Republic of Tajikistan
Ministry of Transport

The Project for Capacity Development for Bridge Management in the Republic of Tajikistan

Project Completion Report

November 2024

Japan International Cooperation Agency

CTI Engineering International Co., Ltd.
Central Nippon Expressway Co., Ltd.
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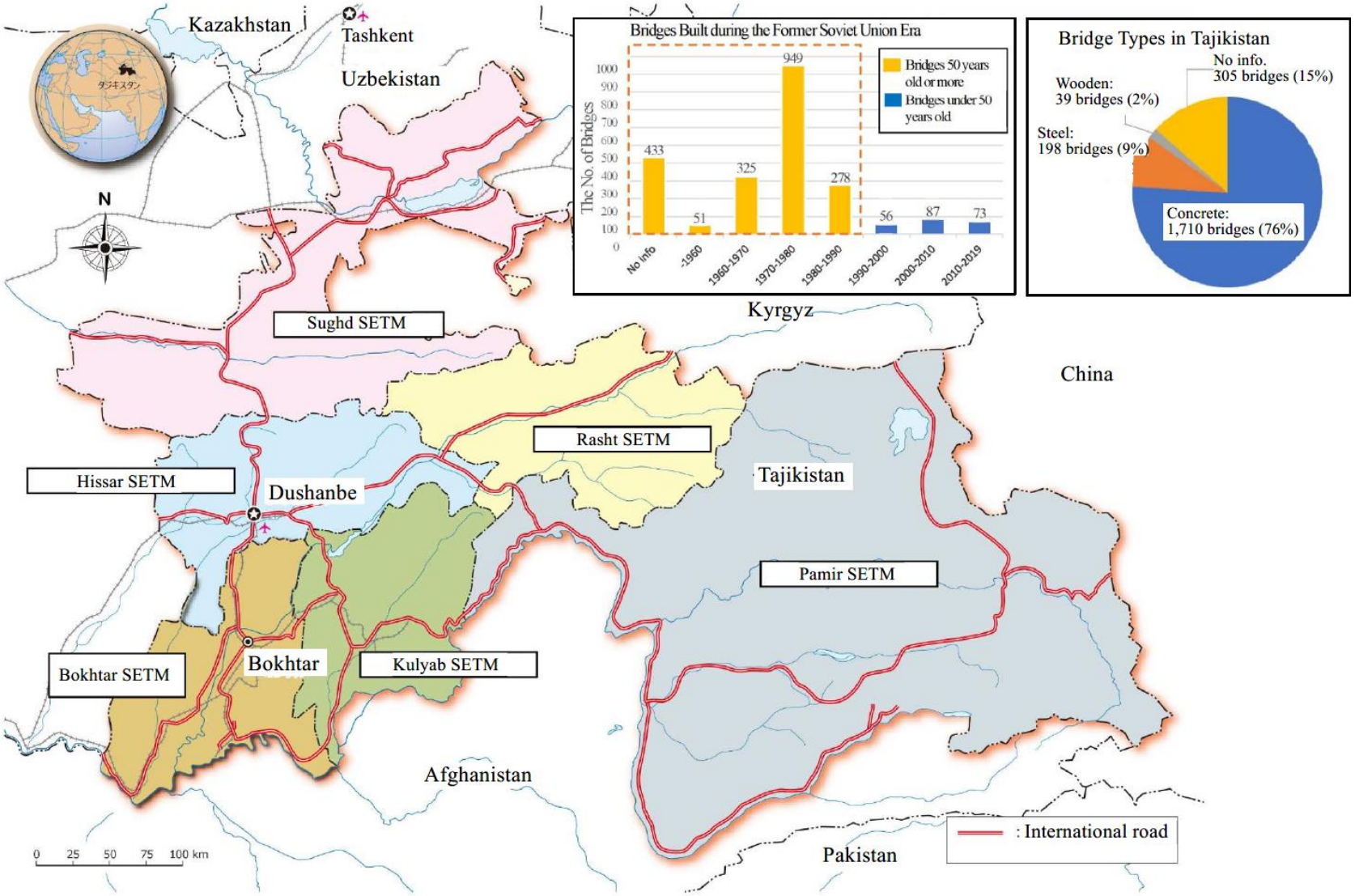

Project Location Map

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List of Abbreviations/Acronyms

ADB	:	Asian Development Bank
AM	:	Asset Management
BMT	:	Bridge Management Taskforce
BMS	:	Bridge Management System
CAREC	:	Central Asia Regional Economic Cooperation
CHET	:	Central Nippon Highway Engineering Tokyo Company Limited.
C/P	:	Counterpart
CTIE	:	CTI Engineering Co., Ltd.
CTII	:	CTI Engineering International Co., Ltd.
DB	:	Database
DITI	:	Design Institute for Transport Infrastructure
DCFI	:	Department on Cooperation with Foreign Investment
EAF	:	Economic Analysis and Forecasting Department
EBRD	:	European Bank for Reconstruction and Development
GOST	:	Gosudarstvennyy Standard
ICT	:	Information and Communication Technology
ITU	:	Information Technology Unit
JCC	:	Joint Coordination Committee
JICA	:	Japan International Cooperation Agency
JV	:	Joint Venture
ME	:	Maintenance Expert
MOT	:	Ministry of Transport
MPEU	:	Maintenance, Planning, and Evaluation Unit
NEXCO	:	Central Nippon Expressway Company Limited
OJT	:	On the Job Training
PDM	:	Project Design Matrix
PO	:	Plan of Operation
RAMS	:	Road Asset Management. System
RDMT	:	Road Disaster Management Taskforce
RCM	:	Road Construction and Management Department
RCU	:	Road Construction Unit
R/D	:	Record of Discussion
SNiP	:	Stroitelnye Normary I Pravila
SEHM	:	State Enterprise for Highway Maintenance
SETM	:	State Enterprise for Transport Management
TTU	:	Tajik Technical University
VR	:	Virtual Reality
WB	:	World Bank
WG	:	Working Group

1 BASIC INFORMATION OF THE PROJECT

1.1 Background

Republic of Tajikistan (hereinafter referred to as Tajikistan) is a landlocked and mountainous (93% of the area is termed mountainous) country bordering Kyrgyzstan, Uzbekistan, Afghanistan, and China, and nearly 90% of the freight within the country is transported by road. On the other hand, Tajikistan has three (3) corridors out of six (6) Central Asia Regional Economic Cooperation (CAREC) corridors connecting Central Asian countries and thus has potential to be a country of transporting goods by overcoming unfavorable circumstances.

In National Development Strategy in 2030 in Tajikistan, economic growth and rural development through eliminating traffic deadlock are set as important goals of national development, and thus it is important to maintain transportation infrastructure appropriately. In addition, in Comprehensive Transportation Development Program 2010-2025, maintenance is set as one of the goals in addition to construction and repair of transportation infrastructure. One of the important issues is bridge maintenance in Tajikistan transport sector. The Ministry of Transport (hereinafter referred to as MOT), the central governing body for the transport sector in Tajikistan has jurisdiction over 2,200 bridges in roads (total length is 14,200 km) and many of them were constructed during the Soviet era. Since independence from the Soviet Union in 1991, the country experienced a fateful civil war in the early 1990s, causing a severe economic setback which forced road assets unattended, and many roads suffered damage during the civil war. Currently, bridges are repaired or reconstructed when the damages become severe. Therefore, the implementation of planned bridge maintenance and management is becoming an urgent issue.

Considering the current status mentioned above, Tajikistan Government requested Japanese Government to implement this project to train experts who have appropriate knowledge of bridge maintenance and to prepare bridge inventory and maintenance system.

1.2 Outline of the Project

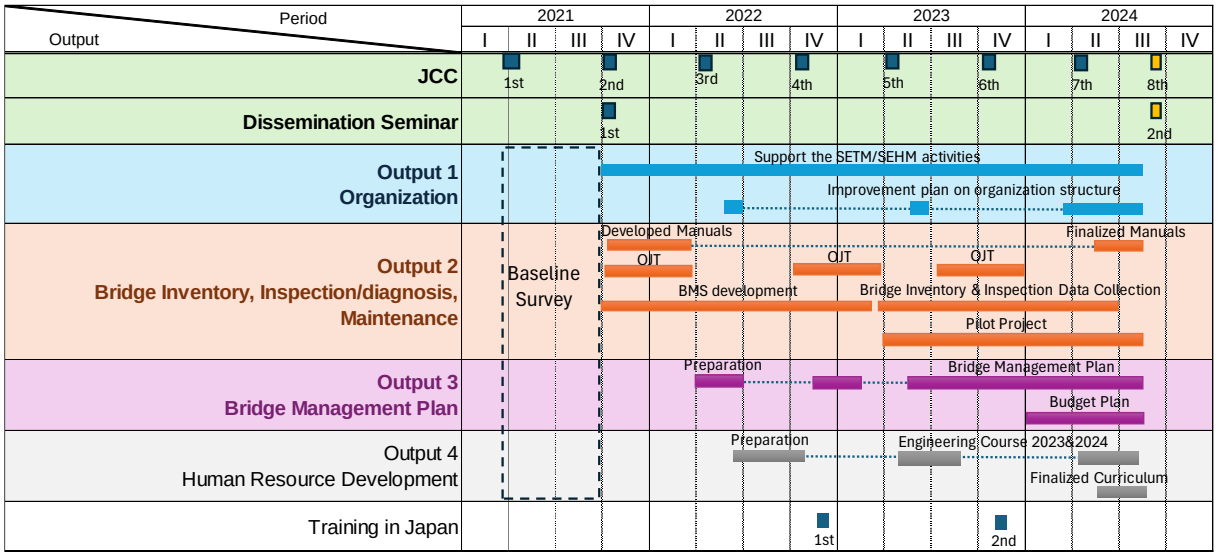
Country		Republic of Tajikistan
Project Title		The Project for Capacity Development for Bridge Management
Overall goal		Bridge management on International and Republic roads is improved.
Project Purpose		Capacities for bridge management of MOT, SETMs/SEHMs, DITI, and TTU are improved.
Output	1	Organizational structure for bridge management of MOT, SETMs/SEHMs and DITI is strengthened.
	2	Capacities for bridge inventory management, inspection/diagnosis, and maintenance of MOT, SETMs/SEHMs, DITI, and TTU are improved.
	3	Capacities for bridge management planning of MOT and Model SETMs are improved.
	4	Sustainable system for human resource development on bridge management is strengthened.
Inputs		【Japan side】 (a) Expert dispatch: 13 persons (b) Dispatch of experts for technology transfer regarding bridge maintenance and management (c) Trainings for C/P in Japan and Tajikistan: 29 persons (Training in Japan two times) (d) Equipment provision –Bridge Management System (BMS) –Material and equipment for bridge management (e) Cost for JICA experts' activities

	(f) Cost for pilot project to repair damage identified from inspection and diagnosis 【Tajikistan side】 (a) C/P arrangement: Project Director, Project Manager, Sub Project Manager, WG leaders and members, Counter personnel (b) Project office for project implementation (c) Non-JICA provision of machinery, equipment, vehicles, etc. necessary for project implementation and operating costs (d) Data and information necessary for project implementation (e) Japanese experts' credentials or ID card (f) Permit for JICA experts to enter the project area (g) Expenses related to C/P activities (h) Tax exemption for imported materials and equipment necessary for project implementation
Project Period	February 2021 – November 2024
Counterparts	・Ministry of Transport: MOT ・State Enterprise for Transport Management: SETM ・State Enterprise for Highway Maintenance: SEHM ・Design Institute for Transport Infrastructure: DITI ・Tajik Technical University: TTU
Host institutions for Japan training	・Central Nippon Highway Engineering Tokyo Co., Ltd. ・Tamana city hall, Kumamoto prefecture ・Shibaura Institute of Technology ・General Incorporated Association Tsutawarudoboku ・CTI Engineering International Co., Ltd.

1.3 Project Schedule

The project schedule is shown in Table 1-1.

Table 1-1 Project Schedule



1.4 Project Organization Chart

The project organization chart is shown in Figure 1-1.

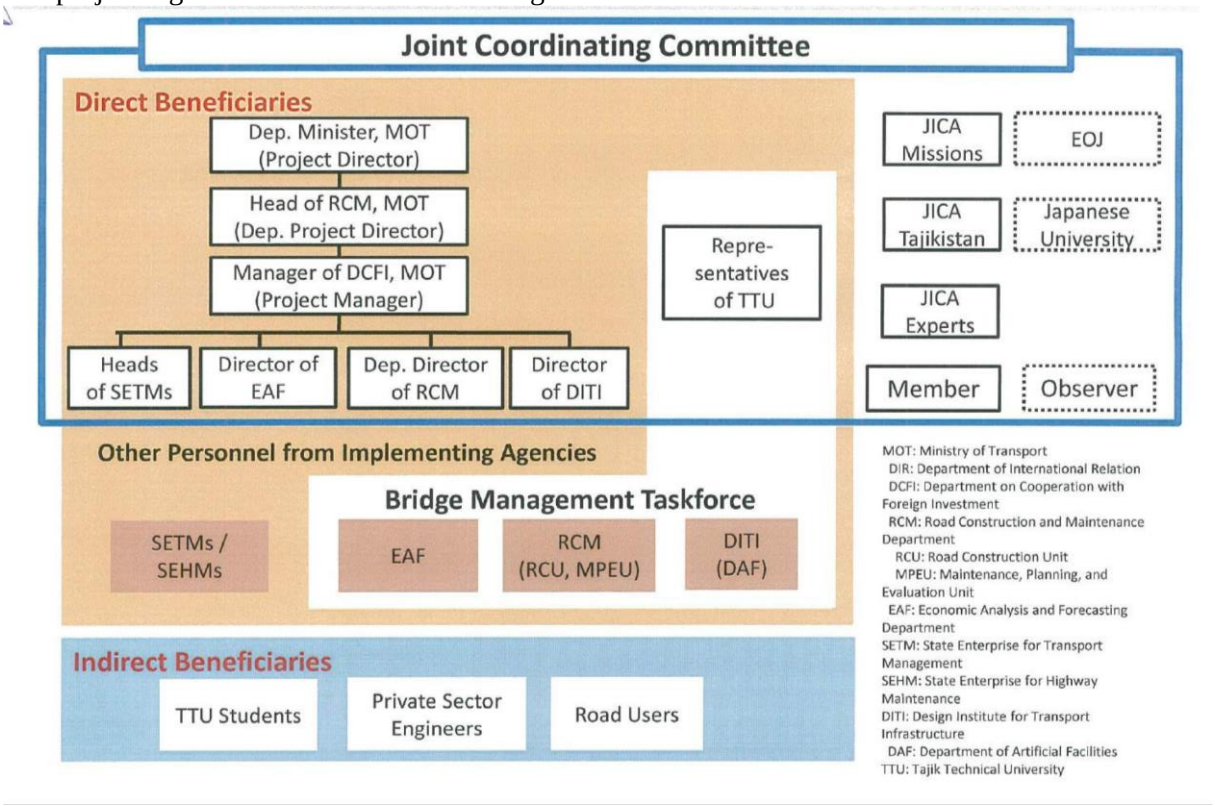


Figure 1-1 Project Organization Chart

1.5 List of Equipment

The list of equipment is shown in Table 1-2.

Table 1-2 List of Equipment

Main material and equipment	Quantity
Color multi-function printer	1
Drones	4
Drone batteries and propellers	4
Schmidt hammer	3
Test anvils for Schmidt hammer	3
High-pressure cleaners (including tanks, water pumps, and generators)	3
Small concrete mixer	6
Small generator (for powering small concrete mixer)	6
PC for BMS server	1
Backup HDD	1
PC for BMS operation	7
Tablet for bridge data collection	44
Scaffolding materials for inspection works	1 set

1.6 Manuals and Reports Produced by the Project

The list of manuals and reports produced by the project is shown in Table 1-3.

Table 1-3 List of Manuals and Reports

Output	Manual, Report, etc.
Output 1	・ Organizational structure for bridge management of MOT, SETMs/SEHMs and DITI is strengthened [Output 1: Activity Report]
Output 2	・ Bridge Inspection Manual ・ Bridge Repair Manual ・ Basic Approach for Bridge Management ・ Bridge inventory ・ Training materials (Bridge inspection, bridge repair, and BMS)
Output 3	・ Mid-term bridge management plan ・ Budget proposal based on mid-term bridge management plan
Output 4	・ Curriculum report for bridge engineering course ・ Training materials (bridge engineering course)

2 RESULTS OF THE PROJECT

2.1 Outline of the Project Output

2.1.1 Output 1: Organizational Structure for Bridge Management of MOT, SETMs/SEHMs and DITI is Strengthened

Major achievements under this output are shown in Table 2-1.

