)] Nagasaki University, Infrastructures Lifetime Extending Maintenance Research Center, Assistant Road Maintenance Engineer

Date and time	Jan. 27, 9:00 to 10:00
Training title	Introduction to Bridges and Transition of Technologies
Lecturer (Job title)	Hiroshi Matsuda
Purpose of lecture	▪Component members of bridges: type of superstructure, type of substructure, type of foundation, bearings.

	▪Transition of bridge technologies: transition of concrete bridge technology, transition of steel bridge technology, transition of substructure technology, transition of bearing technology. ▪Bridge materials used and their deterioration: deterioration of materials used and concrete, deterioration of steel, cables, and coating materials.
Date and time	Jan. 27, 10:00 to 11:00
Training title	Slope Foundation and Inspection Procedures
Lecture (Job title)	Tomofumi Sugimoto
Purpose of lecture	▪Mode of fracture, fracture factors: fracture factors and collapse factors. ▪Cases of collapse: falling rocks, landslide from natural slopes, collapse of a rock slope. ▪Maintenance of the slope: maintenance flow of the slope, outline of the evaluation method of the degree of safety, main check items.
Date and time	Jan. 27, 11:00 to 12:00
Training title	Pavement Foundation and Inspection Procedures
Lecturer (Job title)	Takafumi Nishikawa
Purpose of lecture	▪Status quo of improvement and maintenance of roads. ▪Maintenance of the road and pavement. ▪Survey of pavement. ▪Approach to new road audit.
Date and time	Jan. 27, 13:00 to 14:00
Training title	Design and Construction Technologies of Concrete Bridges
Lecturer (Job title)	Toshihiro Okumatsu
Purpose of lecture	▪Foundation of the concrete structure. ▪Characteristics of reinforced concrete (RC). ▪Construction and transition of reinforced concrete bridges. ▪Characteristics of prestressed concrete (PC). ▪Construction and transition of prestressed concrete bridges.
Date and time	Jan. 27, 14:00 to 15:00
Training title	Causes and Cases of Deterioration of Concrete Structures
Lecturer (Job title)	Toshihiro Okumatsu
Purpose of lecture	▪Examples of cracked concrete bridges, inspection focus points, types of deformation and main factors, various surveys on the decades-old post-tension PCT girder bridges.
Date and time	Jan. 27, 15:00 to 16:00
Training title	Inspection of Concrete Structures
Lecturer (Job title)	Kenji Sasaki
Purpose of lecture	▪Deformation features of concrete structures: initial defects, deterioration, structural deformation and damage. ▪Inspection points of concrete structures: inspection focus points, concrete girders, concrete abutment piers, foundation, expansion devices, bearings, drainage facilities, signs, and lighting facilities.

(5) [Jan. 28 (Tue.)] Nagasaki University, Infrastructures Lifetime Extending Maintenance Research Center, Assistant Road Maintenance Engineer

Date and time	Jan. 28, 9:00 to 10:00
Training title	Focus Points of Concrete Bridge Inspection and Inspection Technology

Lecturer (Job title)	Kenji Sasaki
Purpose of lecture	▪Bridge inspection points. ▪Survey flow, identification of the cause of deterioration, factors for the damage cause, estimation of the cause of cracks. ▪Detailed survey method: type of a detailed survey, survey equipment, survey utensils and devices, evaluation and audit of load bearing capacity.
Date and time	Jan. 28, 10:00 to 11:00
Training title	Features and Deformations of Steel Structures and Steel Materials
Lecturer (Job title)	Video teaching materials
Purpose of lecture	▪Manufacturing method and nature of steel materials, welding methods, inspection motives of steel materials and vital inspection points. ▪Inspection motives of welded structures and vital inspection points, specialty of fatigue fractures, classification by carbon content, crystal structure and phase transformation, types and features of the metal structures of steel for construction, main dominant factors for steel strength. ▪Main alloy elements and their influences, rolled steel for construction, chemical components of the SM material, heat treatment of steel, causes of fracture and evaluation and response (ductile fracture, brittle facture, fatigue fracture), types of welding and jointing, features of the weld zones, types of weld cracks, weld residual stress.
Date and time	Jan. 28, 11:00 to 12:00
Training title	Causes and Cases of Deterioration of Steel Structures
Lecturer (Job title)	Kohei Yamaguchi
Purpose of lecture	▪Policy for damage control measures; “integral” refers to the factors damaging integrity, damage control measures, highly effective “preventive measures” and “early measures.” ▪Cases of damage and deterioration. ▪Requirements for planning measures (determining the urgency of the measure, finding out the cause of damage, setting a target level for the measure, selecting your own construction method and determining the design and construction procedures). ▪Action for a corroded member in order to remedy corrosion. ▪Features of fatigue damage, basic approach to control measures and points of the measure. ▪Damage on the expansion device and the bearings.
Date and time	Jan. 28, 13:00 to 14:00
Training title	Deterioration Phenomenon of Steel Structures
Lecturer (Job title)	Kohei Yamaguchi

Purpose of lecture	▪Main cases of damage on the steel girder bridges and causes of rebuilding of steel bridges. ▪Steel reaction to corrosion, classification of corrosion (galvanic corrosion, pitting, crevice corrosion), factors and causes of corrosion, and steel corrosion preventive methods. ▪Composition of coating and typical deteriorations of coating. ▪Weatherproof steel (differences from ordinary steel, corrosion rate, use record, usage, application conditions) ▪Rust appearance evaluation divisions. ▪About fatigue (type, occurrence and growth, type of crack in the weld zone, factors for fatigue damage). ▪Displacement, deformation, looseness, missing, delayed fracture.
Date and time	Jan. 28, 14:00 to 15:00
Training title	Inspection Focus Points of Steel Structures and Inspection Technologies
Lecturer (Job title)	Video teaching materials
Purpose of lecture	▪Type of inspections, maintenance other than inspections, main inspection items of for steel. ▪Example of a corrosion map, damage evaluation standard (corrosion). ▪Typical fatigue damage, damage evaluation standard (cracks). ▪Damage evaluation standard (looseness, missing, deteriorated corrosion preventive function, floating). ▪Basics for evaluating a division of measure, information required for evaluation and measure evaluation division. ▪Non-destructive inspection technology for steel bridges and methods for surveying the coating film status. ▪Fatigue crack inspection and test flow (eddy current test, magnetic particle test, penetrant test, ultrasonic test).

(6) [Jan. 29 (Wed.)] Nagasaki University, Infrastructures Lifetime Extending Maintenance Research Center, Assistant Road Maintenance Engineer

Date and time	Jan. 29, 8:00 to 12:00
Training title	Inspection Practice of Steel Structures
Lecturer (Job title)	(Lecture) Video teaching materials. (Practice)
Purpose of lecture	▪To give a lecture on the usage, features, measurement principles, accuracies, etc. of typical non-destructive testers and various inspection devices used for maintenance of the actual steel structures and practice with them. (1) Penetrant test, (2) Magnetic particle test, (3) Coating film thickness and rust thickness measurement, (4) Ultrasonic test and (5) Ultrasonic thickness measurement.
Date and time	Jan. 29, 13:00 to 17:00
Training title	Inspection Practice of Concrete Structures
Lecturer (Job title)	(Lecture) Video teaching materials (Practice)
Purpose of lecture	▪To give a lecture on the usage, features, measurement principles, accuracies, etc. of typical non-destructive testers and various inspection devices used for maintenance of actual concrete structures, and practice with them. (1) Electromagnetic radar method, (2) Electromagnetic induction method, (3) Neutralized drill method, (4) Rebound hardness measurement method, (5) Laser range finder, (6) Rotary hammering test method and (7) Infrared method.