Table 2-1 Major Achievements under Output 1

Activities	Major Achievements	Status
Activity 1-1. Conduct Baseline Survey on organizational structure for bridge management.	● Baseline Survey was carried out together with MOT, DITI and TTU in order to collect basic data such as organizational structure on Bridge management. ● The identified issues to consider in the project were summarized in the Baseline Survey report.	Completed
Activity 1-2. Roles and responsibilities of relevant organizations/departments are clarified.	● The roles and responsibilities of the MOT (two departments), SETM, and SEHM have been identified through the Baseline Survey. ● The members of the Bridge Management Taskforce (BMT) recognized the importance of effectively utilizing BMT to overcome the adverse effects of the stove-piped organization and the shortage of experienced bridge engineering staff. ● In addition, the MOT's activities were reflected in the MOT's intention to introduce an information sharing system (draft) led by the WB/ADB as a Road Asset Management System (RAMS).	Completed
Activity 1-3. Support the Model SETMs/SEHMs' activities based on clarification provided in Activity 1-2.	● In supporting the bridge management of the model SETM, BMT held 23 BMT meetings, with 135 participants, focusing on the discussion of technical acquisition and skill improvement for each output. ● In addition, BMT members who are from MOT/SETM/SEHM/DITI/TTU were supported for 1,784 person-days and a total of 430 persons joined OJT trainings and BMS data collection during the project.	Completed
Activity 1-4. Improvement plan on organizational structure for bridge management is prepared and approved by MOT.	● Reviewed Activities 1-2 to 1-3 and organized and analyzed the current status of the bridge maintenance and management system, issues, and proposed solutions. ● A draft report on the proposed improvements to the bridge management system for Output 1 was compiled and approved by BMT members. ● MOT has approved the improvement plan in September 17, 2024.	Completed

(1) Activity 1-1: Conduct Baseline Survey on organizational structure for bridge management.

Prior to the baseline survey, with the cooperation of the C/Ps MOT, DITI, and TTU, information on organizations, etc., was collected, and the survey results were compiled as the Baseline survey report.

SETMs fully understand the necessity of assigning specialists on bridge management and maintenance.

However, while there are many road maintenance specialists, there are hardly any bridge maintenance specialists.

As background to this, according to SETM, “Bridge engineers cannot be trained” in part because the assignment of officials dedicated to bridge maintenance and management is not permitted. Although three (3) to four (4) bridge engineering course graduates from TTU join the SETM/SEHM each year, most of their work is related to the road sector and they are unable to gain practical experience in bridges. The JICA Expert Team believes that this recruitment practice needs to be reviewed together with Output 4 on establishing more comprehensive bridge maintenance course at TTU and with Output 3 on developing a mid-term bridge management plan. This matter is closely linked to Output 4, human resource development, and Output 3, mid-term bridge management planning. Therefore, the issue has been discussed to be properly addressed in consultation with the C/P.

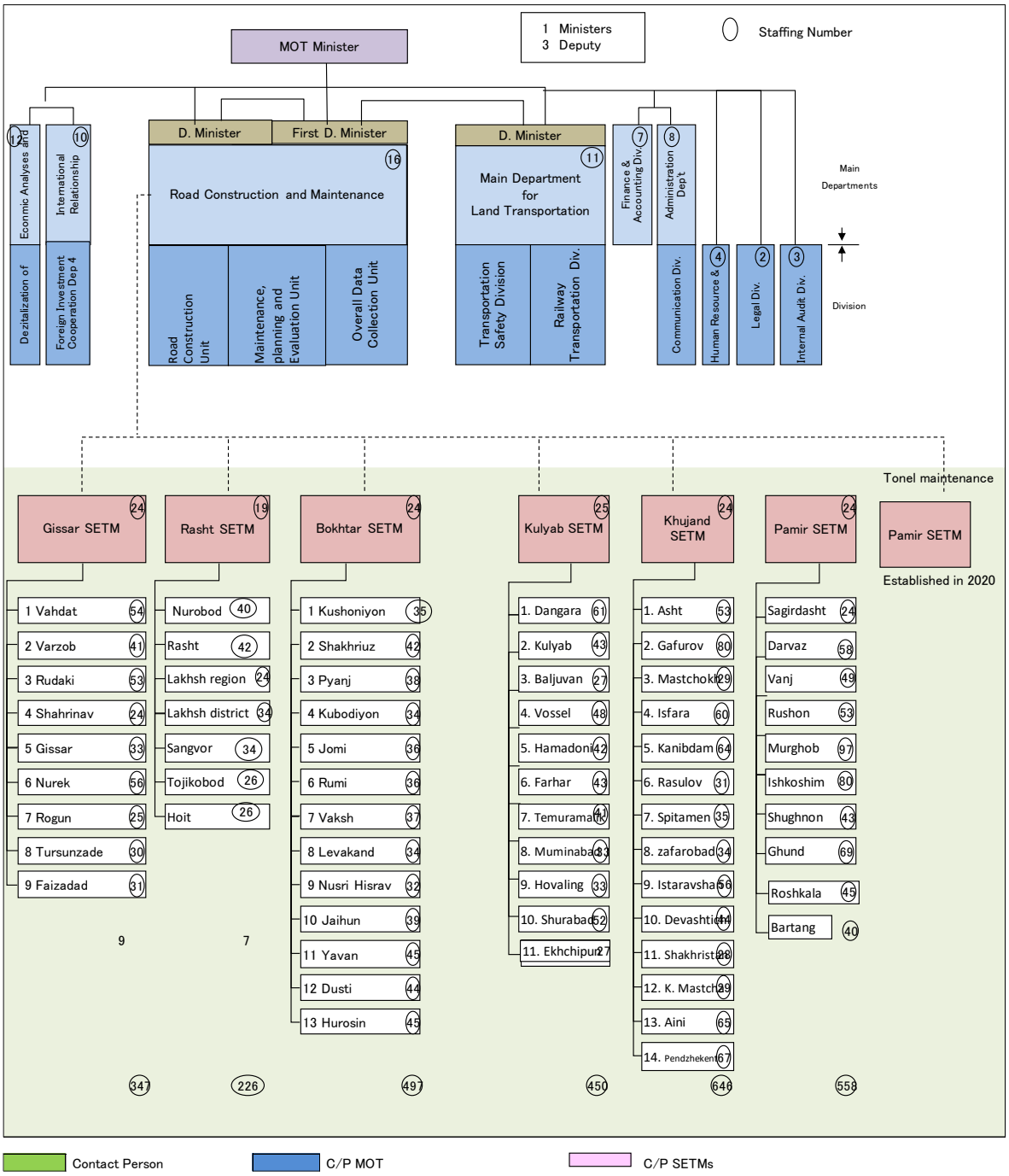


Figure 2-1 Organization Chart of MOT, SETM and SEHM

As for roles and responsibilities in the road and bridge maintenance management system using RAMS, Figure 2-2 describes information sharing system for road and bridge maintenance using RAMS that MOT and WB/ADB are planning to establish.

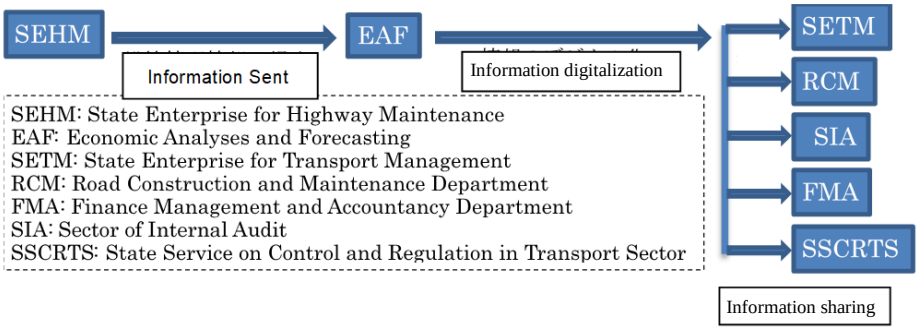


Figure 2-2 Information Sharing System for Road and Bridge Maintenance Using RAMS (draft)

(2) Activity 1-2: Roles and responsibilities of relevant organizations/departments are clarified.

According to the result of baseline survey, organization and role in bridge maintenance and management in MOT are the followings:

Table 2-2 Role Division in Bridge Management and Maintenance in MOT

Department	Role
RCM	The RCM is responsible for the supervision of domestic projects to be implemented. RCM is composed of the following divisions: Road Construction Section (RCU): responsible for supervising the construction and repair of roads and bridges. Maintenance Planning and Evaluation Section (MPEU): responsible for technical review of road and bridge maintenance plans and auditing of maintenance operations.
SETM	SETM is responsible for supervising SEHM under it with respect to road and bridge maintenance operations. SETM reports to the RCM on the status of the implementation of the work.
SEHM	SEHM is responsible for the practical implementation of road and bridge maintenance and management operations (inspections, maintenance planning, daily management, and construction supervision of subcontracted repair and new construction work, etc.). SEHM checks the implementation of maintenance and management operations and reports the results to the SETM.
EAF	The adequacy of the road and bridge maintenance plan will be verified based on economic analysis. EAF will also audit road and bridge maintenance reports submitted by SETM to ensure that adequate budget allocations are being made.

(Source: JICA Expert Team)

On the other hand, there is a lack of coordination among organizations related to bridge maintenance and management, which is attributed to the lack of a cross-organizational mechanism. As a solution to these issues, a Bridge Management Taskforce (BMT) was formed and will continue to be organized after the completion of the project. The role of BMT is to call for regular meetings and information exchange among organizations such as MOT, DITI, and TTU, during the project period. From each BMT participating organization, a representative will be determined, and information will be shared once every six months.

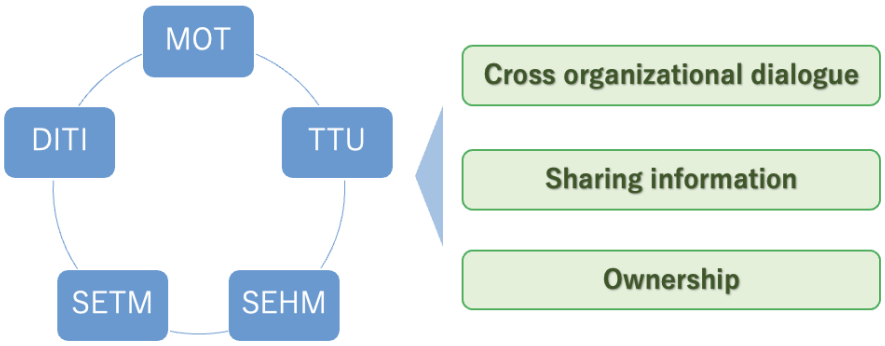


Figure 2-3 Role of BMT

Table 2-3 Proposed Roles of Each Organization in BMT Meetings

Organization	Role
MOT	・Guidance and operation of BMT meetings ・Review of BMT meeting agendas ・Comprehensive management of bridge technology ・Database management of bridges
SETM	・Sharing the status of SEHM's bridge maintenance management ・Concerns about bridge maintenance
DITI	・Advice regarding bridge technology
TTU	・Human resource development of bridge engineers ・Proposal of new technology for bridges

(3) Activity 1-3: Support the Model SETMs/SEHMs' activities based on clarification provided in Activity 1-2

Operational support for BMT meetings was provided by the main members from DITI and TTU, who conducted BMT activities. First, BMT was established to secure initiative and sustainability after completion of this project. At the beginning of the project, coordination among departments was insufficient, and there were no opportunities to discuss bridge maintenance. Thus, in this project, BMT meetings were held regularly to conduct organizational structure, cooperation with other organizations, and clarification of responsibilities and roles. In addition, BMT members joined workshops, OJT trainings and BMS data collection for 1,784 person-days, and 430 trainees participated in the related activities during the project. BMT members play a significant role from a viewpoint of sharing information and decision making. The contents of BMT meetings are shown in Table 2-4.

Table 2-4 Contents of BMT Meetings

No.	Date	Contents
1	July 6 2021	Introduction of project and BMT activities
2	July 14 2021	Discussion on bridge inspection and repair activities
3	Sep. 15 2021	Information sharing on project progress
4	Oct. 5 2021	Information sharing on the outcome of baseline survey and JICA detailed planning survey
5	Dec. 9 2021	Information sharing on project progress and 450 bridges investigation
6	Jan. 31 2022	Discussion on mid-term bridge management plan under Output 3

No.	Date	Contents
7	Feb. 8 2022	Discussion on bridge inspection and repair manuals under Output 2
8	Mar. 9 2022	Discussion on bridge repair manual under Output 3
9	May 20 2022	Discussion on Numerical Values of Indicators on PDM for 3rd JCC Meeting
10	Jul. 4 2022	Discussion on Output 3 Human Resource Development Plan
11	Oct. 6 2022	Discussion on Output 4 Bridge Engineering Course Curriculum, Output 1 Improvement Plan on Bridge Management and Output 2 Training
12	Oct. 27 2022	Discussion on Output 2 Bridge Maintenance Management
13	Feb. 6 2023	Bridge Engineering Model Course and BMS Data Collection Operation
14	Apr. 18 2023	Discussion on cancellation of 3rd country training and allocation of bridge inspection/diagnosis training towards SEHM engineers from non Model SETMs
15	Jun. 15 2023	Discussion on Output 1 Improvement Plan on MOT bridge maintenance
16	Jun. 21 2023	Discussion on Output 2 Preparing revised BMS data collection action schedule for 3 Model SETMs.
17	Dec. 13 2023	Discussion on Output 2 Bridge inspection/diagnosis final evaluation and monitoring results on cross-sectional repair work for Vose bridge.
18	Feb. 21 2024	Exchange of opinions on how to improve Output 1, explanation on Output 3, and discussion on Output 4 regarding the curriculum of the bridge engineering course.
19	Jun. 6 2024	Discussion on Output 1 to the report of improvement plan on organizational structure for bridge management.
20	Jun. 14 2024	Discussion on Output 3 regarding the draft report of mid-term bridge management plan and budget proposals.
21	Jun. 24 2024	Discussion on Output 2 to the final version of Bridge Inspection Manual(Ver. 1)
22	Jul. 16 2024	Discussion on Output 3 regarding the draft report of mid-term bridge management plan and budget proposals.
23	Jul. 26 2024	Explanation on Output 2 regarding result of pilot project 2024 and major issues of bridge design and construction in Tajikistan

(4) Activity 1-4: Improvement plan on organizational structure for bridge management is prepared, and approved by MOT.

On June 6, 2024, a BMT meeting was held to share and explain the contents of the report on proposed improvements for the bridge maintenance and management system, which was a part of Output 1 achievement. The comments received from BMT members, MOT and DITI, were incorporated into the report, and the report was then shared again with BMT members for approval. The report was finalized and submitted to MOT on June 19, 2024 and approved by MOT on September 17, 2024. The main contents of the report are as follows:

1） Recommendations for the continuation of MOT-led BMT activities and Road Disaster Management Task Force (RDMT) activities

JICA Expert Team proposed that BMT continues its activities even after the completion of this project. BMT was composed of a person in charge from each of MOT, DITI, and TTU for the purpose of information sharing and collaboration among the organizations during the project period. The same task force, which has continued its activities after the completion of the Project of Road Disaster Management Capacity Improvement in Tajikistan, suggests continuing its activities after the completion of the project, as these activities have been effective in promoting inter-organizational collaboration.

2） Establishment and operation policy of a dedicated portal site for bridge maintenance and management

JICA Expert Team proposed that MOT establish a portal on the website where materials and videos from the bridge engineering course, conducted under Output 4, can be viewed. This will enable MOT, SEHM, SETM, TTU, DITI, etc. to view lecture materials and create a platform for sharing information.

3） Proposal to establish an organization for bridge maintenance and management

For each of MOT and SETM, it was proposed to establish a department dedicated to bridge maintenance and to assign an engineer in charge of bridge maintenance. For SEHM, due to the relatively small number of staff, it was proposed that no new department dedicated to bridge maintenance be established and that a dedicated engineer for bridges be assigned.

4） Establishment of a career path system for bridge engineers

JICA Expert Team proposed a clear career path for bridge engineers and a system to properly evaluate their skills and experience.

5） Visualization of roles and responsibilities of each responsible organization

At BMT meeting, the roles and responsibilities of each organization were clarified as shown in Table 2-5. Since issues had arisen in terms of inter-organizational collaboration, a proposal was made to continue BMT activities, as suggested in (1).

Table 2-5 Personnel in charge of BMT meeting

Organization	Assign name	Roles
MOT	1. Chief Specialist of Road Construction Unit of RCMD	1.Announcement for implementing BMT meeting
	2. Chief Specialist of Road Construction Unit of RCMD	2.Consider the agenda for BMT meeting
	3. Staff and Specialist of Digitalization of Transport Sector (Assistant)	3.Manage the comprehensive bridge maintenance issues including budget issues
	4. Staff and Specialist of Digitalization of Transport Sector (Assistant)	4.Manage the database of bridges
SETM	1.Chief Engineers of six (6) SETMs	1.Share the bridge maintenance status 2. Propose improvements or concerns for bridge maintenance
DITI	1. Head of Artificial Department of DITI	1.Provide advice on bridge engineering issues related to bridge maintenance
	2. Leading Engineer of Artificial Department of DITI	
	3. Chief Project Engineer of DITI	
TTU	1. Assistant Professor of TTU	1.Develop human resource development program for bridge engineers
	2. Assistant Professor of TTU	2.Propose new technology for bridges

2.1.2 Output 2: Capacities for Bridge Inventory Management, Inspection/Diagnosis, and Maintenance of MOT, SETMs/SEHMs, DITI, and TTU are Improved

Major achievements of Output 2 are shown in Table 2-6.

Table 2-6 Major Achievements of Output 2

Activities	Major Achievements	Status
Activity 2-1. Conduct Baseline Survey on present bridge inventory, bridge condition and activities of bridge management.	● 421 bridges for the inventory survey were selected from 6 SETMs after discussion with MOT. ● In the baseline survey, the project quantitatively assessed the road infrastructure maintenance capacity in Tajikistan at the start of the project in order to evaluate the "level of achievement of road asset management technology establishment" through technical assistance.	Completed
Activity 2-2. Select model SETMs/SEHMs and bridges to be inspected under the Project.	● In the baseline survey, the project designated three model SETMs: Hissor, Bokhtar, and Sughd SETMs. ● A survey was conducted, for 6 days from September 14 to 23 in 2021 in 3 SETM jurisdictions, to understand the general bridge type and typical damage types.	Completed
Activity 2-3. Technical manuals on bridge inventory system, inspection/diagnosis, and maintenance are developed.	● Bridge inspection manual (Ver. 0) was prepared in reference to the Japanese Road Bridge Inspection Manual. Then, the manual contents were discussed with BMT members on February 8, 2022. ● Bridge repair manual (Ver. 0) was completed in March 2022, and a BMT meeting was held on March 9, 2022 to discuss the outline and structure of the manual. Then, the manual contents were approved by MOT and DITI. ● Basic approach for bridge management (Ver. 0) was prepared. The manual describes the overview and status of bridge management in Tajikistan, improvement plans for bridge management and how to make an efficient mid-term bridge management plan by using the collected BMS data. ● 3 technical manuals were drafted and translated into Russian in April to May 2022.	Completed
Activity 2-4. Conduct trainings on bridge inventory management, inspection/diagnosis, and maintenance, for MOT, SETMs/SEHMs, DITI, and TTU.	● Bridge inspection training (classroom) was conducted for SETMs on February 15, 2022 for the initial scope of bridge inspection training (on-the-job training) was conducted for model SETMs on the following dates in June 2022. 1) Sughd SETM: 1st to 2nd of June 2022, 37 trainees 2) Bokhtar SETM: 7th to 8th of June 2022, 29 trainees 3) Hissor SETM: 14th to 15th of June 2022, 25 trainees ● Bridge inspection training (on-the-job training) was conducted for non-model SETMs on the following dates from July to November in 2023. 1) Kulob SETM: 12th to 14th of July 2023, 25 trainees 2) Kulob SETM: 30th August to 1st September 2023, 22 trainees	Completed

Activities	Major Achievements	Status
	3) Rasht SETM: 19th to 23th of July 2023, 12 trainees 4) Rasht SETM: 23th to 25th of July 2023, 15 trainees 5) Pamir(GBAO) SETM: 20th to 22nd of September 2023, 18 trainees 6) Pamir(GBAO) SETM: 15th to 17th of November 2023, 18 trainees ● Training materials were prepared based on the bridge repair manual, and the outline was explained to BMT members and SETM/SEHM. ● Training session to practice scaffolding equipment provided under the Project was held 2 times in the following period. 1) 12th to 14th of October 2022, 12 trainees 2) 19th to 21st of October 2022, 18 trainees ● Equipment for bridge inspection and repair including scaffolding equipment was provided and used in OJT training.	
Activity 2-5. Introduce BMS for MOT and model SETMs/SEHMs.	● The list of basic bridge information to be imported into BMS system (bridge name, road name, national road type, etc.) was discussed for update with Road Construction Unit (RCU) and the departments in charge of RAMS. The confirmation was completed in the end of February 2022. ● JICA Expert Team developed applications for iPads, PCs, and servers that form the BMS. JICA Expert Team began collecting bridge inventory data and bridge inspection data in October 2022. By the end of June 2024, inventory data of 1,643 bridges (74%) were registered in the BMS servers. ● Discussions on operation of RAMS were held with WB, ADB, and MOT. The meetings on RAMS were held 7 times during the project period.	Completed
Activity 2-6. Before) Conduct bridge inspection/diagnosis for the Model SETMs/SEHMs. After PDM changes) Conduct bridge inspection/diagnosis for all SETMs/SEHMs.	● Bridge inspection and diagnosis of 1,176 bridges in the model SETM/SEHM was completed by June 2024. ● Bridge inspection and diagnosis of 467 bridges in the non-model SETM was completed as well. ● Bridge inspections were conducted in all SETMs and 1,643 bridges were completed.	Completed
Activity 2-7. Conduct Pilot Project(s) for bridge maintenance in the Model SETMs/SEHMs.	● A pilot project was implemented at Bokhtar SETM, Hissor SETM, and Sughd SETM from October to November 2023 with the aim of teaching the basics of construction and developing human resources for leadership roles. ● The 2024 pilot project was implemented for on-the-job training of cross-section repair method, crack repair method, repair of expansion joints, and crack repair method with epoxy materials in three model SETMs from May to July.	Completed
Activity 2-8. Finalize the technical manuals for approval by	● Bridge inspection manual, bridge repair manual and bridge maintenance manual were finalized in accordance with the following procedure.	Completed

Activities	Major Achievements	Status
MOT.	● (1) Completion of draft manuals, (2) Discussion at BMT meetings, (3) Modification based on comments, (4) Approval by MOT (September 17, 2024).	
Activity 2-9. Issues on bridge design/construction based on the feedbacks from the bridge inspection/diagnosis are shared among MOT, DITI, and TTU.	● During the dissemination seminar held in 2021, damages related to insufficient bridge design and construction works, which had been discovered through the 450-bridge survey, were shared with C/P and related agencies. Also, importance of quality control of design and construction at the initial stage. ● The issues related to bridge design and construction were highlighted through the bridge inspection and pilot projects. ● Major issues related to bridge design and construction identified through the results of bridge inspection/diagnosis and the pilot projects were compiled into a document and shared at BMT meeting.	Completed

(1) Activity 2-1. Conduct Baseline Survey on present bridge inventory, bridge condition and activities of bridge management.

450 bridges for bridge inventory survey were selected from all 6 SETMs after discussion with the MOT. Then, in late April 2021, a subcontractor for the bridge inventory survey was selected through a competitive quotation process and contract negotiations, and the contract was concluded on May 17, 2021. On the following day, May 18, training for bridge inventory survey and inspection using tablets (iPads) was conducted for the subcontractor, and the survey began on May 26 with two survey teams. The survey was completed on August 9, 2021. Of the 450 targeted bridges, 29 bridges were excluded from inspection target due to security reason near borders with neighboring countries, or inappropriate type of structure as box culverts. Therefore, 421 bridges were targeted in this survey. For more details, see the Baseline Survey Report. In addition, basic survey for assessment of road asset management capabilities was conducted with certain survey/questionnaire form, interviewing C/P, and the survey results were summarized in the Baseline Survey Report.

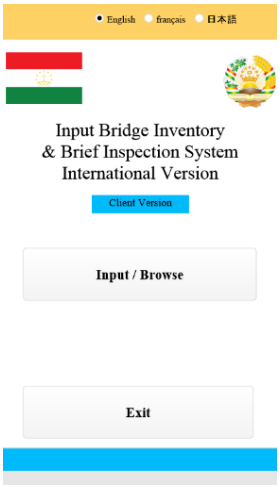


Figure 2-4 Tablet for Bridge Inventory Survey

Table 2-7 Target Sites for Bridge Inventory Survey

	SETM	Planned	Completed	Remarks
1	Hissor SETM	80	77	3 bridges not inspected
2	Sughd SETM	120	105	15 bridges not inspected
3	Bokhtar SETM	110	104	6 bridges not inspected
4	Kulob SETM	40	40	
5	Pamir (GBAO) SETM	60	56	4 bridges not inspected
6	Rasht SETM	40	39	1 bridge not inspected
Total		450 bridges	**421 bridges**	

* The original plan was to conduct a bridge inventory survey of 450 bridges, but the number of bridges included in this baseline survey was 421, excluding 29 bridges located near the border or box culverts.

(2) Activity 2-2. Select model SETMs/SEHMs and bridges to be inspected under the Project.

As a result of the baseline survey, three model SETMs were identified, namely Hissor, Bokhtar, and Sughd SETMs. The number of bridges to be inspected was set at 1,538. Field surveys were conducted in the three model SETMs for 6 days from 14th to 23rd of September in 2021 to confirm the standard bridge types and typical damage types in Tajikistan.

(3) Activity 2-3. Technical manuals on bridge inventory system, inspection/diagnosis, and maintenance are developed.

1) Preparation of Bridge Inventory

In the inventory, the following information is entered (An image of the BMS input screen is also shown below):

Table 2-8 Information included in Bridge Inventory

Item	Contents
Photo	Overview, road surface, name plate
General	Administrator, road name, latitude, longitude, length of bridge, carriageway margin, sidewalk, construction year
Pavement	Material, sidewalk
Superstructure	Material, structure type, No. of girder per span, junction of spans
Deck slab	Material
Appurtenances	Bearing, expansion joint, bridge railing, pole light, drainage, attachment
Pier	Material, structure type, No. of columns per one pier, dimension, pier height
Abutment	Material, structure type, foundation type, height of A1 and A2

Figure 2-5 An Example of Input Screen of Bridge Inventory

2) Preparation of Manuals

Following three types of manuals were prepared under the project according to the current requirement.

Bridge inspection manual	Bridge repair manual	Basic approach for bridge management

Figure 2-6 Manuals Prepared in this Project

(a) Bridge inspection manual:
This manual consists of (1) General, (2) Periodic inspection, (3) Routine inspection, (4) Urgent inspection, (5) Detailed inspection. Collection of damage types and BMS operation procedures are attached to the manual as Appendix.

(b) Bridge repair manual:
This manual mainly describes general damage types/mechanisms and repair methods. Also, overview of repair method procedures is summarized based on the pilot project result as the Appendix of the manual.

(c) Basic approach for bridge management:
This manual describes the overview and status of bridge management in Tajikistan, improvement plans for bridge management and how to make an efficient mid-term bridge management plan by using the collected BMS data.

(4) Activity 2-4. Conduct trainings on bridge inventory management, inspection/diagnosis, and maintenance, for MOT, SETMs/SEHMs, DITI, and TTU.

1) Training for bridge inspection

Overview of Bridge Inspection Training (Model SETMs)

A classroom training on bridge inspection was conducted for SETMs on February 15, 2022. The training included an explanation of necessity of bridge inspections and specific examples of typical damage types in Tajikistan.

Bridge inspection training (OJT) was conducted in June 2022.

Figure 2-7 Scenes from OJT Training for Bridge Inspection

Bridge Inspection Training Overview (Non-Model SETM)

OJT training for the non-model SETMs (Kulob, Rasht, and Pamir(GBAO) SETMs) were approved at the 5th JCC meeting, and the trainings were conducted for 3 days from July to November. Please note that since there are no PC bridges in the Kulob SETM and Rasht SETM jurisdictions, trainings were conducted focusing on RC/steel bridges. In Pamir(GBAO) SETM, the inspection of suspension bridges was added to the training menu considering the regional characteristics.

The OJT training consisted of 1-day classroom lecture on bridge types, damage types, examples of bridge fall-down, and importance of bridge inspection, and 2-day field training on the standard bridge types (steel bridges and RC bridges).

Classroom lectures at Kulob SETM

OJT training at Rasht SETM

Figure 2-8 Scenes from OJT Training for Bridge Inspection in Non-model SETMs

Training on equipment for bridge inspection/repair works

Bridge maintenance equipment for bridge inspection and repair works was procured, and the training including drone, boat and Schmidt hammer was conducted in October 2022 for training of 6 SETMs in Bokhtar SETM and Hissor SETM jurisdictions.

Bridge inspection using drones



Bridge inspection using boat



Measurement with Schmidt hammer

Figure 2-9 Training on Equipment

2) Training for repair

Training materials were prepared based on the Bridge repair manual, and its outline was explained to BMT members and SETM/SEHM by giving a lecture. After that, lecture-style trainings utilizing the training materials were carried out repeatedly by the project national staff from late March 2022.

3) Training for utilization of scaffolding for bridge inspection

Training for utilization of scaffolding was conducted in order to train a total of five officials per 6 SETMs who are in leadership positions so that SEHM engineers can safely install suspended scaffolds as needed during inspections and repairs under their instruction. The training was conducted two times.

(1) Target: About 5 officials per SETM ⇒ 30 officials in total.
(2) Location: Model bridges (PC bridges and steel bridges) were set up in the Hissor SETM area, and the training was divided into two sessions for 30 participants.
(3) Schedule: The 1st course was conducted for 12 trainees, and the 2nd course was conducted for 18 trainees for 3 days. The course consisted of safety management (0.5 day) and on-site training (2.5 days).


1st Scaffolding Training at PC Bridge


1st Scaffolding Training at Steel Bridge


2nd Scaffolding Training in classroom lecture style

Figure 2-10 Training for Utilization of Scaffolding

4) Follow-up training by national staff

In addition to the training conducted by JICA Experts in October 2022, 2-day training course including BMS training (project activity 2-5), mainly led by project national staff who graduated from TTU's bridge engineering course, was held in each model SETM during the winter period from November to December.

SETM winter training (lecture)

SETM winter training (field trip)

Figure 2-11 Follow-up Trainings Led by Project National Staff

Test results and analysis on bridge inspection before/after the training

A total of 1,489 trainees from 6 SETMs participated in 112 OJT training sessions: 59 trainees for bridge inspection training, 17 trainees for BMS training, 13 trainees for bridge repair training, and 23 trainees for training of equipment and materials. These OJT trainings were basically a combination of classroom lectures and on-site training. However, during the winter season, classroom lectures were conducted regularly to ensure that the trainees maintain what they learned and consolidate the skills/knowledge. Initially, OJT was conducted only for three model SETMs/SEHMs (Hissor SETM, Sughd SETM, and Bokhtar SETM), but at the expansion of the target area due to the R/D change dated on 5th July, 2023, the three non-model SETMs were also included in the target of OJT, and the additional OJT sessions were conducted accordingly.

In addition, basic tests (10 questions, maximum score of 100 points, together with feedback from trainees) related to bridge inspection were conducted before and after the OJT to confirm effectiveness of the training and collect opinions for the training. The test results and feedback were considered in the following training sessions for improvement. Figure 2-12 shows the test results before and after OJT. Comparing the average score before and after the training, the score improved by more than 10 points. The average score after the training was 80 points, which means that most of the participants understood 80% of the bridge inspection training content. This fact indicates that the SETM/SEHM trainees who participated in the training sessions basically understood the basic knowledge and skill instructed in bridge inspection training.