(7) [Jan. 30 (Thu.)] Nagasaki University, Infrastructures Lifetime Extending Maintenance Research Center, Assistant Road Maintenance Engineer

Date and time	Jan. 30, 10:00 to 12:00 and 13:00 to 16:00
Training title	Inspection Practice of Concrete Bridges and Steel Bridges
Lecturers (Job titles)	Seiichi Yamane, Shogo Matsunaga, Yuko Yoshida
Purpose of lecture	▪To practice inspection of deformed concrete and steel bridges in Nagasaki.

(8) [Jan. 31 (Fri.)] Nagasaki University, Infrastructures Lifetime Extending Maintenance Research Center, Assistant Road Maintenance Engineer

Date and time	Jan. 31, 10:00 to 12:00, 13:00 to 16:00
Training title	Inspection Practice of Slopes
Lecturers (Job titles)	Kouji Yamashita, Shogo Matsunaga, Yuko Yoshida
Purpose of lecture	▪To practice inspection of the deformed concrete and steel bridges in Nagasaki.

(9) [Feb. 3 (Mon.)] NEXCO West Nippon, Ibaraki Technical Training Center

Date and time	Feb. 3, 10:00 to 11:30
Training title	Overview of Asset Management of Expressways
Lecturer (Job title)	Takeshi Takeno
Purpose of lecture	▪To outline asset management of the expressways and deepen knowledge.
Date and time	Feb. 3, 13:00 to 14:30
Training title	Overview of Expressway Renewal Project
Lecturer (Job title)	Kazuhiro Ito
Purpose of lecture	▪To outline maintenance operations of the expressways and deepen knowledge, centering on the expressway renewal project.
Date and time	Feb. 3, 14:30 to 17:00
Training title	Inspection of Expressway Repair Work Site
Lecturer (Job title)	―
Purpose of lecture	▪To decide an inspection destination in view of the actual repair work status after deciding on a time for training.

(10) [Feb. 4 (Wed.)] Nagoya University

Date and time	Feb. 12, 9:30 to 11:30
Training title	Field Trip to N2U-Bridge (Deteriorated Structures Consolidation Facility)
Lecturer (Job title)	Hikaru Nakamura
Purpose of lecture	▪To visit N2U-Bridge, a facility jointly installed by NEXCO Central Nippon and Nagoya University for educating engineers and enabling them to learn about cases of fostering road maintenance engineers in Japan.

(11) [Feb. 5 (Thu.)] Gifu University

Date and time	Feb. 5, 10:00 to 15:00
Training title	Periodic Inspection of Kakamigahara Bridge Utilizing Robot Technology
Lecturer (Job	Keitetsu Rokugo

title)	
Purpose of lecture	▪To deepen knowledge on research and development of advanced road management technology through a lecture on periodic inspections of the Kakamigahara Bridge utilizing robot technology, or Gifu University's SIP implementation project.

7.4.6 Overview of 2019 JICA Training by Issue, "Road Asset Management (Intermediate Level)"

7.4.6.1 Basic Training Information

(1) Training name
(Japanese) 道路アセットマネジメント（新機軸・高品質プログラム）
(English) Road Asset Management

(2) Training period (scheduled):
Feb. 20 (Thu.), 2020 to Mar. 20 (Fri.), 2020
[Technical training period: Feb. 21 (Fri.), 2020 to Mar. 19 (Thu.), 2020]

(3) Number of trainees: Capacity of 14 persons

(4) Participant countries:
Those implementing a maintenance technology cooperation project:
1)Bangladesh, 2)Laos, 3)Myanmar, 4)Philippines, 5)Timor-Leste (+2), 6)Cambodia, 7)Tajikistan, 8) Bolivia, 9) Mozambique, 10) Zambia, 11) Ghana, 12) Ethiopia
(Total 12country, 14 people)

(5) Intended personnel:
1) New and mid-level road administration officials engaged in maintenance operations of roads and bridges, particularly maintenance planning and formulation.
2) Those having 5 years or more experience in the said field.
(Those having 1 to 2 years of experience in inspections and audit operations and 1 to 3 years of experience in maintenance planning operations.)
3) University graduates or those having an equivalent educational background.
4) Those having the linguistic capability to communicate smoothly in English training.
5) Those both mentally and physically healthy.

(6) Training agency:
1) Japan International Cooperation Agency, Tokyo International Center (to be referred to as JICA Tokyo)

(7) Language: English

7.4.6.2 Background of the Training

There is high demand for infrastructure development in developing countries, the amount of which is expected to be about 26 trillion dollars in the Asia-Pacific region by 2030. Also, the infrastructure that have been built with Japan's assistance since the 1970s are almost 50 years old and considering demands for new construction projects, it is essential to reduce costs for such projects by introducing the concept of preventive maintenance and optimizing maintenance. Therefore, it is important to acquire the idea of asset management that, based on the understanding of the current condition of road assets (e.g., bridges), allows to predict the deterioration (aging) of and damage to respective assets, extend

their service lives by conducting timely repairs and reinforcements, and realize maintenance plans with minimum life-cycle cost. This training is intended to provide training for trainees to acquire necessary knowledge and skills toward securing funding sources for the road asset maintenance work carried out in developing countries and for carrying out such work over a medium to long-term period.

7.4.6.3 Goal of Training

To clarify the issues on each participant country's own road maintenance and formulate responsive measures and improvement measures for a solution of the issues and rooting of future efficient road asset management through an understanding of approaches and R&D for the rooting of domestic road asset management in Japan as well as understanding and learning about budgeting based on the inspection data and an integrity transition estimation method.

After undergoing Training, trainees are expected to:

1) Be able to clarify issues on road maintenance in each country and parent organization.
2) Understand road asset status and road maintenance methods in Japan.
3) Understand approaches to road asset management, human resource development methods and R&D status in Japan; learn about technologies and knowledge introducible to your own country.
4) Understand the features of and damage on the concrete and steel structures; learn about the management concept of the infrastructural structures by utilizing inspection data.
5) Consider measures for formulating a proper road maintenance plan through gaining knowledge and understanding of technologies required for road asset management.
6) Formulate responsive measures and improvement measures required for the rooting of road asset management back home.