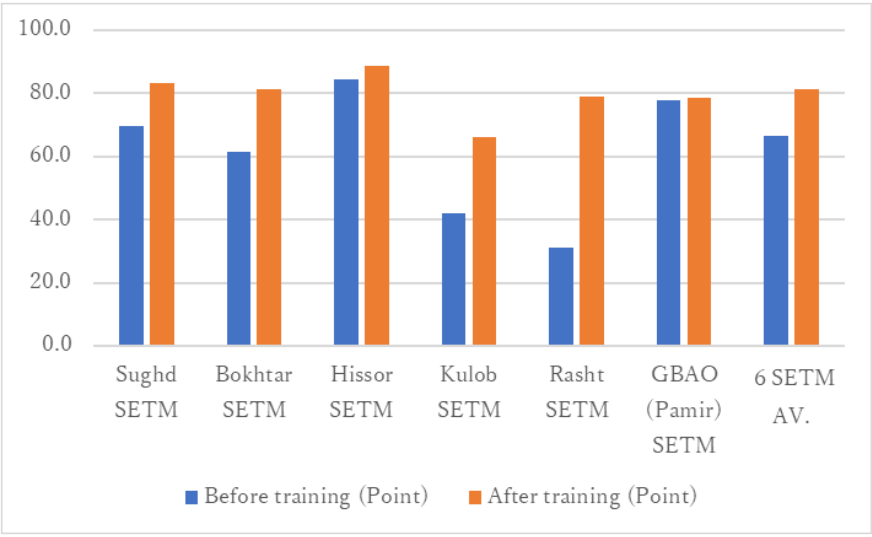
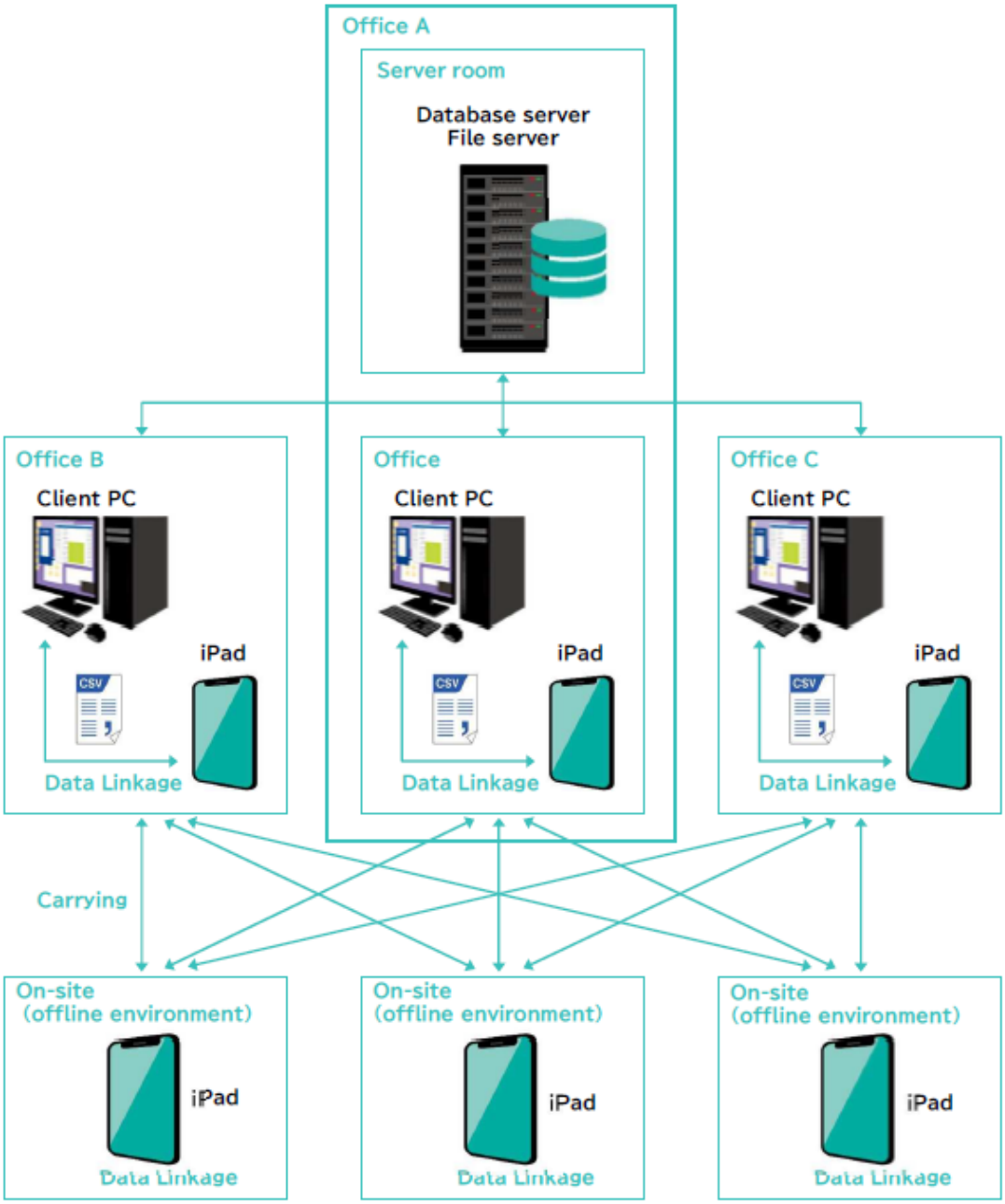


Figure 2-12 Test Results Before and After OJT (6 SETMs)

(5) Activity 2-5. Introduce BMS for MOT and all SETMs/SEHMs.

1) Outline of BMS

There has been coordination between JICA Expert Team and C/P since May 2021 for the establishment of BMS system, such as collection of bridge inventory and bridge inspection data by tablet device, installation of PCs and other equipment, and confirmation of network maintenance by MOT. In October 2022, the tablet device application for bridge inventory and bridge inspection (trial version) was installed, and operation training was conducted for SETM/SEHM during the same period. The application (trial version) of the tablet device for bridge inventory and bridge inspection was installed in October 2022, and training was conducted for SETM/SEHM at the same time. The tablet device application was used as a tool for collecting bridge inventory and bridge inspection data in Activity 2-6 from February 2023, and the data of 1,643 bridges were stored in the BMS server.



(Source: JICA Expert Team)

Figure 2-13 Outline Figure of BMS

2) Meeting on establishment of RAMS

Discussions regarding RAMS and BMS of this project were held with the IT section of MOT.

Table 2-9 Outline of Meetings on Establishment of RAMS

No	Date	Content
1	March 14 2022	Explanation of current progress and sharing information on future plans.
2	May 17 2022	Face-to-face meeting with ADB engineer Mr. Serge to share the progress of both projects and to discuss future policies.
3	June 13 2022	ADB hosted the meeting with WB to review progress of RAMS.
4	Sep. 30 2022	It was identified that progress of RAMS led by WB and ADB was slow, and that the completion time of RAMS development was unclear.
5	July 6 2023	1) RAMS meeting resumed by the MOT's request. 2) Work progress of the private consultant hired in June 2023 by WB and outline of JICA project and BMS system were explained. Also, the output format of the integration of the BMS into the RAMS were confirmed and agreed by WB. 3) Both sides agreed to hold information sharing meetings every few months.
6	Sep. 19 2023	1) The 1st RAMS supervisory committee meeting was held, led by the consultant employed by WB. 2) The consultant gave a report on current status of the inception phase of the RAMS development. 3) JICA Experts Team requested to participate in the future committee meeting as the member.
7	Jan. 22 2024	WB and ADB reported progress of the RAMS development.

(Source: JICA Expert Team)

3) BMS operation training

Training on how to input results of bridge inventory survey and bridge inspection into tablet device was conducted in October 2022. In addition, MOT requested that bridge inventory should include general drawings of bridges (hand drawing), so preparation of general drawings was practiced as a part of training.

Workshops were also conducted for each SETM to practice data uploading process from tablet device to PC and from PC to the MOT data server. Trainees used tablet device and PC during the training session to promote understanding of data uploading process.

Figure 2-14 Tablet Training

Figure 2-15 Preparation of General Drawing of Bridges

Figure 2-16 A Scene from Workshop

4) Follow-up training by national staff

Follow-up training on operation of the tablet device for BMS (bridge inventory and bridge inspection) was conducted as a part of Activity 2-4 training in November 2022. The training of bridge inventory survey and bridge inspection using the tablet device started in February 2023, instructed by project

national staff and BMT members. After that, follow-up trainings were conducted continuously.

(6) Activity 2-6. Conduct bridge inspection/diagnosis for all SETMs/SEHMs.

Inventory, bridge inspection, and diagnosis using BMS in the model area started in February 2023 under direct management by SETM/SEHM staff. Follow-up support was provided by the JICA Expert Team, BMT members, and consultant local staff. Note that the scope of this work at the beginning of the project was only limited to the model SETMs including Hissor SETM, Bokhtar SETM and Sughd SETM. In response to a strong request from the MOT, the R/D for this project was changed on July 5, 2023 to expand the coverage area, and in addition to these three model SETMs, the Kulob SETM, Rasht SETM and Pamir(GBAO) SETM would also conduct the bridge inspection/diagnosis activities. The activities of the additional SETMs began in July 2023.

A Scene from Classroom Training

A Scene from Bridge Inspection

Figure 2-17 Training for Bridge Inventory Survey and Bridge Inspection (Model SETMs)

In August 2023, in order to share and resolve issues that each SETM was facing in data collection work, MOT and JICA Expert Team conducted interviews with Hissor SETM and Bokhtar SETM and confirmed the status of data collection. As the result of interviews, major issues were 1) the lack of knowledge on bridge structures (technical issues) 2) turnover of trained engineers and the lack of vehicles for transportation (operational issues). These issues were addressed by dispatching the consultant national staff to provide additional technical support and requesting operational support from MOT and SETMs.

The results of bridge inventory survey and bridge inspection are shown in Table 2-10 and Table 2-11.

Table 2-10 Data Collection for Bridge Inventory and Inspection (Model SETM)

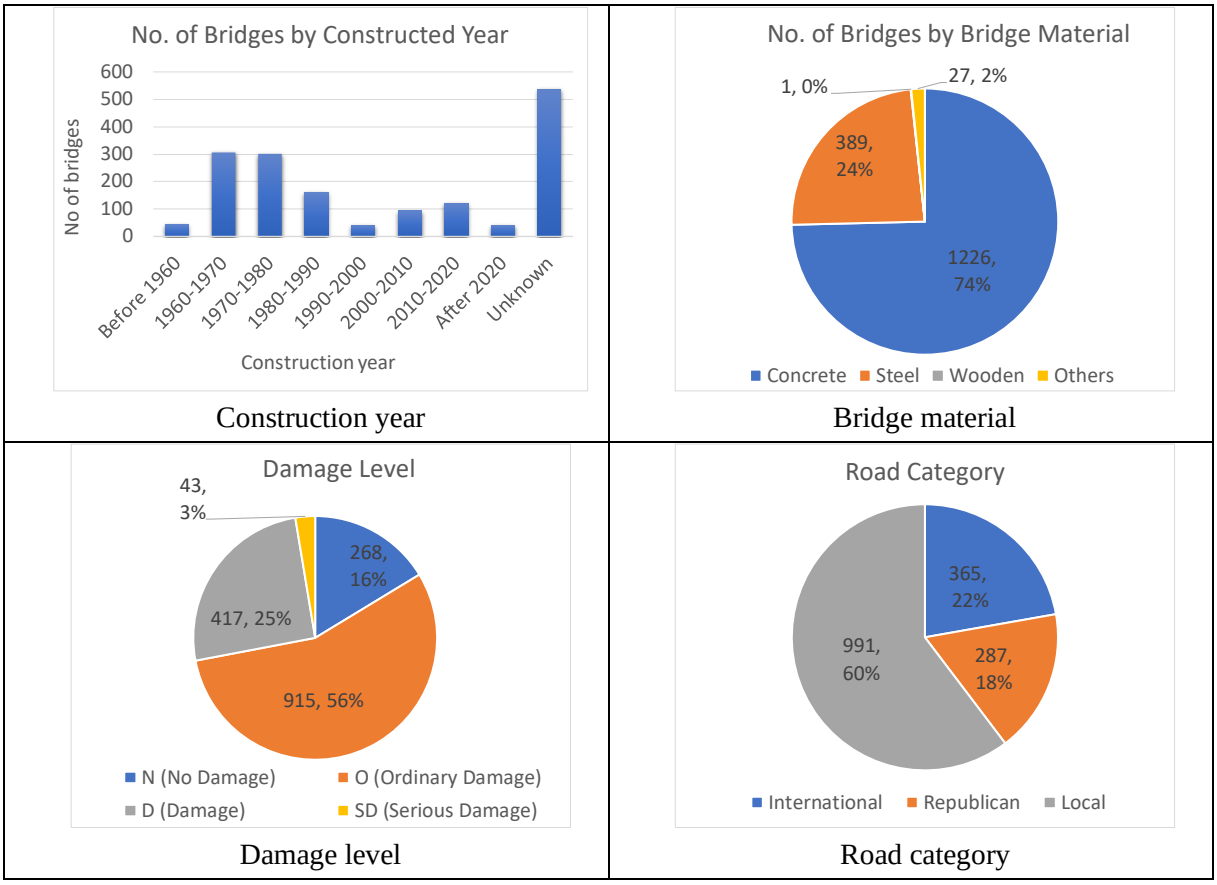
	Bridges (Plan)	Bridges (Actual)	Achievement (%)
1 Hissor SETM	367	330	89.9
2 Bokhtar SETM	601	455	75.7
3 Sughd SETM	570	450	78.9
Total	1,538	1,235	80.3

(Source: JICA Expert Team)

Table 2-11 Data Collection for Bridge Inventory and Inspection (Non-Model SETM)

	Bridges (Plan total)	Bridges (Actual total)	Achievement (%)
1 Kulob SETM	303	285	94.1
2 Rasht SETM	116	110	94.8
3 Pamir(GBAO) SETM	274	189	69.0
Total	693	584	84.3

(Source: JICA Expert Team)



(Source: JICA Expert Team)

Figure 2-18 Bridge Inventory Result based on Bridge Inspection Result

[Response to MOT request]

1) On November 25, 2022, a drone survey was requested to check the pier defects of a bridge (in service since 1985) on the International Road РБ07_71+095 under the jurisdiction of Rogun SEHM, as a task connected to Activity 2-6.

Figure 2-19 Aerial View of the Bridge Taken by Drone Provided in the Project

2) As requested by the Deputy Minister of MOT, the project national staff conducted the inspection of the damaged bridge and registered the results into BMS together with Sughd SETM engineers (Mastchohi Kuhi SEHM) on December 22, 2022. OJT training on bridge inspection and BMS data registration was carried out as a part of this activity.


Figure 2-20 Inspection of the Damaged Bridge under Sughd SETM Jurisdiction

3） The inspection of the bridge (РБ04_180+150) under Kulob SETM jurisdiction (Vose SEHM) was conducted on December 5, 2023 to observe the status of concrete cross-section repair work completed on November 22, 2023. As a result, the sufficient quality of the concrete cross-section repair work was confirmed. The results were shared at the 17th BMT meeting, and recommendations were made, to BMT members, to continue monitoring of the bridge, so that the rapid damage progression would not be missed.

(7) Activity 2-7. Conduct Pilot Project(s) for bridge maintenance in the Model SETMs/SEHMs.

The pilot project was conducted two times for model SETMs in 2023 and 2024. In 2023, small-scale repair works (cross-section repair method) were conducted for training of SETM officials. Also, in 2024, medium-scale repair works (cross-section repair method, replacement of expansion joints, and crack repair method) were conducted by hiring contractors. In both pilot projects, the on-the-job training was conducted for officials of three model SETMs including a total of 184 trainees participating over a period of 11 days.

1) Pilot project 2023

The survey to find repair methods, material, and equipment to be implemented in Tajikistan started in October 2022. The pilot project aimed at training SEHM engineers to acquire the skills necessary to conduct detailed surveys and small-scale bridge repair work for damaged bridges, to learn the basics of construction procedures, and to develop human resources who can play a leadership role.

The program included practical training for construction procedures, quality control, material handling, use of necessary materials and equipment.

A) Training target

About 10 officials were selected from each SETM for training sessions, a total of about 30 trainees. The training was divided into three sessions, three days per location, at 3 model SETMs.

Bokhtar SETM: October 16 to 18, 2023
Hissor SETM: October 23 to 25, 2023
Sughd SETM: October 31 to November 2, 2023

B) Outline of training sessions

The following steps were taken for trainees to learn basics of detailed survey and repair works.

Day 1: AM: In-house training to understand safety management, tool usage, and construction procedures
PM: On-site training at sites for detailed survey
Day 2: Hands-on training at sites for repairing bridges (concrete cross-section repair, concrete chipping, and concrete filling)
Day 3: Hands-on training at sites for repairing bridges (concrete cross-section repair and coating of concrete surface for finishing)

C) Photos

		
Classroom (Bokhtar SETM)	Neutralization test (drill method) (Bokhtar SETM)	Concrete Cutter (Bokhtar SETM)
		
Mixing of polymer cement mortar (Bokhtar SETM)	Practical training (Hissor SETM)	Scaffolding installation (Hissor SETM)

Figure 2-21 Pilot Project 2023

2) Pilot project 2024

Preparation for pilot project 2024 began in October 2023 to select a local contractor for outsourcing repair works, confirm repair materials, and select repair methods to be practiced. Also, OJT for concrete crack repair using epoxy resin was conducted for SEHM engineers belonging to 3 model SETMs.

A) Outline of Pilot Project 2024
Package A: Bridges under Hissor SETM and Bokhtar SETM
Contractor: LLC Mostootryad
Construction period: March 6 to August 10, 2024 (Bokhtar site: period of April 15 to June 20, 2024)
(Hissor site: period of June 1 to July 31, 2024)

Table 2-12 Outline of Package A

SETM	Bridge	Outline
Hissor	37＋180	Repair of expansion joints, construction of pavement, backfilling around abutments, placement of concrete around abutment slope (thickness: 15cm), painting of outer concrete girders
Bokhtar	0＋300	Cross-sectional repair of concrete girders, repair of expansion joints, installation of bridge surface drainage, painting of outer concrete girders

Package B: A bridge under Sughd SETM
Contractor LLC Rohi Obod
Construction period March 5 to August 10, 2024 (period of April 15 to June 20, 2024)

Table 2-13 Outline of Package B

SETM	Bridge	Outline
Sughd	5＋100	Repair of expansion joints, installation of bridge surface drainage, Installation of U-channel, construction of slope protection, cross-sectional repair of concrete girders, painting of outer concrete girders

B) OJT target

About 10 trainees were selected from each SETM, and a total of about 30 trainees were selected for the training. The training was divided into three sessions and held for three days per location at 3 model SETMs.