7.4.6.4 Contents of the Training

The training items shown below will apply, mutatis mutandis, to the curriculum structure of these courses. The participating trainees must clarify the current status, issues and problems of the maintenance of road assets in their home countries through the preparation of the Job and Country Report as preliminary activities. On that basis, trainees will consider how to solve the issues and problems by utilizing the knowledge acquired through the training. Moreover, this training aims at having trainees prepare action plans so that they can disseminate in their home countries the skills and knowledge they acquired in the training. After returning home, trainees will conduct efforts in the maintenance of road assets in accordance with the action plans formulated by all the trainees from all the participating countries, they will submit the review reports on the status of implementation about 12 months after they return home. JICA will also consider visiting the relevant countries to give advice or hold workshops, as applicable, as follow-up for trainees.

< Training items >

(1) Lectures will be given on Japan's current status of infrastructure, on the characteristics of and damage to concrete and steel structures and on the idea of infrastructure management.
(2) Visits will be made for the following purposes:

1) State-of-the-art efforts: expressway maintenance, repair technology, efforts for inspection and management, development of inspection and maintenance standards, development of engineers; and
2) Efforts by universities: deteriorated structure accumulation facilities, research and development of advanced road maintenance technology, and development of engineers;

- Analysis exercise of road asset inspection data;
- Formulation of preventive and effective maintenance plans in Japan;
- Activities based on maintenance plans in Japan (inspection, assessment, planning, etc.);
- Lectures, visits and practice related to actual maintenance work, disaster prevention, etc.; and
- Sharing of the maintenance status and issues of road assets in respective countries, and

preparation of, presentation of and discussion on action plans toward the entrenchment of road asset management methods after returning home.

7.4.6.5 Training methods

(1) Lectures: texts, summaries, etc., will be prepared, and audio-visual materials will be used, if necessary, in order to enhance the understanding by trainees.
(2) On-site visits and training trips: these opportunities are intended to be conducive to their practice after returning home, giving weight to the connection with the lectures, and arranging such opportunities to allow trainees to review the contents they learned at the lectures with reference to the textbooks and to nurture their applied skills.
(3) Preparation and presentation of action plans: each trainee is required to prepare and present his or her action plan and will receive comments and advice from lecturers. The trainee will revise the action plan based on those comments and submit the final plan. For the purpose of the trainee's presentation of his or her country's action plan, JICA will consider deepening the mutual understanding between the trainee and Japanese stakeholders and endeavor to enhance his or her problem-solving ability after returning home.
(4) For the review reports (e.g., the implementation status of the action plans of each relevant country, the status of horizontal dissemination of training content acquired) to be made by trainees of all the participating countries, JICA assumes that the reports will be made by, for example, using JICA's teleconference system that connects responsible offices and agencies with overseas offices. The results will be shared by all the trainees from all the participating countries via email or the like. Also, about the problems and issues acknowledged in the review, JICA will conduct follow-up activities by holding consultations with trainees and their superiors or holding workshops in their country.

7.4.6.6 Input

(1) Input by Japanese side
- Project cost necessary for training, such as expenses for the dispatch of Japanese lecturers, and travel and lodging expenses and per diem allowances of participating trainees from counterpart countries.

(2) Input by counterpart countries
- Cost for preparation and distribution of General Information brochures (GI)
- Cost for recruitment and selection of participants and notification of selection results through diplomatic channels

7.4.6.7 Schedule and Training Curriculum (Draft)

Table 7-19 Schedule and Curriculum for Road Asset Management (Intermediate Level) (Draft)

Date		Style	Description (Draft)	Lecturer (Draft)	Affiliation and Title
Feb 20	Thu.		Arrival in Japan		
Feb 21	Fri.	Others	Opening ceremony, briefing, program orientation	JICA	JICA Tokyo
Feb 22	Sat.		Holiday		
Feb 23	Sun.		Holiday		
Feb 24	Mon.	Review meeting	Job and country report publication meeting	JICA course leader	JICA Tokyo
Feb 25	Tue.	Lecture	Status quo of Japanese infrastructure	Kouhei Nagai	Institute of Industrial Science, the University of Tokyo

Date		Style	Description (Draft)	Lecturer (Draft)	Affiliation and Title
Feb 26	Wed.	Lecture	Features of and damage on steel structures	Kouhei Nagai, Tsukasa Mizutani	Institute of Industrial Science, the University of Tokyo
Feb 27	Thu.	Lecture	Management concept of the infrastructural structures	Kouhei Nagai	Institute of Industrial Science, the University of Tokyo
Feb 28	Fri.	Lecture	Analytical practice of the inspection data	Kouhei Nagai, Koji Matsumoto	Institute of Industrial Science, the University of Tokyo
Feb 29	Sat.		Holiday		
Mar 1	Sun.		Holiday		
Mar 2	Mon.	Lecture	Analytical practice of the inspection data	Kouhei Nagai, Koji Matsumoto	Institute of Industrial Science, the University of Tokyo
Mar 3	Tue.	Lecture	Analytical practice of the inspection data	Kouhei Nagai, Koji Matsumoto	Institute of Industrial Science, the University of Tokyo
Mar 4	Wed.	Lecture	Introduction of bridge repair materials	Naoki Yamashita	Taiheiyo Materials
		Lecture and field trip	Bridge repair material test, field trip to the bridge repair site	Fabinia Romero	Alpha Kogyo
		Move	From Tokyo to Nagoya		
Mar 5	Thu.	Field trip	Field trip to N2U-Bridge (Deteriorated structures accumulation facility)	Hikaru Nakamura	Long Bridge Life Promotion Office, Nagoya University
		Lecture	Periodic inspection of the Kakamigahara Bridge utilizing robot technology	Keitetsu Rokugo	Center for Infrastructure Asset Management Technology and Research, Gifu University
		Move	From Gifu Hajima to Kyoto		
Mar 6	Fri.	Lecture	Overview of expressway asset management	Takeshi Takeno	NEXCO West Nippon, Ibaraki Technical Training Center
		Lecture	Overview of the expressway renewal project	Kazuhiro Ito	
		Field trip	Inspection of the expressway repair work site (repair work site scheduled)		
Mar 7	Sat.		Holiday		
Mar 8	Sun.		Holiday		
Mar 9	Mon.	Lecture	Maintenance of the long and large bridges, approaches to inspection and management, and improvement of inspection, maintenance and repair standards	Naoki Toyama	Honshu-Shikoku Bridge Expressway
		Field trip	Field trip to an exhibition of construction technologies		Bridge Exhibition Center
		Field trip	Field trip to the Akashi Kaikyo Bridge		Akashi Kaikyo Bridge