Bokhtar SETM/Kurob SETM: May 15, 2024 (20 trainees)
Sughd SETM: June 14, 2024 (16 trainees)
Hissor SETM: July 10, 2024 (14 trainees)

C) Outline of training sessions

i) Introduction of the pilot projects in 2023 and 2024

ii) Explanation on procedures of cracks injection method by epoxy injection method

- After completing installation of injection packer, mix material-A and material-B
- Use the material within 30 minutes after opening the material packet
- Clean the equipment before start mixing material-A and material-B for the next lot
- Set injection packer on the 1st day, and remove the packer in 24 hours on the 2nd day

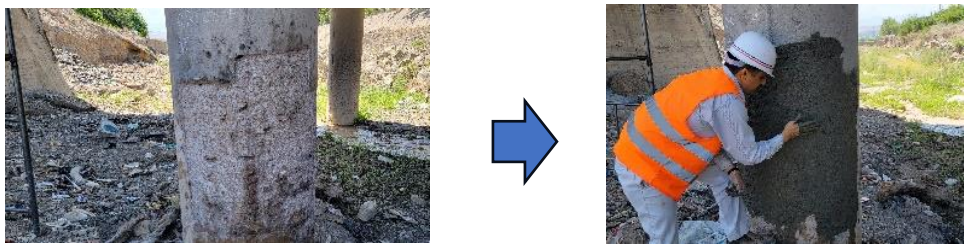
iii) Instruction on overview of repair works by the construction contractor (explanation of technical details for each repair method according to the drawings)

- Concrete cross-section repair method using polymer cement
- Repair of expansion joints
- Improvement of drainage on bridge surface by installing drainage pipes
- Surace protection of concrete girders by coating liquid glass
- Installation of chains in between sidewalk railings
- Installation of U-shaped gutter into slope area of the abutment

D) Photos

Crack repair work by epoxy injection method

Cross-section repair work using polymer cement (for concrete girders)



Cross-section repair work using polymer cement (for bridge piers)

Figure 2-22 Outline of Pilot Project 2024 (1/2)

Repair of expansion joints

Improvement works of drainage on bridge surface by installing drainage pipes

Surace protection of concrete girders by coating liquid glass

Installation of chains in between sidewalk railings

Installation of U-shaped gutter into slope area of the abutment

Figure 2-23 Outline of Pilot Project 2024 (2/2)

(8) Activity 2-8. Finalize the technical manuals for approval by MOT.

Three manuals prepared in this project were reviewed at BMT meetings and approved by MOT on September 17, 2024.

(9) Activity 2-9. Issues on bridge design/construction based on the feedbacks from the bridge inspection/diagnosis are shared among MOT, DITI, and TTU.

At the dissemination seminar held in 2021, damage cases caused by inadequate bridge design and construction, identified through bridge inspection, were shared with C/P and related organizations to explain importance of ensuring initial construction quality.

In addition, the following six issues related to bridge design and construction were identified through the bridge inspection and pilot projects. JICA Expert Team proposed and shared the improvement plans with BMT members.

1) Lack of concrete cover depth of concrete girders

Concrete bridges in Tajikistan are likely to have concrete spalling and rebar exposure due to insufficient concrete cover depth of rebars. In this regard, some of the exposed rebars are corroded by water. As a countermeasure, it is recommended to secure larger concrete cover depth of rebars in design and construction stages.

2) Improvement of bridge surface drainage system

As a typical damage of concrete bridges in Tajikistan, frost damage is often seen on outer side of concrete deck slab and concrete girders, caused by insufficient drainage system on bridge surface. As the countermeasures, (1) installation of drainage basins, (2) sufficient drainage slope, and (3) installation of water drip at the edges of concrete deck slab are recommended.

3) Countermeasures against frost damage in areas where runoff and stagnant of water are concerned

Frost damage often occurs on outer concrete girders and at the edge of concrete deck slabs, where water flow and water retention are likely to occur. As a countermeasure, it is recommended that concrete surface protection method should be applied to reduce water absorption from the concrete surface and improve durability of reinforced concrete structures.

4) Waterproofing of concrete deck slab at sidewalks

In Tajikistan, there are many cases where precast concrete members are used over unpaved bridge sidewalks, and material-loss or fall-off of concrete deck slab due to frost damage is frequently observed in sidewalk sections. As countermeasures, it is recommended that (1) asphalt pavement should be installed in the sidewalk sections and (2) waterproofing layers should be installed under the pavement.

5) Utilization of steel bridges in areas prone to frost damage

Because Tajikistan is a dry region, steel bridges remain sound after 70 years without being repainted. On the basis of the fact that steel girders are not affected by frost damage, utilization of steel girders in areas where concrete girders are severely damaged by frost damage would contribute to reducing the life cycle cost of bridges.

6) Countermeasures against scouring for bridge substructures

In Tajikistan, melting snow and rainfall in the mountains frequently cause river flooding, which subsequently causes significant scouring around abutments and piers of bridges crossing rivers. As countermeasures, in addition to installation of revetments around the substructure, (1) improvement of river channel to reduce gradient of the entire river alignment and (2) reduction of river flow velocity by installing drop structure and weirs are recommended to cope with the high river velocity due to the steep topographical conditions in Tajikistan.

(1) Lack of concrete cover depth of concrete girders: Spalling and rebar exposure

(2) Bridge surface drainage system: An example of installation of drainage pipes into concrete deck slab of sidewalks

(3) An example of frost damage of a concrete girder in Tajikistan, and an example of surface protection work for concrete girders

(4) An example of frost damage of concrete deck slab of the sidewalk without asphalt pavement

(5) An example of steel girders in good condition located in area prone to frost damage

(6) Scouring in font of an abutment

Reduction of river flow speed by installation of weir

Figure 2-24 Bridge Design and Construction Issues in Tajikistan

2.1.3 Output 3: Capacities for Bridge Management Planning of MOT and Model SETMs are Improved

Major achievements under this output are shown in Table 2-14.

Table 2-14 Major Achievements under Output 3

Activities	Major Achievements	Status
Activity 3-1. Conduct Baseline Survey on bridge management planning.	● Budget information was collected and compiled as a part of baseline survey report in cooperation with MOT, DITI, and TTU.	Completed
Activity 3-2. Draft a Mid-term bridge management plan.	● Mid-term bridge management plans for five and ten years using BMS data were prepared, respectively.	Completed
Activity 3-3. Prepare a budget proposal(s) on bridge management activity(ies) for submission to MOF/international donor(s).	● Three bridges for replacement with high urgency were selected and draft budget proposals were prepared. ● The budget proposal will be submitted to MOF and/or international donors before October 2024.	Completed
Activity 3-4. Finalize the Mid-term Bridge Management Plan for approval by MOT.	● Mid-term bridge management plan including 5-year mid-term and 10-year long-term plans were finalized and submitted to MOT on 22nd July 2024. ● It was approved by MOT in September 17, 2024.	Completed

(1) Activity 3-1: Conduct Baseline Survey on bridge management planning.

Prior to the baseline survey, budget information was collected and compiled as a part of baseline survey report in cooperation with MOT, DITI, and TTU.

It was found that bridge maintenance was managed using a portion of the road maintenance budget, and that budget allocation for necessary measures (repair, reinforcement, and replacement) is not sufficient as 13 to 25% of overall maintenance budget. The table below shows changes of bridge maintenance budget over the past four years.

Table 2-15 Trends in Bridge Maintenance Expenditures

Type of maintenance	Works	Works Expenditure for Bridge Maintenance (Upper: 1,000TJS) (Lower: 1,000 USD)			
		2017	2018	2019	2020
MOT/SETM Road Maintenance	Bridge repair/maintenance works	1,492 (189)	1,165 (132)	1,566 (166)	1,130 (117)
Supplementary Budget/Expenditure on Bridge Works	Bridge construction works	1,270 (161)	1,750 (198)	2,880 (305)	2,194 (226)
	Bridge recovery works	596 (76)	1,800 (204)	3,280 (348)	2,256 (233)
	Sub Total	1,866 (237)	3,550 (403)	6,160 (653)	4,449 (459)
Total Bridge Maintenance		3,358 (426)	4,715 (535)	7,726 (819)	5,579 (576)
MOT Road Maintenance Budget	Road Maintenance including Bridge Maintenance	26,620 (3,380)	26,940 (3,055)	30,250 (3,208)	32,200 (3,323)
% of Bridge Maintenance		12.6	17.5	25.5	17.3

Note: Exchange Rate (TJS-USD): January 1st of each year from the National Bank of Tajikistan.
(Source: JICA Expert Team)

(2) Activity 3-2: Draft a Mid-term bridge management plan.

The bridge maintenance and management plan was developed based on the bridge inspection results from 3 model SETMs. Based on the road class and damage assessment (Figure 2-25), two types of maintenance plans were developed: "5-year mid-term bridge management plan (2025-2029)" (1-4 in Figure 2-25, Table 2-17) for bridges with high repair urgency (Table 2-17) and "10-year long-term bridge repair plan (2025-2034)" (5-9 in Figure 2-25, Table 2-17) for those with low repair priority for preventive maintenance (Table 2-18). Note that the target bridges for the 5-year mid-term bridge repair plan and the 10-year long-term bridge repair plan do not overlap. In other words, the 5-year plan with high urgency should be implemented first, but it is desirable to combine it with the 10-year plan, which is the target of preventive maintenance, from the perspective of future sustainability.

International	-	-	5	2	1
Republican	-	-	7	4	3
Local	-	-	9	8	6
Damage	N	O	D	SD	SD
	0-10	11-50	51-99	100-130	>130

Legends
- Urgent Replacement in 5-year Mid Term Plan (2025-2029)
- 5-year Mid-term Plan (2025-2029) including 1
- 10-year Long-term Plan (2025-2034)
- Routine Maintenance

Figure 2-25 Method for Determining Bridge Repair Priority

Table 2-16 Summary of Estimated Budget Required for 5-year and 10-year Plans

SETM	Total No. of target bridges	No. of bridges for 5-year plan	Estimated budget for 5-year plan (1000USD)	No. of bridges for 10-year plan	Estimated budget for 10-year plan (1000USD)
Hissor	330	14	$16,438	84	$8,109
Bokhtar	415	3	$7,183	98	$4,197
Sughd	431	1	$17	107	$7,824
Total	**1,176**	**18**	**$23,638**	**289**	**$20,130**

(Source: JICA Expert Team)

Table 2-17 5-year Mid-term Bridge Management Plan

(Unit：1000USD)

#	SETM	SEHM	Bridge Name	Road Type	Length (m)	Width (m)	Bridge Type	Const Year	2025	2026	2027	2028	2029
1	Hissor	Vakhdat	РБ04_19+800	International	150.6	14.4	Concrete	2009	$6,164				
2		Rogun	РБ07_71+095	International	76.3	12.9	Concrete	1986		$2,798			
3		Vakhdat	РБ04_24+730	International	10.5	13.4	Concrete	2009	$114				
4		Faizobod	РБ07_31+00	International	37.5	12.7	Concrete			$362			
5		Faizobod	РБ07_37+800	International	24.6	12.5	Concrete	2007	$223				
6		Vakhdat	РЧ022_3+300	Republican	107	12.9	Concrete	1961		$3,923			
7		Rudaki	РЧ042_11+200*	Republican	99	20	Concrete	1985					$0.00*
8		Vakhdat	РЧ022_29+500	Republican	10.4	10.9	Steel	2004				$322	
9		Rudaki	РЧ042_9+800*	Republican	70.2	21	Concrete	1985					$0.00*
10		Vakhdat	РЧ047_00+050	Republican	104	12.5	Concrete	2007					$1,090
11		Vakhdat	РЧ022_25+348	Republican	12	11.3	Concrete	1961			$111		
12		Rudaki	РЧ042_9+802	Republican	86	16.7	Concrete	1984				$1,133	

#	SETM	SEHM	Bridge Name	Road Type	Length (m)	Width (m)	Bridge Type	Const Year	2025	2026	2027	2028	2029
13		Rudaki	РЧ045_4+188	Republican	18	9.5	Concrete	1962				$134	
14		Vakhdat	РЧ022_31+100	Republican	12.9	7	Steel	2004			$64		
1		Shahrituz	РБ11_97+000	International	222	10.9	Steel	1961			$6,878		
2	Bokhtar	Shahrituz	РБ11_109+500	International	21	13.5	Concrete	1984	$212				
3		Vakhsh	РЧ057_1+200	Republican	24	5.3	Steel	1960				$93	
1	Sughd	Kuhistoni Mastchoh	РМС_134+000	Republican	4.1	5.4	Steel	1975				$17	
							Total Budget		**$6,713**	**$7,083**	**$7,053**	**$1,699**	**$1,090**
							Total Bridges		**4**	**3**	**3**	**5**	**3**

**These bridges are under detailed design and consideration for replacement by MOT in coordination with international donor.*

(Source: JICA Expert Team)

Table 2-18 10-year Long-term Bridge Management Plan

（Unit：1000USD）

SETM	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Hissor	$816	$955	$829	$793	$854	$729	$877	$715	$725	$814
Bokhtar	$452	$453	$448	$452	$451	$442	$449	$336	$311	$402
Sughd	$716	$706	$361	$1,043	$850	$880	$717	$670	$745	$1,136
Total Budget	**$1,984**	**$2,114**	**$1,638**	**$2,288**	**$2,155**	**$2,051**	**$2,043**	**$1,721**	**$1,781**	**$2,352**
Total Bridges	**28**	**25**	**27**	**29**	**28**	**31**	**30**	**32**	**31**	**28**

(Source: JICA Expert Team)

(3) Activity 3-3: Prepare a budget proposal(s) on bridge management activity(ies) for submission to MOF/international donor(s).

To prepare budget proposals for international donor agencies, MOT shared information on the past bridge repair projects prepared for international donors. We worked with BMT to prepare draft budget proposals for international donors for 3 bridges identified from the BMS data (high priority bridges to be replaced along the international road). The details of 3 bridges are given in Table 2-19 Table 2-20, and Table 2-21.

Table 2-19 Details and estimated cost of reconstruction of bridge РБ07_71+095

Bridge Name	РБ07_71+095
SETM	Hissor SETM (Rogun SEHM)
Location	Vahdat-Rasht-Lakhsh road, Latitude: 38.720733, Longitude: 69.683419
Estimated Cost (USD)	$2,797,743
Reason of Selection	The bridge has serious damages. The Pi-shaped girder in middle span was constructed based on experience but performance of the girder is poor as the structural system and technical parameters were not verified with normative documents.

Overview of Bridge

(Source: JICA Expert Team)

Table 2-20 Details and estimated cost of reconstruction of bridge РБ11_97+000

Bridge Name	РБ11_97+000
SETM	Bokhtar SETM (Shahrituz SEHM)
Location	Kizilkala-Jarbuja road, Latitude: 37.272153, Longitude: 68.148175
Estimated Cost (USD)	$6,878,173
Reason of Selection	The bridge has serious damages. Large settlement in the pier was found, which means there is a high probability of falling. Moreover, the technical parameters and bridge structure do not meet the current normative documents.

Overview of Bridge

(Source: JICA Expert Team)

Table 2-21 Details and estimated cost of reconstruction of bridge РБ04_19+800

Bridge Name	РБ04_19+800
SETM	Hissor SETM (Vahdat SEHM)
Location	Dushanbe-Kulma-Vahdat-Kulob-Khorug road, Latitude: 38.557023, Longitude: 69.008327
Estimated Cost (USD)	$6,164,262
Reason of Selection	This bridge has the highest damage score of 187 out of a scale of 200. All structural members of the bridge have serious damages and technical parameters do not meet the current normative documents.

Underside of Bridge

(Source: JICA Expert Team)

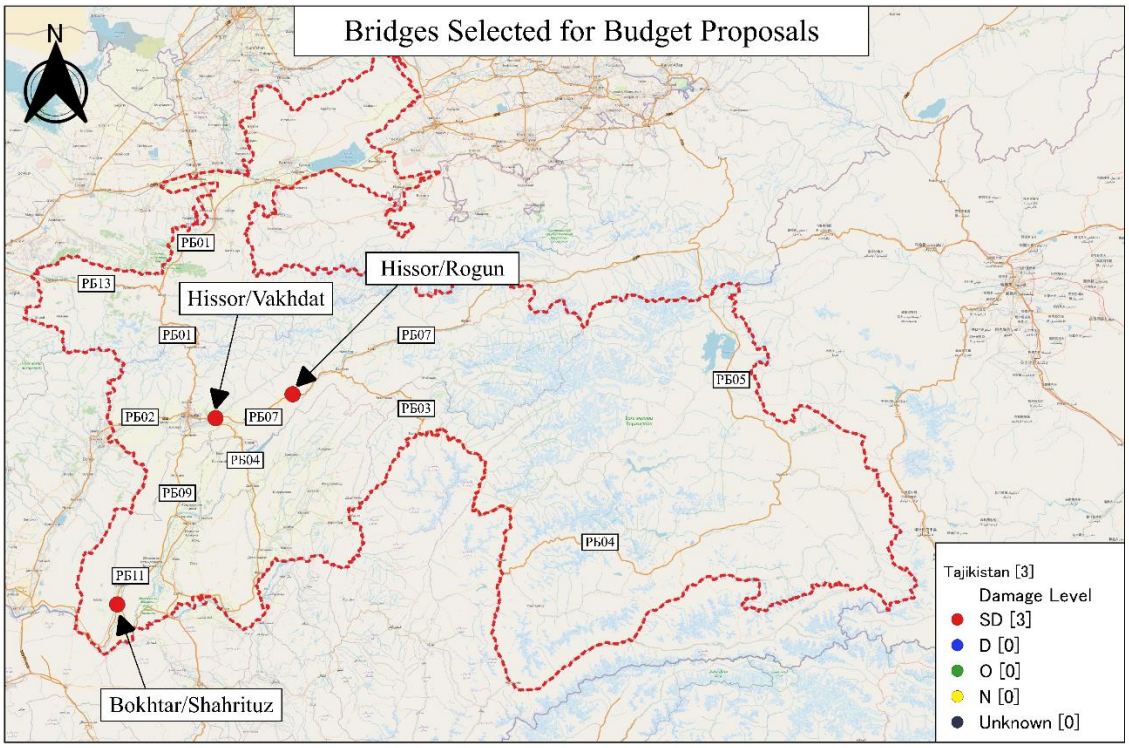


Figure 2-26 Location Map of the 3 budget proposal bridges

(4) Activity 3-4: Finalize the Mid-term Bridge Management Plan for approval by MOT.