Date		Style	Description (Draft)	Lecturer (Draft)	Affiliation and Title
		Move	From Kobe to Tokyo		
Mar 10	Tue.	Lecture	Development of advanced road management technologies by private organizations	Kazuya Aoki, Chikakuni Maeda	
Mar 11	Wed.	Lecture	Practice of budgeting and the integrity transition estimation system	Kouhei Nagai, Koji Matsumoto	Institute of Industrial Science, the University of Tokyo
Mar 12	Thu.	Lecture	Practice of budgeting and the integrity transition estimation system	Kouhei Nagai, Koji Matsumoto	Institute of Industrial Science, the University of Tokyo
Mar 13	Fri.	Lecture	Practice of budgeting and the integrity transition estimation system	Kouhei Nagai, Koji Matsumoto	Institute of Industrial Science, the University of Tokyo
Mar 14	Sat.		Holiday		
Mar 15	Sun.		Holiday		
Mar 16	Mon.	Lecture	Status quo and maintenance of the road bridges	Yoshinobu Oshima	Public Works Research Institute
		Field trip	Field trip to a yard for removed members, wheel load running tester, and 3,000-ton loading tester	—	
		Field trip	Field trip to a shaking table	—	
Mar 17	Tue.	Practice	Preparation of an action plan	JICA course leader	JICA Tokyo
Mar 18	Wed.	Review meeting	Action plan publication meeting, social gathering	JICA course leader	JICA Tokyo
Mar 19	Thu.	Others	Evaluation meeting, closing ceremony, and debrief meeting	JICA	JICA Tokyo
Mar 20	Fri.		Holiday (Vernal Equinox Day) Departure from Japan		

Source: JICA Study Team

7.4.6.8 Details of Training Curriculum (Draft)

(1) [Feb. 25 (Tue.)] Institute of Industrial Science, the University of Tokyo

Date and time	Feb. 25, 10:00 to 12:00, 13:00 to 17:00
Training title	Status Quo of Japanese Infrastructure
Lecturer (Job title)	Kouhei Nagai
Purpose of lecture	▪To deepen knowledge on the general overview of bridge-related technologies and the status quo of bridge maintenance in Japan.

(2) [Feb. 26 (Wed.)] Institute of Industrial Science, the University of Tokyo

Date and time	Feb. 26, 10:00 to 17:00
Training title	Features of and Damage on Steel Structures
Lecturers (Job titles)	Kouhei Nagai, Tsukasa Mizutani
Purpose of lecture	▪To deepen understanding of the monitoring technology for learning about the structural characteristics of and the types and mechanisms of damage on the bridges; to understand bridge conditions.

(3) [Feb. 27 (Thu.)] Institute of Industrial Science, the University of Tokyo

Date and time	Feb. 27, 10:00 to 17:00
Training title	Management Concept of Infrastructural Structures
Lecturer (Job title)	Kouhei Nagai
Purpose of lecture	▪To learn the basic concept of infrastructure management and utilization of the database.

(4) [Feb. 28 (Fri.), Mar. 2 (Mon.), Mar. 3 (Tue.)] Institute of Industrial Science, the University of Tokyo

Date and time	Feb. 28, 10:00－17:00, Mar. 2, 10:00 to 17:00, Mar. 3, 10:00 to 17:00
Training title	Analytical Practice of Inspection Data
Lecturers (Job titles)	Kouhei Nagai, Koji Matsumoto
Purpose of lecture	▪To practice a case analysis of the bridge inspection data. ▪To learn classification and organization methods, using the inspection data. ▪To learn the concept of how to utilize the bridge data in the future.

(5) [Mar. 4 (Wed.)] Taiheiyo Materials, Alpha Kogyo

Date and time	Mar. 4, 10:00 to 12:00
Training title	Introduction of Bridge Repair Materials (Taiheiyo Materials)
Lecturer (Job title)	Naoki Yamashita
Purpose of lecture	▪To deepen knowledge about bridge repair materials in Japan.
Date and time	Mar. 4, 14:00 to 16:00
Training title	Bridge Repair Materials Test, Field Trip to Bridge Repair Site (Alpha Kogyo)
Lecturer (Job title)	Fabinia Romero
Purpose of lecture	▪To deepen knowledge about bridge repair materials in Japan through a lecture, test and field trip.

(6) [Mar. 5, (Thu.)] Nagoya University, Gifu University

Date and time	Mar. 5, 9:30 to 11:30
Training title	Field Trip to N2U-Bridge (Deteriorated Structures Accumulation Facility)
Lecturer (Job title)	Hikaru Nakamura
Purpose of lecture	▪To visit N2U-Bridge, a facility jointly installed by NEXCO Central Nippon and Nagoya University for educating the engineers and enabling them to learn about cases of fostering road maintenance engineers in Japan.
Date and time	Mar. 5, 13:00 to 16:00
Training title	Periodic Inspection of Kakamigahara Bridge Utilizing Robot Technology
Lecturer (Job title)	Keitetsu Rokugo
Purpose of lecture	▪To deepen knowledge about research and development of advanced road management technology through a lecture on periodic inspections of the Kakamigahara Bridge that utilize robot technology, or Gifu University's SIP implementation project.

(7) [Mar. 6 (Fri.)] NEXCO West Nippon, Ibaraki Technical Training Center

Date and time	Mar. 6, 10:00 to 11:30
Training title	Overview of Expressway Asset Management
Lecturer (Job title)	Takeshi Takeno
Purpose of lecture	▪To outline expressway asset management and deepen knowledge.
Date and time	Mar. 6, 13:00 to 14:30
Training title	Overview of Expressway Renewal Project
Lecturer (Job title)	Kazuhiro Ito
Purpose of lecture	▪To outline maintenance operations of the expressways and deepen knowledge, based on the expressway renewal project.
Date and time	Mar. 6, 14:30 to 17:00
Training title	Inspection of Expressway Repair Work Site
Lecturer (Job title)	―
Purpose of lecture	▪To decide on an inspection destination in view of the actual repair work status after deciding on a time for training.

(8) [Mar. 9 (Mon.)] Honshu-Shikoku Bridge Expressway

Date and time	Mar. 9, 9:00 to 16:00
Training title	Maintenance of Long and Large Bridges, Approaches to Inspection and Management, Improvement of Inspection, Maintenance and Repair Standards, Field Trip to Exhibition of Construction Technologies, and Field Trip to Akashi Kaikyo Bridge
Lecturer (Job title)	Naoki Toyama
Purpose of lecture	▪To deepen knowledge about maintenance of long and large bridges and its specialty based on the world's highest-level technologies through a lecture on bridge maintenance operations.

(9) [Mar. 10 (Tue.)] PASCO Corporation

Date and time	Mar. 10, 10:00 to 12:00
Training title	Advanced Road Management Technologies by Private Organizations
Lecturers (Job titles)	Kazuya Aoki, Chikakuni Maeda
Purpose of lecture	▪To deepen knowledge about advanced road management technologies by Japanese private organizations.

(10) [Mar. 11 (Wed.), Mar. 12 (Thu.), Mar 13 (Fri.)] Institute of Industrial Science, the University of Tokyo

Date and time	Mar. 11, 10:00 to 17:00, Mar. 12, 10:00 to 17:00, Mar. 13, 10:00 to 17:00
Training title	Practice of Budgeting and Integrity Transition Estimation System
Lecturers (Job titles)	Kouhei Nagai, Koji Matsumoto
Purpose of lecture	▪To use bridge and road position data, GIS, and to learn a method to display said data on the map.

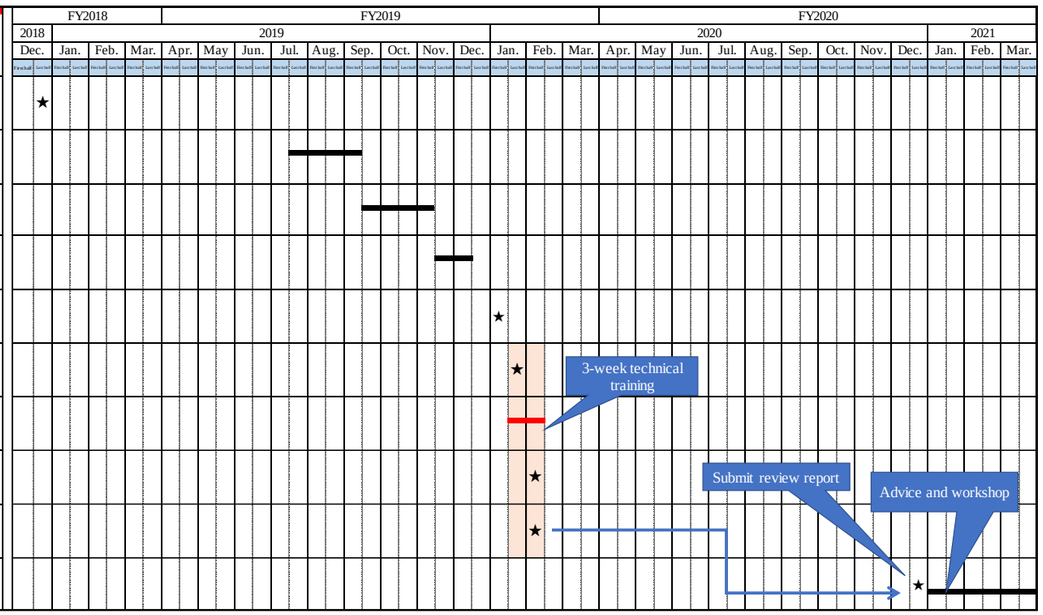
(11) [Mar. 16 (Mon.)] Public Works Research Institute

Date and time	Mar. 16, 13:00 to 14:30
Training title	Status Quo and Maintenance of Road Bridges
Lecturer (Job title)	Yoshinobu Oshima
Purpose of lecture	▪To deepen knowledge about maintenance of the bridges in Japan.
Date and time	Mar. 16, 15:00 to 16:30
Training title	Field Trips to Shaking Table, Yard for Removed Members, Wheel Load Running Tester and 3,000-ton Loading Tester
Lecturer (Job title)	―
Purpose of lecture	▪To visit the world's largest-scale experimental facilities to deepen knowledge.

7.4.6.9 Office Procedures for JICA Training by Issue, “Road Asset Management”

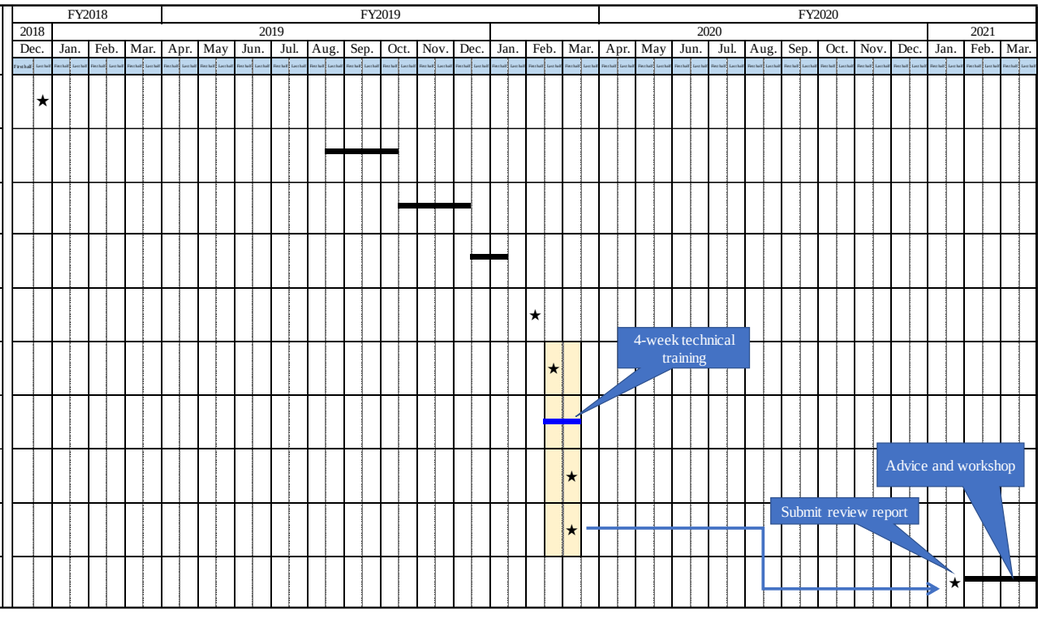
Beginner's level

	Item	Description	Remark
①	Preparation of annual acceptance plan	Preparation of a detailed acceptance plan including countries of allocation of candidates, number of trainees accepted by the country, etc. for each project of the next fiscal year (per each training course if implementing multiple times), based on the results of a request survey.	To be decided around Dec. of the year before implementation
②	Preparation of the GI	Preparation of the GI (guidelines for applicants) which state the purpose, goal and period of the project, details of training (curriculum), application method, qualification requirements, contact details, accommodation, etc.	4 months before start of training
③	Recruitment, application and screening	The recruiting country selects a candidate based on the GI. Once the candidate is selected, an application form is prepared and submitted to the local Japanese body which will then perform screening to assess the propriety of the candidate.	2 months before start of training
④	Decision of acceptance	Checking of the application form and selection of the trainee to be accepted through screening by JICA and trustees, etc.	1 month before start of training
⑤	Arrival in Japan	After acceptance, the trainee is explained about going to Japan at the local JICA office, etc., acquires necessary documents and takes a specified flight on the specified day to come to Japan.	
⑥	Initial briefing, etc. after arrival in Japan	Provision of briefing and general orientation.	
⑦	Technical training	Provision of program orientation and technical training.	
⑧	Evaluation meeting and closing ceremony	Holding of an evaluation meeting and closing ceremony.	
⑨	Departure for home	The trainee takes a specified flight on the specified day to return home.	
⑩	Monitoring	Submission of a review report on the implementation status and visiting of the trainees in their countries to give advice or hold a workshop as required as follow-up support, in 12 months time.	



Intermediate level

	Item	Description	Remark
①	Preparation of annual acceptance plan	Based on the results of a request survey, prepare a detailed acceptance plan such as allocated countries, number of trainees accepted by country, etc. for each project of the next fiscal year (for each training course in the case of implementing multiple times).	To be decided around Dec. of the previous year of implementation.
②	Preparation of the GI	Prepare the GI (guidelines for applicants) which describes the purpose, goal and period of the project, details of training (curriculum), application method, qualification requirements, contact, accommodation, etc.	4 months before start of training.
③	Recruitment, application and screening	An objective country of recruitment selects a candidate based on the GI. Once the candidate is selected, they prepare and submit an application form to the local Japanese body which will then perform screening to assess the propriety of the candidate.	2 months before start of training.
④	Decision of acceptance	Check the application form and select the trainee to be accepted through screening by JICA and trustees, etc.	1 month before start of training.
⑤	Arrival in Japan	After deciding acceptance, the trainee is explained about going to Japan at the local JICA office, etc., acquires necessary documents and takes a specified flight on a specified day to come to Japan.	
⑥	Initial briefing, etc. after arrival in Japan	Provide briefing and general orientation.	
⑦	Technical training	Provide program orientation and technical training.	
⑧	Evaluation meeting and closing ceremony	Hold an evaluation meeting and a closing ceremony	
⑨	Departure for home	The trainee takes a specified flight on a specified day to return home.	
⑩	Monitoring	In 12 months, submit a review report on the implementation status and visit the trainees in their countries to give advice or hold a workshop as required as follow-up support for them.	