The final version of the draft mid-term bridge management plan developed in Activity 3-2 was explained at the BMT meeting on 16 July 2024, submitted to MOT on 22 July 2024, and approved by MOT on 17 September 2024.

2.1.4 Output 4: Sustainable System for Human Resource Development on Bridge Management is Strengthened

Major achievements under this output are shown in Table 2-22.

Table 2-22 Major Achievements of Output 4 Activities

Activities	Major achievements	Status
Activity 4-1. Conduct Baseline Survey on human resource development for bridge management.	● Information on bridge engineering education was collected and compiled as the baseline survey report in cooperation with MOT, DITI, and TTU.	Completed
Activity 4-2. Draft curriculum of a bridge engineering course.	● Human resource development plan for bridge maintenance including bridge engineering course curriculum was drafted to share a unified policy for human resource development among related organizations.	Completed
Activity 4-3. Bridge engineering course(s) are held under cooperation with MOT, DITI, and TTU based on the draft curriculum.	● From 19th to 23rd June 2023, the 1st bridge engineering course was held at TTU with participants of 19 officials from MOT, 12 from TTU students, and 13 TTU lecturers as the observer. ● From June 18th to 22nd 2024, the 2nd bridge engineering course was held at TTU's Dushanbe campus with participants of 15 MOT officials, 12 TTU students, 14 TTU lecturers and management as the observer.	Completed
Activity 4-4. Finalize the curriculum for approval by MOT.	● The bridge engineering course curriculum was summarized in the report, compiling basic matters, the current status and issues of human resources related to bridge maintenance and management, the draft curriculum for the engineer training course, and the details of the first engineer training course. ● After holding the 2nd bridge engineering course in June 2024, the project finalized the report on strengthening the human resource development system for bridge maintenance and management. The report was reviewed at the BMT meeting. ● It was approved by MOT on September 17, 2024.	Completed

(1) Activity 4-1: Conduct Baseline Survey on human resource development for bridge management.

Information on bridge engineering education was collected and compiled as the baseline survey report in cooperation with MOT, DITI, and TTU.

One of the key issues in human resource development for bridge maintenance in Tajikistan is the lack of an adequate educational and human resource development system for training bridge engineers (design, construction, and maintenance). The following is the current status of human resource

development system for bridge engineers in Tajikistan:

[Educational environment in university]

The main educational organization for bridge engineering course in Tajikistan is TTU which was established in 2003. TTU students spend first two years in learning the basics of civil engineering while focusing on the road engineering. Then, for the remaining two years of the program, TTU students select a specific course of study on roads, tunnels, bridges, etc. Since TTU does not have a faculty member specializing in bridge engineering, students are given the opportunity to gain 2-3 months of practical work experience in the third and fourth years at private consulting firms affiliated with the university (about 20 firms) or at DITI, to compensate for the lack of a bridge engineering faculty member in TTU. In the past, DITI staff used to teach at TTU, but this educational system is no longer implemented because DITI staff are too busy with practical design work. Considering this background, TTU faculty members strongly desire for the development of manuals to explain overview of bridge design and construction in addition to development of bridge maintenance manual, and the assignment of faculty members in order to strengthen the educational system for bridge engineering.

16-20 students enter TTU bridge engineering courses each year, but only 5-6 of them graduate from the courses (the others leave school in the middle of the school terms). After graduation, about 2 students are employed by DITI, and 3-4 are employed by SETM/SEHM.

During the month of October 2021, JICA Expert Team had a discussion with representatives of TTU on 7 October 2021. This discussion was made to enable the JICA Expert Team to understand the bridge engineering course curriculum, use of textbooks, and the reason why many students had to quit the bridge engineering course prematurely. Especially on the premature departure by students, it was learnt that 1) the course was considerably more difficult than other courses and 2) even if skills and knowledge are acquired at school, there would not be sufficient job opportunities available. As such, TTU representatives expect establishment of special bridge maintenance posts within MOT, and there would be more job opportunities for TTU students.

[Human resource development environment in SETM and SEHM]

3-4 bridge engineering course graduates from TTU are employed at SETM/SEHM each year. However, as mentioned above, most of the job descriptions are related to the road sector, and the engineers are not allowed to gain practical experience regarding bridge management because they are not appointed as a full-time person in charge of bridge maintenance and management. Therefore, in addition to improve the educational environment at universities, one of the most important issues is to improve the human resource development environment for engineers in SETM/SEHM.

(2) Activity 4-2: Draft curriculum of a bridge engineering course.

From the results of the baseline survey in Activity 4-1, it was confirmed that MOT does not have a human resource development plan for specialized fields such as bridges, and therefore the objectives, goals, and implementation methods for human resource development are not clear, and necessary resources such as budget and human resources cannot be secured in a planned manner. In preparing the draft curriculum for the bridge maintenance and management training course, a basic plan for human resource development was first prepared, and a draft curriculum in line with the development plan was shared among the parties involved. The draft human resource development plan indicated the following contents in order to systematically promote human resource development for bridge management.

- Necessity of human resource development
- Current situation and issues to be addressed
- Development target
- Development policy

Regarding human resource development methods, given the shortage of experienced engineers capable of on-the-job training, JICA Expert Team proposed off-the-job (acquiring necessary skills through training, seminars, and workshops away from work) using TTU's facilities as the first step. Specifically, JICA Expert Team proposed to establish four different courses, based on the level of the trainees and the proposed curriculum was included in this report of human resource development plan.

Table 2-23 shows outline and curriculum of the bridge engineering course.

Table 2-23 Outline and Curriculum of Bridge Engineering Course

Course Name	Objective	Skills and Knowledge to be acquired	Requirements
Introductory course	Understanding of basic knowledge on road and bridge engineering	Basic knowledge necessary for bridge maintenance	All persons
Bridge Inspection course	Understanding of basic knowledge on bridge structures and bridge inspection	Knowledge and skills necessary for bridge inspection	All persons
Diagnosis/ repair course	Understanding of bridge diagnosis and repair plan	Knowledge and skills necessary for bridge diagnosis	All persons
Intermediate level course	Understanding of bridge management and advanced knowledge	Knowledge and skills necessary for professional bridge engineers	All person

(Source: JICA Expert Team)

(3) Activity 4-3: Bridge Engineering Course(s) are held under cooperation with MOT, DITI, and TTU based on the draft curriculum.

The course in 2023

During the month of June 2023, from 19th to 23rd June, 2023 bridge engineering course was held at TTU classroom on the west side of Dushanbe. There were 19 MOT officials, 12 TTU students and 13 other observers. The curriculum of the bridge engineering course consisted basically of 4.5 days of training contents with 1-day field training and 3.5-days lectures, and all students were given certificate of completion on the last day of the course by the chief advisor of JICA Expert Team. The entire course was recorded, and it's been available on the MOT website since August 2023. Professor Henry of Shibaura Institute of Technology also traveled to Tajikistan from June 18 to 27 to give a lecture to the trainees.

Figure 2-27 Bridge Engineering Course Held in 2023

The course in 2024

From June 18th to 22nd 2024, the 2nd bridge engineering course was held at TTU's Dushanbe campus with the participants of 15 MOT officials, 12 TTU students, and 14 lecturers and management personnel as observer. As well as 2023, the course implementation period was set after the end of TTU exams in consideration of convenient time for TTU instructors/students, MOT officials, and DITI staff.

The curriculum of the bridge engineering course followed the content of 2023 course, and the course consisted of 4.5 days of training contents with 1-day field training and 3.5-days lectures.

Also, all the participants received certificate of completion from JICA Expert Team on the final day. This course was recorded in video format and posted on the MOT website. Professor Henry of Shibaura Institute of Technology gave lectures to students online on June 19th and 21st.

Figure 2-28 Bridge Engineering Course Held in 2024

Test Results

In the FY2023 and FY2024 Bridge Engineer Training Courses, a 10-question test (each question was worth 10 points on a 100-point scale) was administered after the lectures to check the trainees' understanding of the course. The results of the bridge engineer training course for FY2023 and FY2024 are shown in Figure 2-29 and Figure 2-30. A score of 80 or higher was considered passing for the comprehension test.

In FY2023, an average of 35 trainees (104 person-day in total), mainly MOTs and TTUs, took the bridge engineer training course and took the confirmation test three times. 34 out of 35 students (98% of the total) obtained 80 points or more in the three days. In FY2024, as in FY2023, an average of 26 trainees (102 person-day in total) took the 4 review tests, and 20 out of 26 trainees (79% of the total) scored 80 or higher, suggesting that the trainees in FY2023 and FY2024 generally understood the content of the lectures. Overall, 61 trainees participated in the two bridge engineer training courses, and 54 who scored 80 points or higher passed the course, inferring that they generally understood the lecture content.

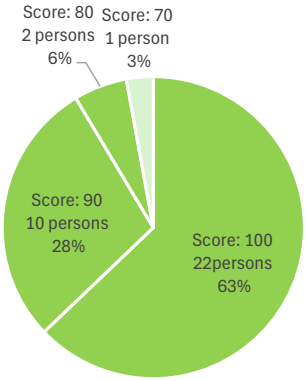


Figure 2-29 Test results 2023

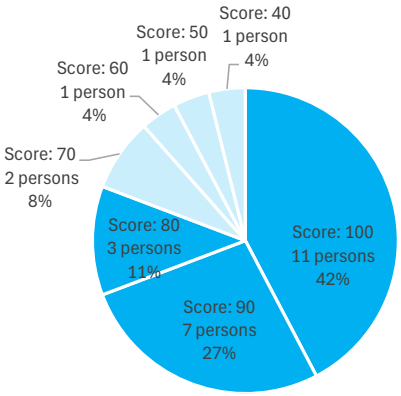


Figure 2-30 Test results 2024

The results of the questionnaire received from the participants after the 2024 bridge engineering course were analyzed. The questionnaire surveyed participants' responses regarding (1) the need for the course, (2) the difficulty of the course, and (3) their satisfaction with the course. Also, trainees' opinions on duration of the course were surveyed. As a result, 34 respondents gave high evaluation results as shown in the graph below.

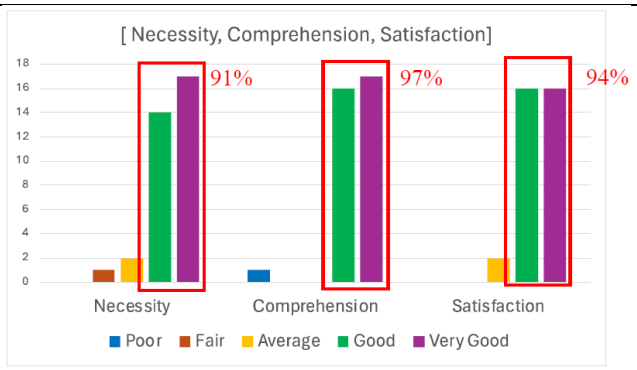


Figure 2-31 Results of the Questionnaire regarding the Need, the Comprehension and the Satisfaction

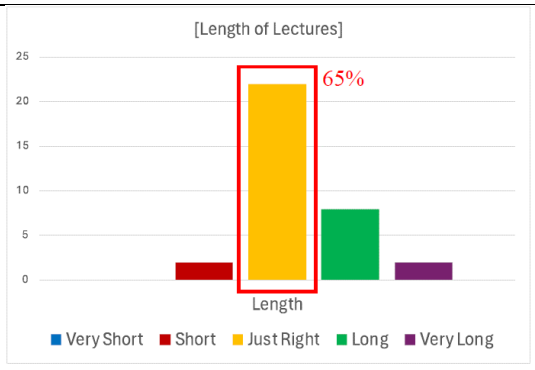


Figure 2-32 Results of the Questionnaire regarding Length of Lectures

(Source: JICA Expert Team)

(4) Activity 4-4: Finalize the curriculum for approval by MOT.

The bridge engineering course curriculum was summarized in the report. The report based on the baseline survey identifies human resource development issues in bridge maintenance in Tajikistan. Specifically, the report suggested proceeding on the basis of Off-JT and, after the human resource development system is in place, combining it with OJT. The curriculum for the bridge engineering course was drafted for TTU as one of the Off-JT programs, and the curriculum was improved when implemented in 2024, based on the questionnaires received in 2023. The report compiling the final curriculum was approved at the BMT meeting by MOT.

Table 2-24 Curriculum of Bridge Engineering Course

Day	Course	Content
1	Introductory Course	Understanding of basic knowledge of road and bridge engineering
2	Management Course	Understanding of bridge conditions in Tajikistan and bridge maintenance and management cycle Understanding of maintenance cycle of bridge
3	Inspection Course	Understanding of damage case and bridge inspection manual Understanding of specific inspection method in OJT
4	Diagnosis and Repair Course	Understanding of outline of bridge diagnosis and repair Understanding of specific diagnosis in OJT from DITI based on the outline
5	Intermediate Course	Understanding of bridge management plan and repair

(Source: JICA Expert Team)

2.1.5 Others

(1) Training in Japan

1) 1st Japan Training in 2022

2022 Japan Training was held for 15 days from 7th to 21st of November 2022. In addition to one participant from an official of the presidential administration office, the trainees consisted of 15 MOT/SETM/SEHM officials, 2 DITI staff, and 1 TTU staff, a total of 19 participants.

The training started with JICA briefing in Nagoya, followed by training, observation, and cultural exchange meeting. Then they moved to Kyushu and completed 1) training and observation in Fukuoka and 2) training and observation in Tamana City of Kumamoto Prefecture. JICA evaluation meeting was held in November 18. The training plan and several photos during the training are shown below.

Table 2-25 Contents of 1st Japan Training in 2022

Date	Contents
Nov. 7 2022	Departure from Dushanbe
Nov. 8 2022	Arrival at Tokyo
Nov. 9 2022	Move to Nagoya, orientation
Nov. 10 2022	Training on BMS tablets, road operator outline
Nov. 11 2022	NEXCO, Gifu site visit
Nov. 12 2022	Understanding Japanese culture and industry
Nov. 14 2022	Move to Fukuoka, site visit on Fukuoka Expressway
Nov. 15 2022	Site visit on bridge maintenance, move to Nagoya
Nov. 16 2022	Bridge maintenance training, lecture on bridge asset management
Nov. 17 2022	Lecture on student learning
Nov. 18 2022	Trainee presentation, closing ceremony
Nov. 19 2022	Departure from Narita
Nov. 20 2022	Arrival at Istanbul
Nov. 21 2022	Arrival at Dushanbe

Nov. 11 2023 Site visit, NEXCO central

Nov. 18 2023 Trainee presentation

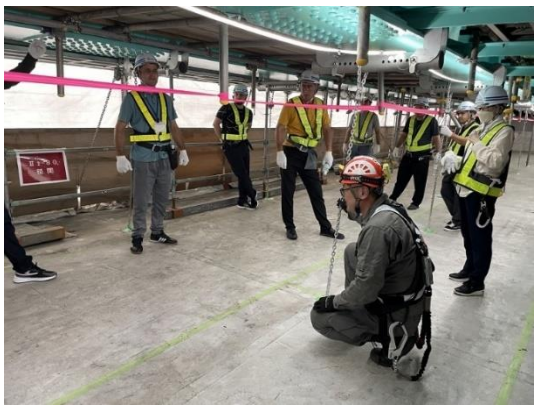
Figure 2-33 Training Photos in 2022

2) 2nd Japan Training in 2023

2nd Japan Training was held for 10 trainees from 20 to 31 August in 2023 (period based on arrival/departure in Japan) in Kanagawa, Nagoya, Fukuoka, and Kumamoto regions. Although 11 trainees were planned to participate in the training, 1 trainee of Kulob SETM had to cancel the participation due to traffic accident in Kulob SETM jurisdiction. The report on this training was submitted on September 29, 2023. The training plan and several photos during the training are shown below.