Source: JICA Study Team

7.5 Planning of a Special Program for Long-term Trainees

7.5.1 Purpose of Consideration

A long-term special training program shall be intended to conduct practical research activities in light of the needs for special guidance on the classes and research subjects for each trainee, development issues in their own countries, etc. in addition to the existing curriculum to be provided by the universities which accept the trainees. The program shall and consider the details of training for understanding the approaches to road asset management in Japan so that they can be useful reference cases for the long-term trainees after going back home, considering the status quo and the issues for each country.

The special program is assumed to be implemented for about 5 days by utilizing the university's long-term vacation from FY2019. Its details shall be considered, centering around the approaches and inspections which can be useful reference cases for the long-term trainees after going back home, such as NEXCO's leading-edge approaches, research and development of related technologies at the university, etc., and the approach of local Japanese governments.

7.5.2 Overview 2019 JICA Special Program for Long-term Trainees, "Road Asset Management"

7.5.2.1 Basic Training Information

(1) Training name
(Japanese) 道路アセットマネジメント特別プログラム
(English) Road Asset Management Special Program

(2) Training period: Aug. 5 (Mon.), 2019 to Aug. 9 (Fri.), 2019

(3) Number of trainees: Annually about 10. Ensure that the long-term trainees participate once without fail during the training period.

(4) Intended personnel: Long-term trainees at the accepting universities

Country	Trainee	Admission Year	University/Academic Advisor	Postgraduate Course	Research Subject
Laos	Ms. Amphaphone BOUNNAK	Spring of FY2018	Hokkaido Univ./ Prof. Henry	Master's course	Overload control measures in asset management; effect and impact of weight measuring technology
	Mr. Thavone KHOUNSIDA	Spring of FY2018	Nagasaki Univ./ Prof. Nishikawa	Doctor's course	Research of maintenance models contributive to the long life of steel bridges
	Mr. Bounthipphasert SOUMPHONPHAKDY	Spring of FY2018	Nagasaki Univ./ Prof. Nakamura	Doctor's course	Bridge inspection and evaluation methods for asset management
Cambodia	Mr. Eam SOVISOTH	Spring of FY2018	Univ. of Tokyo/ Prof. Nagai	Master's course	Utilization and analysis of bridge damage data

Country	Trainee	Admission Year	University/Academic Advisor	Postgraduate Course	Research Subject
Philippines	Ms. Geneeva Villamor	Spring of FY2019	Kanazawa Univ./ Senei Kubo	Master's course	Comparison of bridge management systems between Japan and Philippines
	Mr. Vincent Andrew Amores	Spring of FY2019	Ryukyu Univ./ Prof. Tai	Master's course	Analysis for enforcement of corrected guidelines for maintenance of national roads and bridges
Bangladesh	Mr. Mohamad Golam Mostofa	Spring of FY2019	Kanazawa Institute of Technology/ Prof. Miyazato	Master's course	Hybridization of the RC girder structural enhancement system exposed to shock load
	Mr. Santanu Palit	Spring of FY2019	Ryukyu Univ./ Prof. Suda	Master's course	Possibility of utilizing carbon fiber reinforced plastic construction methods as a bridge maintenance technology in Bangladesh
Mongolia	Ms. Khosgerel Tsogkhuu	Spring of FY2019	Gifu Univ./ Prof. Kinoshita	Master's course	Planning, execution, management and evaluation of road development in Mongolia
	Ms. Erdenetsogt Agiimaa	Later than autumn of FY2019	Hokkaido Univ./ Prof. Henry	Master's course	Establishment of a repair method suitable to the climate conditions in Mongolia
Egypt	Mr. Mohamed Saied	Spring of FY2019	Nagasaki Univ./ Prof. Nishikawa	Doctor's course	Risks and uncertainty for use and maintenance of the expressway assets in Egypt

Source: Provided by JICA

(5) Training agency: 1) Japan International Cooperation Agency, Tokyo International Center (to be referred to as JICA Tokyo)

(6) Working language: English

7.5.2.2 Background of Training

There is high demand for infrastructure development in developing countries, the amount of which is expected to be about 26 trillion dollars in the Asia-Pacific region by 2030. Also, the infrastructure that have been built with Japan's assistance since the 1970s are almost 50 years old and considering demands for new construction projects, it is essential to reduce costs for such projects by introducing the concept of preventive maintenance and optimizing maintenance. Therefore, it is important to acquire the idea of asset management that, based on the understanding of the current condition of road assets (e.g., bridges), allows to predict the deterioration (aging) of and damage to respective assets, extend their service lives by conducting timely repairs and reinforcements, and realize maintenance plans with minimum life-cycle cost. This training is intended to provide training for trainees to acquire necessary knowledge and skills toward securing funding sources for the road asset maintenance work carried out in developing countries and for carrying out such work over a medium to long-term period.

This project is intended to provide training for the purpose of learning the knowledge and technologies required for maintenance work of the road assets executed in the developing countries and securement of the financial sources for continuous execution of maintenance work for a medium to long term.

7.5.2.3 Goal of Training

To formulate the responsive measures and improvement measures for the rooting of road asset management in their own countries through understanding of approaches and research and development for the rooting of domestic road asset management in Japan, and also to understand and learn about budgeting based on the inspection data and the integrity transition estimation method.

The following lists the results expected from this training:

1) For the trainees to understand the classes taken by them and learn practical knowledge and experience in line with the actual circumstances in their countries by surveying and learning the specific cases related to the research subjects.、
2) For the trainees to build a network contributive to the future activities between them and the Japanese researchers and various related bodies.

7.5.2.4 Contents of the Training

The activity curriculum of this course shall comply with the following training items. The participating trainees clarify the status quo, issues and problems related to maintenance of the road assets in their own countries. Then, they utilize the knowledge obtained through training to figure out solutions to the issues and problems. In order to spread the knowledge and technologies learned through this training in their own countries, all the trainees will address maintenance of the road assets after going back home.

<Training items>

(1) Following inspections.
   1) State-of-the-art efforts: maintenance of the expressways, repair technology, approaches to inspection and management, improvement of the inspection, maintenance and repair standards, development of engineers.
   2) Efforts by universities: research and development of advanced road management technology, development of engineers.
   3) Efforts by private companies: development of advanced road management technology as well as bridge and pavement repair technologies.

For the inspection destinations in the special program, a wide range of candidates are selected, including expressway companies, universities and local governments which have been implementing the 9 research and development subjects related to the activities of the JICA Technical Project based on the “Memorandum of understanding between JICA and Cross-ministerial Strategic Innovation Promotion Program; Infrastructure Maintenance, Update and Management Technologies Related to Implementation of Road Asset Management” concluded on Oct. 23, 2017.

Table 7-20 9 SIP Infrastructure Research and Development Subjects (Reference)

No.	R&D Subject	Responsible Researcher (place of employment)	Joint Research Group
5	Development of automatic inspection and audit technologies for pavement and embankment structures	Atsushi Yashima (Gifu University)	Celery Co., Ltd., Construction Research Center of Gifu Prefecture
9	Development of internal defect inspection technology for tunnel lining by high-speed running non-contact radar and integrated audit system	Akira Yasuda (Pacific Consultants Co., Ltd.)	Walnut Ltd., i System Research Co., Ltd., Sanei Co., Ltd., Forum 8 Co., Ltd.
11	Research and development of learning type hammering analysis technology	Masahiro Murakawa (National Institute of Advanced Industrial Science and Technology)	Shutoko Engineering Co., Ltd., East Nippon Expressway Co., Ltd., NEXCO Engineering Co., Ltd., Techny Co., Ltd.
39	Research, development and social implementation of road surface and bridge screening technology based on large-scale sensor information integration for preventive maintenance of infrastructure	Masataka Ieiri (JIP Techno Science Corporation)	The University of Tokyo
57	Comprehensive research aiming at development and domestic and overseas implementation of a road infrastructure management cycle	Koichi Maekawa (The University of Tokyo)	C.E. Management Integrated Laboratory Co., Ltd., NIPPO Corporation, East Nippon Expressway Co., Ltd., Metropolitan Expressway Co., Ltd., Others
58	Clarification of early deterioration mechanisms of concrete bridges and development of a total management system based on evaluation of materials and structural performance	Kazuyuki Torii (Kanazawa University)	Kanazawa Institute of Technology, National Institute of Technology, Ishikawa College, Nagaoka University of Technology, Fukui University
64	Implementation of necessary SIP maintenance technology by ME network	Keitetsu Rokugo (Gifu University)	Gifu University
68	Research, development and social implementation of innovative advanced technology for infrastructure maintenance	Hiroshi Matsuda (Nagasaki University)	Nagasaki University
69	Development of bridge maintenance technology suitable for subtropical islands and fostering of auditors	Yasunori Arizumi (Ryukyu University)	Ryukyu University

7.5.2.5 Training Methods

This special program uses the following three training methods:

(1) Special lectures: special lectures, etc. by an external lecturer. Texts, summaries, etc. are prepared

and audiovisual teaching materials are used as required to enhance understanding by the trainees.

(2) Academic meetings, field surveys, etc.: by putting focus on the relevance of the lecture, this ensures that the trainees can confirm what is learned in the lecture while referring to the text while also fostering applied skills so as to make practical use of them in actual practices after going back home.

(3) Supplementary guidance at the accepting university: tutors, etc. are hired (supplementary lessons, guidance and assistance for preparation of theses and experiments, support for daily life to create an educational environment, etc.).

7.5.2.6 Input

(1) Cumulative upper-limit expenses
The "upper-limit expenses" for each trainee are annually 500,000 yen.

(2) Details of the expenses
1) Remunerations
(a) Remuneration for lecturers, (b) Remuneration for manuscripts, (c) Remuneration for assistant lecturers
2) Travel expenses
(a) Air fare, (b) Travel expenses (except for the air fare), (c) Domestic and overseas travel expenses required when inviting an external lecturer
3) Overhead
(a) Expendables, (b) Teaching materials, (c) Facility and equipment rental fees, (d) Materials and equipment transportation cost, (e) Assistant lecturers, (f) Participation fee

7.5.2.7 Schedule and Training Curriculum (Draft) CASE-1

Table 7-21 Schedule and Curriculum of Special Program for Long-term Trainees (Draft) CASE-1

Date		Style	Description (Draft)	Lecturer (Draft)	Affiliation and Title
8/4	Sun.	Move	Holiday: From each university to Tokyo	—	—
8/5	Mon.	Observation	Observation at Center for Advanced Engineering Structural Assessment and Research (CAESAR)	—	Public Works Research Institute
8/6	Tue.	Observation	Observation of Road Surface Condition Checking System Using Smartphone (DRIMS)	Masataka Ieiri	JIP Techno Science
		Move	From Tokyo to Nagoya	—	—
8/7	Wed.	Observation	Observation of N2U-Bridge (Deteriorated structures accumulation facility)	—	Nagoya University
		Observation	Observation at Gifu University, Center for Infrastructure Asset Management Technology and Research	—	Center for Infrastructure Asset Management Technology and Research, Gifu University
8/8	Thu.	Observation	Kakamigahara Bridge	—	Kakamigahara City
		Move	From Gifu Hajima to Kyoto	—	

Date		Style	Description (Draft)	Lecturer (Draft)	Affiliation and Title
8/9	Fri.	Lecture and Observation	Overview of expressway asset management	Takeshi Takeno	NEXCO West Nippon, Ibaraki Technical Training Center
		Lecture	Overview of the expressway renewal project	Kazuhiro Ito	
		Observation	Inspection of the expressway repair work site (repair work site scheduled)		
8/10	Sat.	Move	Holiday: From Kyoto to each university	―	

7.5.2.8 Details of Training Curriculum (Draft) CASE-1

(1) [Aug. 5 (Mon.)] Public Works Research Institute

Date and time	Aug. 5, 10:00 to 17:00
Training title	Observation at Center for Advanced Engineering Structural Assessment and Research (CAESAR)
Lecturer (Job title)	―
Purpose of lecture	▪To observe 1) structure experimental facility, 2) structural mechanics experimental facility, 3) member seismic strength experimental facility, 4) wind resistant experimental facility, 5) foundation special experimental facility, 6) foundation machine storage, 7) clinical research removed member storage facility, 8) test bridge etc. and, through the observation of the experimental facilities, learn the latest technology in Japan.

(2) [Aug. 6 (Tue.)] JIP Techno Science

Date and time	Aug. 6, 10:00 to 15:00
Training title	Observation of Road Surface Condition Checking System Using Smartphone (DRIMS)
Lecturer (Job title)	Masataka Ieiri
Purpose of lecture	▪Findings through inspection of Road Surface Condition Checking System Using Smartphone (DRIMS) developed in [study and development of road surface and bridge screening technology based on large-scale sensor information integration for infrastructure preventive maintenance] which is a SIP infrastructure research and development endeavor. Also, deepen understanding.