Table 2-26 Contents of 2nd Japan Training in 2023

Date	Contents
Aug. 19 2023	Departure from Dushanbe
Aug. 20 2023	Arrival at Tokyo
Aug. 21 2023	Orientation, current situation and maintenance of bridges in Japan and Tajikistan
Aug. 22 2023	Move to Niigata, lecture on safety initiatives by NEXCO
Aug. 23 2023	Site visit for bridge maintenance, move to Fukuoka
Aug. 24 2023	Overview of Tsutawarudoboku's activities and Fukuoka Expressway, move to Kumamoto
Aug. 25 2023	Bridge maintenance by Tamana city (DIY), move to Kanagawa
Aug. 26 2023	Lecture on bridge asset management by NEXCO
Aug. 29 2023	Introduction of knowledge sharing methods after OJT, education for student
Aug. 30 2023	Concrete deterioration factors, preparation for presentation
Aug. 31 2023	Trainee presentation, closing ceremony, move to Haneda
Sep. 1 2023	Transit
Sep. 2 2023	Arrival at Dushanbe



Aug. 24 2023, Field trip to Tsutawarudoboku, Fukuoka Kitakyushu Urban Expressway repair site

Aug. 25 2023, Tamana city office, field trip on DIY repair methods

Figure 2-34 Training Photos in 2023

(2) Dissemination Seminar

1) 1st Dissemination Seminar

The Dissemination Seminar was held on 18 October 2021 at Conference Room of Tajikistan Hotel. There were guests invited from the Japanese Embassy in Tajikistan, Tajik governmental offices such as Ministry of Foreign Affairs, Ministry of Finance, Committee on Emergency Situation and Civil Defense, the C/Ps (MOT, SETMs, SEHMs, DITI and TTU), JICA Tajikistan Office and the JICA Expert Team. The welcome speech was offered by His Excellency Minister of Transport, Mr. Azim Ibrohimi, His Excellency Mr. Takayuki Miyashita, Ambassador Extraordinary and Plenipotentiary, and Mr. Muneo Takasaka, Chief Representative of JICA Tajikistan Office. There were 103 participants including 92 from Tajikistan side and 11 participants from the Expert Team/JICA Tajikistan Office in Dushanbe.

2) 2nd Dissemination Seminar

The Dissemination Seminar was held on 13 September 2024 at Conference Room of Tajikistan Hotel. There were guests invited from the Japanese Embassy in Tajikistan, Tajik governmental offices such as Ministry of Foreign Affairs, Ministry of Finance, Committee on Emergency Situation and Civil Defense, the C/Ps (MOT, SETMs, SEHMs, DITI and TTU), JICA Tajikistan Office and the JICA Expert Team. The welcome speech was offered by His Excellency Minister of Transport, Mr. Azim Ibrohimi, His Excellency Mr. Toshihiro Aiki, Ambassador Extraordinary and Plenipotentiary, and Mr. Seiju Imai, Chief Representative of JICA Tajikistan Office. There were 73 participants including 64 from Tajikistan side and 9 participants from the Expert Team/JICA Tajikistan Office in Dushanbe.

1st Dissemination Seminar

2nd Dissemination Seminar

Figure 2-35 Dissemination Seminar Photos

(3) RAMS

For the development of Road Asset Management System (RAMS), WB, ADB, JICA and MOT was held in the meeting. In the meetings, activities and progress of each donor were shared, and problems faced by each donor were discussed. Meetings were held in 9 times as shown in Table 2-27.

Table 2-27 List of RAMS Meetings

No.	Date	Meeting Topics
1st	June 22, 2021	Sharing of information on issue faced by MOT
2nd	July 14, 2021	Sharing the contents of the draft version of inventory items by JICA project Sharing the schedule for the future
3rd	March 14, 2022	Sharing of activities in 2022
4th	May 17, 2022	Report on the progress of both projects and discuss future policies with ADB engineers
5th	June 13, 2022	Confirmation of current progress
6th	September 30, 2022	Report on WB and ADB current progress

No.	Date	Meeting Topics
7th	July 6, 2023	Introduction of WB consultants and JICA Expert Team Explanation of BMS system Confirmation of output format by BMS
8th	September 19, 2023	Report on inception phase by WB consultant
9th	January 22, 2024	Report on WB and ADB current progress

(4) Public Relation and Awareness Activities for the Project

JICA Expert Team conducted public relation and awareness activities regarding the project activities as shown in Table 2-28.

Table 2-28 List of Public Relation and Awareness Activities

No.	Date	Event	Outline
1	May 28 2021	1st JCC	• TV news coverage • The 1st JCC was broadcast from 20:30 on May 31, 2021 by Tajikistan Channel • Publication in MOT homepage • Facebook posting by JICA Tajikistan office
2	Oct. 14 2021	2nd JCC	• Publication in MOT homepage • Facebook posting by JICA Tajikistan office
3	Oct. 18 2021	1st Dissemination seminar	• TV news coverage • The seminar was broadcast from 20:00 on October 22, 2021 by Tajikistan Channel • Publication in MOT homepage • Facebook posting by JICA Tajikistan office
4	March 14, 15 2022	Presentation at 1st Infrastructure Maintenance Symposium	• Presentation on project activities
5	May 26 2022	3rd JCC	• Publication in MOT homepage • Facebook posting by JICA Tajikistan office
6	May, June 2022	1st OJT	• Facebook posting by JICA Tajikistan office
7	Dec. 5 2022	4th JCC	• Publication in newspaper article by MOT on December 12 2022
8	Nov. 28 2023	6th JCC and training	• Publication in newspaper article by MOT on December 5 2023
9	Sep. 13 2024	2nd Dissemination seminar	• TV news coverage • Publication in MOT homepage • Publication in newspaper article by MOT
10	Sep. 20 2024	Final 8th JCC	• TV news coverage • Publication in MOT homepage • Publication in newspaper article by MOT

2.2 Achievement of the Output

The status of achievement regarding the Output indicators listed in the PDM is as follows.

Table 2-29 Achievement of the Output

Output	Objectively Verifiable Indicators	Achievement
Output 1. Organizational structure for bridge management of MOT, SETMs/SEHMs and DITI is strengthened.	1. Regulations for Segregation of Duties and Standard Operating Procedures with task demarcation of MOT, SETMs/SEHMs and DITI are approved by MOT. (1-3, 1-4)	• The improvement plan for the existing work procedure including the task demarcation of MOT/SETMs/SEHMs was prepared and approved by the BMT meeting in June 2024. • MOT has approved the improvement plan in September 2024.
Output 2. Capacities for bridge inventory management, inspection/diagnosis, and maintenance of MOT, SETMs/SEHMs, DITI, and TTU are improved.	1. BMS is installed for MOT and SETMs and operated based on the manual. (2-5)	• BMS is operational in MOT and all SETMs. • Collected data of 1,643 bridges was transferred to Main Server of the BMS.
	2. 30 staffs have participated in On-the-job trainings and pass the post-training tests (2-4, 2-6)	• All the training sessions were carried out in November 2023 and the number of persons, who passed the test over 80% and more is set as the passing line. • 75 staff out of 96 staff passed the post training test.
	3. The technical manuals are approved by MOT. (2-3, 2-8)	• The technical manuals are scheduled to be finalized between May and August. • The finalized ones will be confirmed among BMT members until July and approved by MOT.
	4. Pilot maintenance work(s) are implemented for 3 bridges. (2-7)	• Pilot projects were conducted in 2023 (direct construction with C/P) and 2024 (indirect construction with local re-commissioning work); 3 bridges in 2023 and 3 bridges in 2024, for a total of 6 bridges.
Output 3. Capacities for bridge management planning of MOT and Model SETMs are improved.	1. Mid-term Bridge Management Plan is approved by MOT. (3-2, 3-4)	• The 8th workshop on mid-term bridge management plan was held on 16 July 2024, in which 5-year mid-term and 10-year long-term bridge management plans were presented to BMT and agreed. • The final version of the mid-term plan was submitted to MOT on 22 July 2024. • It was approved by MOT on September 17, 2024.
	2. Budget proposal(s) for bridge repair works/preventive measures of any scale is submitted to MOF. (3-3)	• The workshop was held on 16 July 2024 to present the budget proposals of 3 selected bridges to BMT members. • The draft budget proposals were submitted to MOT on 22 July 2024. • The budget proposal will be submitted to MOF and/or international donors before October 2024.
Output 4. Sustainable system for human resource development on	1. Curriculum of bridge engineering course is approved by MOT. (4-2, 4-4)	• The Curriculum of second Bridge Engineering Course scheduled between 18-22 June 2024 in TTU was prepared. • The curriculum was explained at the

Output	Objectively Verifiable Indicators	Achievement
bridge management is strengthened.		BMT meeting on July 16, 2024 and approved by MOT on September 17, 2024.
	2. 15 staffs/students participate in the bridge engineering course and pass the final tests. (4-3)	• The first bridge engineering course was held in June 2023 with 35 participants. A comprehension test was given three times after the lecture, and 34 of the 35 participants (98% of the total) scored 80 or higher. • In June 2024, the second bridge engineering course was held with 26 participants, and 20 out of 26 (79% of the total) scored 80 or higher in the four comprehension check tests. • Overall, 61 students participated in the course over the two-year period, and 54 who scored 80 or higher passed the course.

2.3 Achievement of the Project

The status of achievement of the project purpose stated in the PDM is shown in Table 2-30.

Table 2-30 Outline of Project Achievement

Project Purpose : Capacities for bridge management of MOT, SETMs/SEHMs, DITI, and TTU are improved.				
Indicators	**Achievement in November 2024**		**Means of verification**	**Related outputs and other intervention**
a. Bridge inventories are provided and managed based on the technical manual for 55 % of bridges under MOT jurisdiction.	● As of December 31 2023, at 1227 bridges out of the 2231 bridges (55%) under MOT jurisdiction, inventory survey was completed.	100%	Data of BMS	[Related output] ・Output 2 [Other intervention] ・Not applicable
b. Based on the technical manuals, 55 % and 30% of bridges in the Model SETMs/SEHMs and the non-Model SETMs/SEHMs respectively are inspected and diagnosed.	● As of the end of October 2023, 845 bridges out of the 1,538 bridges (55%) in the model SETM jurisdiction, bridge inspection and diagnosis were completed. ● As of the end of December 2023, at 207 bridges out of the 693 bridges (30%) in the non-model SETM jurisdiction, bridge inspection and diagnosis were completed.	100%	Data of BMS	[Related output] ・Output 2 [Other intervention] ・Not applicable
c. Based on the technical manuals, maintenance works are done for 240 bridges in the Model SETMs/SEHMs.	Result of bridge maintenance • Total: 225 bridges (Total: 240 bridges in the end of November 2024) 2022: 60 bridges 2023: 112 bridges 2024: 53 bridges by the end of July (68 bridges have been scheduled to be completed by the end of November 2024)	93.75% (100% will be achieved in the end of November 2024)	Data of BMS	[Related output] ・Output 2 [Other intervention] ・Not applicable

Project Purpose : Capacities for bridge management of MOT, SETMs/SEHMs, DITI, and TTU are improved.				
Indicators	**Achievement in November 2024**		**Means of verification**	**Related outputs and other intervention**
d. Budget proposal(s) for large-scale repairs/replacement of 3 bridges is submitted to MOF/international donors	• The budget proposals for large-scale repairs/replacement of 3 bridges were prepared and submitted to MOT on 22 July 2024. • The budget proposals shall be submitted to MOF and/or international donors before October 2024 as per yearly budget procedure.	100%	budget request proposal	[Related output] ・Output 3 [Other intervention] ・Not applicable

The current achievement of the overall goal at the end of the Project is shown in Table 2-31.

Table 2-31 Outline of the Overall Goal

Overall Goal：Bridge management on International and Republic roads is improved.				
Indicators	**Achievement in November 2024**		**Means of verification**	**Related outputs and other intervention**
a. Bridge inventories are provided and managed based on the technical manual for 100 % of bridges under MOT jurisdiction.	• At the end of the project, inventory was completed for 1,643 bridges out of the 2,231 bridges (74%) in MOT jurisdiction.	74 %	・Data of BMS	[Related output] ・Output 2 [Other intervention] ・Not applicable
b. Based on the Mid-term Bridge Management Plan and the technical manuals, 100 % of bridges on International/Republican roads are inspected and diagnosed.	• At the end of the project, inspection and diagnosis were conducted for 727 bridges out of 843 bridges [1] (86%) on international/national roads in 6 SETMs accordance with the medium-term bridge maintenance plan and the technical manual.	86 %	・Data of BMS	[Related output] ・Output 2 [Other intervention] ・Not applicable
c. Based on the Mid-term Bridge Management Plan and the technical manuals, 20 bridges are repaired annually.	-	-	Data of BMS	[Related output] ・Output 2 [Other intervention] ・Not applicable
d. Based on the feedbacks of bridge management activities, the Mid-term Bridge Management Plan is revised.	-	-	Amendment record of the Mid-term Bridge Management Plan	[Related output] ・Output 3 [Other intervention] ・Not applicable

[1] Out of the 2,231 total bridges, 499 are on international roads and 344 are on national roads, for a total of 843 bridges. The number of bridges along the local roads is 1,388.

3 ROAD INFRASTRUCTURE/ASSET MANAGEMENT ASSESSMENT

3.1 Outline of Road Infrastructure/Asset Management Assessment

In this project, the achievement assessment of road asset management technology was conducted at the beginning of the project (detailed planning survey in 2021) and at the end of the project (2024) to compare and verify the project results. The evaluation was carried out based on "Road Asset Management Platform Technical Support Information Collection and Confirmation Survey" conducted by JICA in 2020 and the "Road Asset Management Achievement Evaluation Method" conducted in 2022. The assessment from 2020 version contains three major items for analysis such as pavements, bridges, and organizational management, while the assessment from 2022 version includes a total of five items with additional two items such as monitoring and earthwork (slopes). In this project, the assessment was conducted using the 2020 version as well as the assessment conducted in the detailed planning survey in 2021.

3.2 Target Agencies

Target agencies are MOT and SETMs/SEHMs, which are responsible for road infrastructure maintenance and management.

3.3 Assessment of Road Asset Management Achievement

Achievement of road asset management was assessed, quantifying the evaluation items shown in Table 3-1.

Table 3-1 Evaluation Items and Contents of Road Asset Management Evaluation Sheet

	Major Item	Content
Technical Items	Inspection	Is inspection carried out periodically with adequate method, content, personnels and possession of inspection equipment?
	Diagnosis	Are causes of identified damages analyzed? And are they ranked in terms of urgency/importance for repair work?
	Repair Plan	Are measures appropriate to the cause and scale of the damage planned in the medium to long term? Is preventive maintenance concept put in practice?
	Maintenance	Is daily maintenance (cleaning, grass-cutting, small-scale repairs) carried out periodically and necessary equipment prepared?
	Repair Works	Are planned measures implemented with sufficient quality?
	Recording	Are results of inspection and repair adequately documented and stored? Also, are changes/aging over time monitored?
Operation and Management Items	Organization/ Structure	Is the number of necessary personnel with willingness and ability allocated? Is collaboration with other departments done to promote road asset management?
	Budget/ Financing	Is fund adequately planned and financing sufficiently secured? Is there financial resource secured for road maintenance?
	Bidding/ Contract System	Is the appropriate bidding and contracting system established, and is the outsourcing of maintenance and repair works effectively carried out based on appropriate cost estimation done by client?
	Data management system, database	Is there a database system to manage the asset? Is asset management effectively carried out using the system?

(Source: Road Asset Management Platform Technical Support Information Collection and Confirmation Survey (2020, JICA))

Each evaluation item in the detailed section is set as a five-point scale, which are as follows: (Definition of each level is provided in Table 3-2)

i) Level 1 : Initial stage,
ii) Level 2 : Awakening stage,
iii) Level 3: Structuring stage,
iv) Level 4: Development stage, and
v) Level 5 : Best practice

Table 3-2 Definition of Assessment Item Level

Levels	Definition
Level 1 Initial Stage	Effective technical support does not exist in the asset management. Inspection, diagnosis, repair planning, maintenance, repair work, data recording are not implemented. Organization, budget/financing, bidding/contract system, system, database are not established. Organizational top-down or lateral communication is non-existent.
Level 2 Awakening Stage	Asset management involves collection and processing of basic data. Inspection, diagnosis, repair planning, maintenance, repair work, data recording are partially implemented. Organization, budget/financing, bidding/contract system, system, database are partly organized. Organizational top-down or lateral communication is minimal.
Level 3 Structuring stage	Asset management system forms the core of the organization's activity. Inspection, diagnosis, repair planning, maintenance, repair work, data recording are implemented. Organization, budget/financing, bidding/contract system, system, database are established. Organizational top-down or lateral communication exists but not systematized.
Level 4 Development Stage	Asset management system is utilized in finance allocation, cost control and management of achievement. Inspection, diagnosis, repair planning, maintenance, repair work, data recording are systematically implemented. Organization, budget/financing, bidding/contract system, system, database are established and systematically carried out. Organizational top-down or lateral communication is effectively conducted.
Level 5 Best Practice	Asset management information technology is utilized for periodical design of newer, more effective tool and process. Inspection, diagnosis, repair planning, maintenance, repair work, data recording are systematically implemented and continuously improved. Organization, budget/financing, bidding/contract system, system, database are established and systematically carried out. Organizational top-down or lateral communication is effectively conducted and continuously improved.

(Source: Road Asset Management Platform Technical Support Information Collection and Confirmation Survey (2020, JICA))

The degree of achievement was quantified by classifying items into major, medium, minor and detailed items. Average of the numerical values of the minor and detailed items is then plotted as the numerical value of the medium item in a radar chart. Please note that among the detailed evaluation items, there are some items that simply ask whether something is present or absent, or whether it has been implemented or not. In those cases, the achievement target level for these items was set to level 3. In addition, when evaluating the degree of achievement, the degree of achievement for these detailed items was evaluated with level 3 being 100%, and the degree of achievement for other detailed items up to level 5 was evaluated with level 5 being 100%. An example of the structure of this evaluation sheet is shown in Figure 3-1 and Figure 3-2.