(3) [Aug. 7 (Wed.)] Nagoya University, Gifu University

Date and time	Aug. 7, 9:30 to 11:30
Training title	Observation to N2U-Bridge (deteriorated structures accumulation facility)
Lecturer (Job title)	―
Purpose of lecture	▪ To visit N2U-Bridge, a facility jointly installed by NEXCO Central Nippon and Nagoya University for educating engineers and enabling them to learn about cases of fostering road maintenance engineers in Japan.
Date and time	Aug. 7, 13:00 to 16:00
Training title	Observation to Gifu University Infrastructure Museum
Lecturer (Job	―

title)	
Purpose of lecture	▪For maintenance engineers to visit a facility to learn about the prestressed concrete (PC) bridges, steel bridges as well as tunnel design and construction to deepen knowledge.

(4) [Aug. 8 (Thu.)] Kakamigahara City

Date and time	Aug. 8, 10:00 to 16:00
Training title	Observation to Kakamigahara Bridge
Lecturer (Job title)	―
Purpose of lecture	▪To visit the Kakamigahara Bridge which is inspected on the girders utilizing robot technology.

(5) [Aug. 9 (Fri.)] NEXCO West Nippon, Ibaraki Technical Training Center

Date and time	Aug. 9, 10:00 to 11:30
Training title	Overview of Expressway Asset Management
Lecturer (Job title)	Takeshi Takeno
Purpose of lecture	▪To outline expressway asset management and deepen knowledge.
Date and time	Aug. 9, 13:00 to 14:30
Training title	Overview of Expressway Renewal Project
Lecturer (Job title)	Kazuhiro Ito
Purpose of lecture	▪To outline maintenance operations of the expressways and deepen knowledge based on the expressway renewal project.
Date and time	Aug. 9, 14:30 to 17:00
Training title	Inspection of Expressway Repair Work Site
Lecturer (Job title)	―
Purpose of lecture	▪To decide on an inspection destination in view of the actual repair work status after deciding on a time for training.

7.5.2.9 Schedule and Training Curriculum (Draft) CASE-2

Table 7-22 Schedule and Curriculum of Special Program for Long-term Trainees (Draft) CASE-2

Date		Style	Description (Draft)	Lecturer (Draft)	Place of employment and position
8/4	Sun.	Move	Holiday: From Each university to Tokyo	―	―
8/5	Mon.	Observation	Observation at Center for Advanced Engineering Structural Assessment and Research (CAESAR)	―	Public Works Research Institute
8/6	Tue.	Observation	Observation of Road Surface Condition Checking System Using Smartphone (DRIMS)	Masataka Ieiri	JIP Techno Science
		Move	From Tokyo to Sendai	―	―

Date		Style	Description (Draft)	Lecturer (Draft)	Place of employment and position
8/7	Wed.	Observation	Observation at Center for Infrastructure Management Research, Tohoku University	―	Center for Infrastructure Management Research, Tohoku University
		Move	From Sendai to Yamagata	―	―
8/8	Thu.	Observation	Observation of Integrated Database System of Bridge Maintenance, Yamagata Pref.	―	Yamagata Constructional Engineering Center
		Move	From Yamagata to Takasaki	―	
8/9	Fri.	Lecture	Outline of Technical Training Center Bridge inspection method and repair technology training	―	NEXCO-East Engineering Technical Training Center
		Observation and Training	Observation and training of: Civil Engineering Testing Laboratory, Equipment, Civil Engineering Equipment, ETC Equipment	―	
		Exercises	Bridge inspection training	―	
8/10	Sat.	Move	Holiday: From Takasaki to Each university	―	

7.5.2.10 Details of Training Curriculum (Draft) CASE-2

(1) [Aug. 5 (Mon.)] Public Works Research Institute

Date and time	Aug. 5, 10:00 to 17:00
Training title	Observation at Center for Advanced Engineering Structural Assessment and Research (CAESAR)
Lecturer (Job title)	―
Purpose of lecture	▪To observe 1) structure experimental facility, 2) structural mechanics experimental facility, 3) member seismic strength experimental facility, 4) wind resistant experimental facility, 5) foundation special experimental facility, 6) foundation machine storage, 7) clinical research removed member storage facility, 8) test bridge etc. and, through the observation of the experimental facilities, learn the latest technology in Japan.

(2) [Aug. 6 (Tue.)] JIP Techno Science

Date and time	Aug. 6, 10:00 to 15:00
Training title	Observation of Road Surface Condition Checking System Using Smartphone (DRIMS)
Lecturer (Job title)	Masataka Ieiri
Purpose of lecture	▪Findings through inspection of Road Surface Condition Checking System Using Smartphone (DRIMS) developed in [study and development of road surface and bridge screening technology based on large-scale sensor

	information integration for infrastructure preventive maintenance] which is a SIP infrastructure research and development endeavor. Also, deepen understanding.

(3) [Aug. 7 (Wed.)] Center for Infrastructures Management Research, Tohoku University

Date and time	Aug. 7, 10:00 to 15:00
Training title	Observation at Center for Infrastructure Management Research, Tohoku University
Lecturer (Job title)	―
Purpose of lecture	▪ Observation at Center for Infrastructure Management Research, Tohoku University to deepen knowledge through the research results at this research center.

(4) [Aug. 8 (Thu.)] Yamagata Constructional Engineering Center

Date and time	Aug. 8, 10:00 to 15:00
Training title	Observation of Integrated Database System of Bridge Maintenance, Yamagata Pref.
Lecturer (Job title)	―
Purpose of lecture	▪Observation of Integrated Database System of Bridge Maintenance, Yamagata Pref, which is a regional implementation example of an infrastructure integrated DB, to deepen knowledge.

(5) [Aug. 9 (Fri.)] NEXCO-East Engineering Technical Training Center

Date and time	Aug. 9, 10:00 to 12:00
Training title	Outline of Technical Training Center Bridge Inspection Method and Repair Technology Training
Lecturer (Job title)	―
Purpose of lecture	▪Learn about outlines of the main training machines installed in the Technical Training Center as well as bridge inspection methods and repair techniques.
Date and time	Aug. 9, 13:00 to 14:30
Training title	Observation and training of: Civil Engineering Testing Laboratory, Equipment, Civil Engineering Equipment, ETC Equipment
Lecturer (Job title)	―
Purpose of lecture	▪ Deepen knowledge through inspection of the main training machines installed in the Technical Training Center.
Date and time	Aug. 9, 14:30 to 17:00
Training title	Bridge inspection training
Lecturer (Job title)	―
Purpose of lecture	▪ Deepen knowledge through bridge inspection training at the Gomei Bridge Training Center.

Chap. 8 Challenges and Improvements for Future Research

The results of this survey include the following issues and improvements:

This survey evaluated only the target organization of the technical project, and the correspondence should be considered because it is not reflecting the situation of other organizations.

Because the Road AM performance index developed this time is not a completed form, it is necessary to improve it continuously in the expansion of the surveyed country.

As for the timing of the investigation, it is considered that it is better to conduct the technical project before the end of the period because it will be possible to hear from the technical project team and respond if it is a valid improvement.

In the domestic trend survey, some local governments have formulated plans to prolong the life of the pavement and by gathering and further refining the ideas, actual repair methods and repair work, it is possible to use them as a support plan and training theme for developing countries.

In addition, the inspection diagnosis on the bridge was completed in the first round. It is necessary to identify the problems for the second round and use the experience from the first round as a lesson for developing countries.