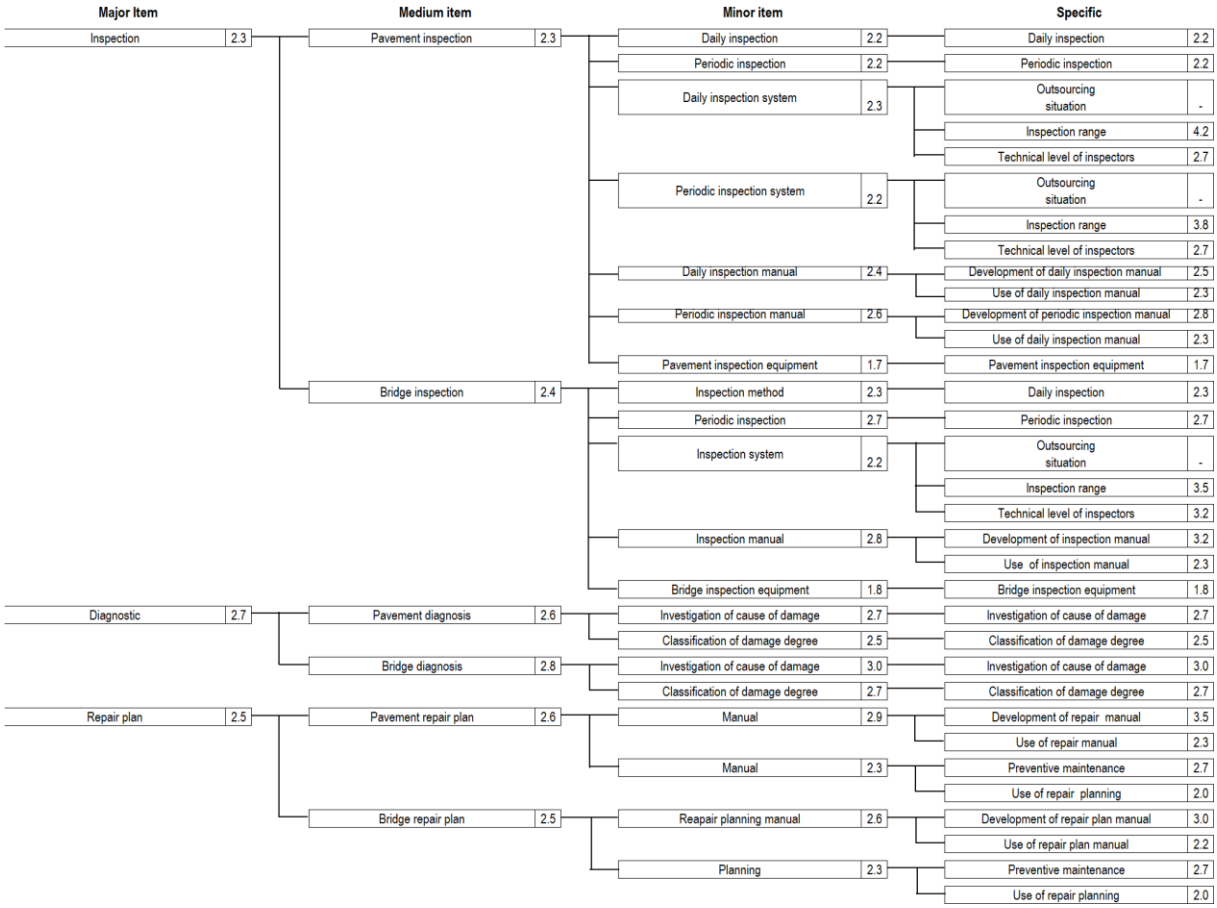


Figure 3-1 Structure of Assessment Sheet (1)

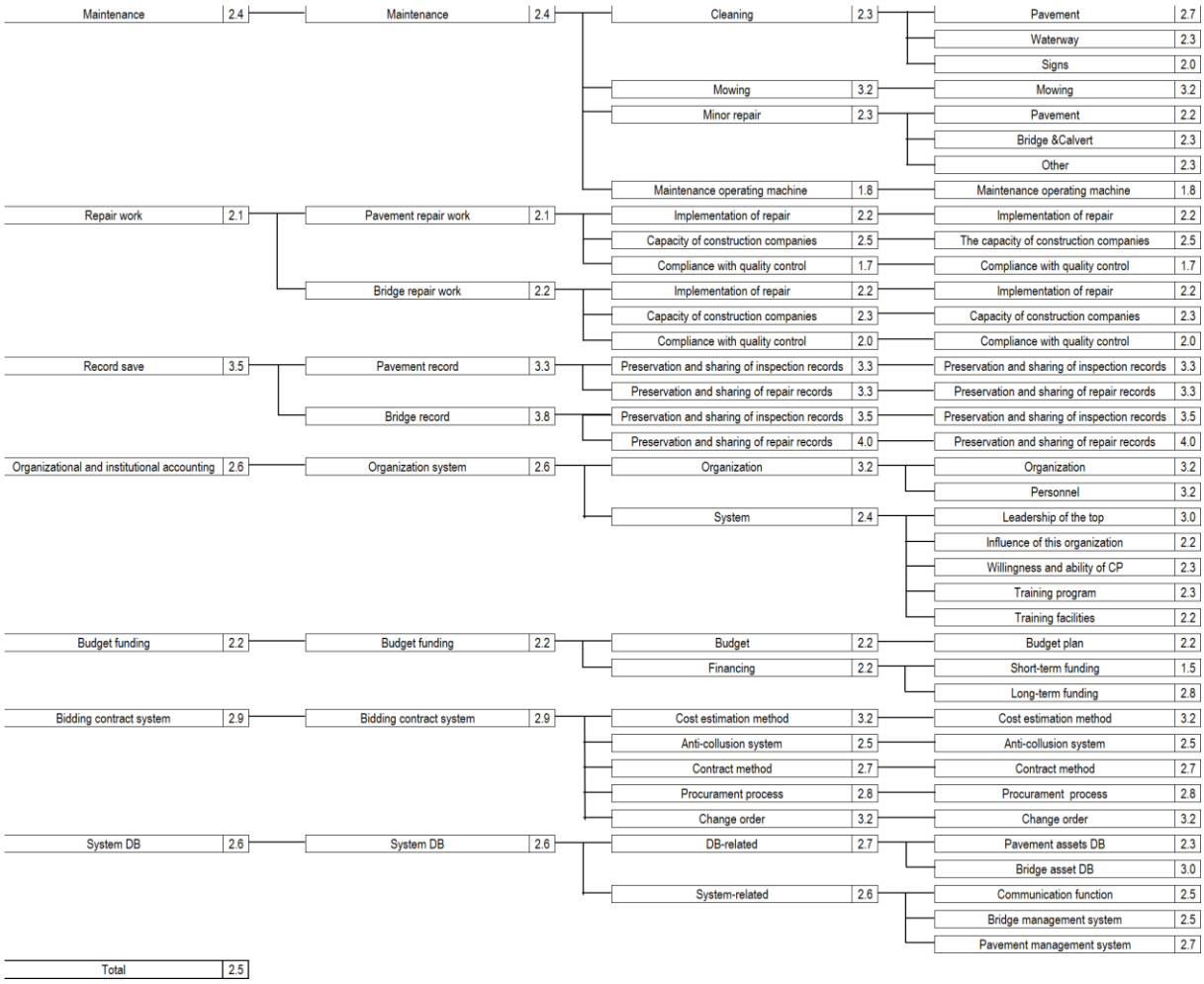


Figure 3-2 Structure of Assessment Sheet (2)

3.3.1 Road Infrastructure/Asset Management Assessment by MOT

The assessment results regarding medium items based on MOT responses are shown in Figure 3-3. Redar chart indicates evaluations implemented at the time of baseline survey in 2021 (blue line) and at the end of the project in 2024 (orange line).

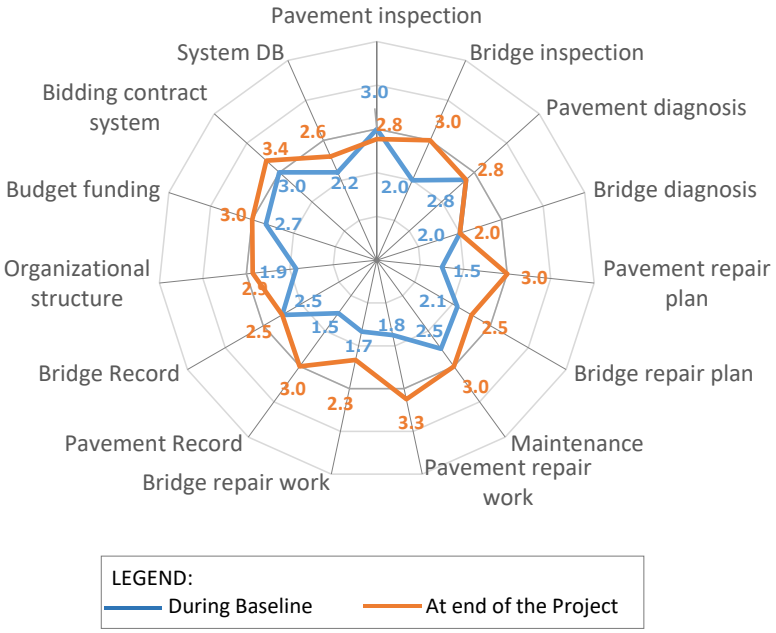


Figure 3-3 Road Infrastructure/Asset Management Assessment by MOT

(1) Summary

The comprehensive evaluation at the end of the project in 2024 was 2.9, compared to 2.4 in the baseline survey conducted in 2021. The score in 2024 is 0.5 point higher than that in 2021, and almost all the medium items in 2024 got higher scores than those in 2021. In particular, scores of bridge inspection, bridge diagnosis, bridge repair plan, recording bridge information, and organizational structure remarkably increased.

For pavement, comparing the survey result of 2021 and that of 2024, the scores have changed. In this section, the pavement management is out of scope of this project and affected by the progress of RAMS led by ADB and WB; therefore, the pavement results are not discussed here. Any evaluation related to pavement should be conducted after the full implementation of RAMS.

(2) Bridge Inspection, Diagnosis, Repair Plan

Before the project was implemented, there was no substantial inspection and diagnosis of bridges, and there was almost no minimum equipment and tools required for inspections. At the end of the project, compared to before the start of the project, the inspection system, inspection manual development and operation, bridge inspection equipment, and bridge diagnosis had improved. This is presumably due to the repeated on-the-job training for inspection and diagnosis, both classroom and on-the-job, which helped to consolidate the techniques, and to the improved efficiency of inspection and diagnosis by the BMS.

The bridge repair plan was developed by reflecting the experience and lessons learned from the pilot project in the manual, which better fits the actual situation in Tajikistan, and by including the selection of repair methods and specific construction procedures. The points are considered to have increased significantly because it is now possible to formulate bridge repair plans based on the actual inspection and diagnosis results.

(3) Bridge Repair Work, Maintenance

With regard to bridge repair work, the respondents indicated that the management capacity of the construction companies in particular had improved, especially since small-scale repairs were directly managed by SEHM and medium-scale repairs were subcontracted in the pilot project. As for maintenance management, there was no particular change in the daily cleaning and maintenance of work equipment, which were reported to be carried out at a minimum level.

(4) Bridge Record, System DB

Prior to the start of the project, each SETM was recording bridge inventories and inspection results in its own format, and there was no uniformity in terms of what was reported. This time, the development of the BMS and the introduction of information collection tools using tablet terminals resulted in a significant increase of 1.5 percentage points in bridge records. In addition, the system and DB also increased by 0.4 points compared to before the start of the project. However, the System/DB resulted in slower growth than expected due to the development of communication functions and the inclusion of evaluation items for pavement-related systems.

(5) Organizational structure, Budget funding, Bidding contract system

Regarding the organizational structure, a BMT was established for this project to enable cross-sectoral discussions among MOT, SETM, DITI, and TTU. The BMT also proposed the establishment of a department for bridge maintenance and management and the assignment of bridge maintenance and management engineers to each SETM.
In addition, budget financing increased by 0.3 percentage points from before the start of the project, as BMT members worked together to develop a medium-term (5-year) budget plan and budget documents for the three bridges. However, since the long-term (10-year) budget plan was under discussion when the exit questionnaire was conducted, further improvement is expected once it is established.

3.3.2 Road Infrastructure/Asset Management Assessment by SETM

Assessment results regarding medium items based on SETMs are shown in Figure 3-4.

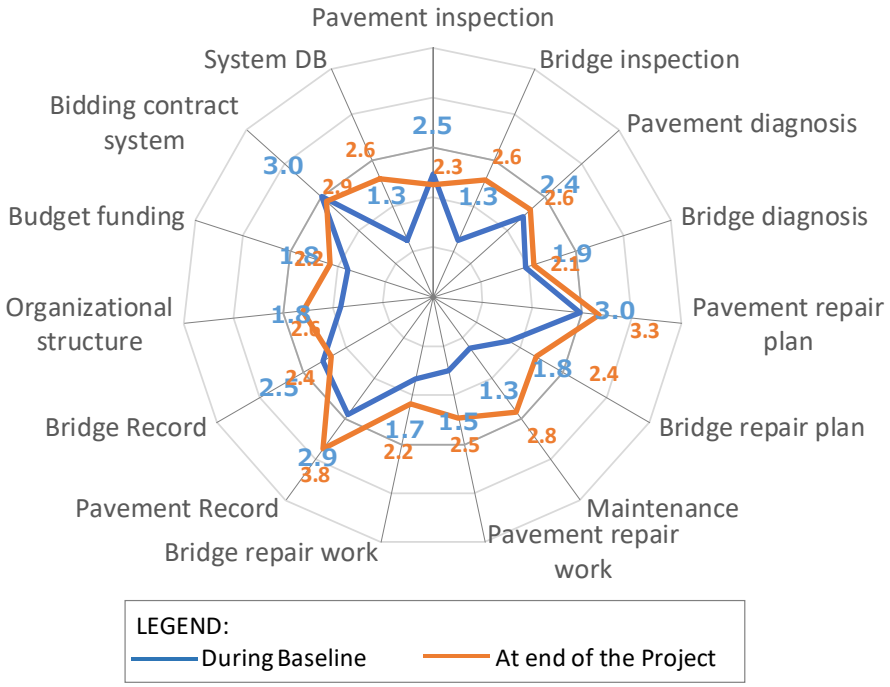


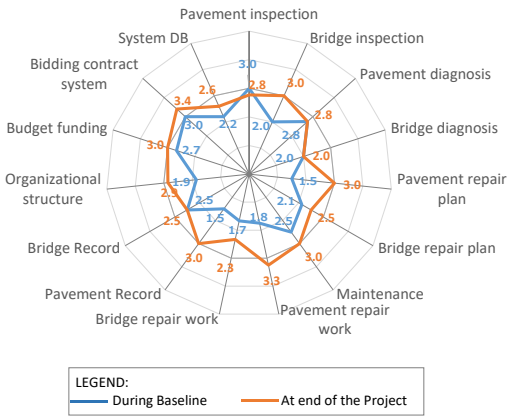
Figure 3-4 Road Infrastructure/Asset Management Assessment by SETM

Achievement assessment of 6 SETMs was conducted by averaging survey results of each SETM. Comprehensive evaluation at the end of the project in 2024 was 2.6 while that in baseline survey in 2021 was 2.2. The score in 2024 is 0.4 point higher than that in 2021, and almost all the medium items in 2024 got higher scores than those in 2021. In particular, scores of bridge inspection, bridge diagnosis, bridge repair plan, bridge repair work, recording bridge information and system/DB increased remarkably. It is likely that repeated OJT regarding identification of damages, damage factor analysis, and knowledge on repair methods, and implementation of pilot project led to deep understanding of repair work carried out in the past. In addition, efficiency of recording bridge information using tables contributed to higher score of recording bridge information and system/DB, considering the fact that SETMs used to have difficulty in data collection by inefficient recording with paper.

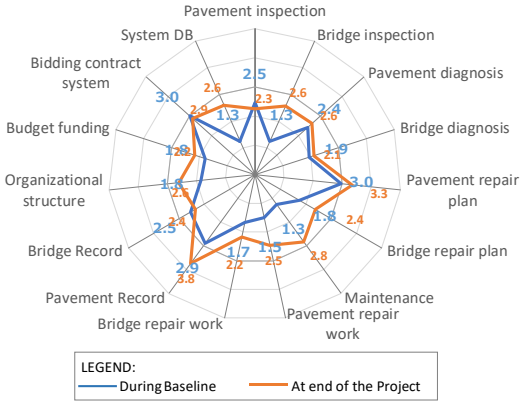
Scores of pavement-related items have changed, comparing scores of 2021 and those of 2024. It is desirable that evaluation of pavement-related items should be conducted after RAMS implementation by ADB and WB as in the case with evaluation of MOT.

3.3.3 Achievement Comparison between MOT and SETM

Achievement assessment results of MOT and SETM are shown in Figure 3-5. As a result of comparison, the following findings were confirmed:



Achievement assessment of MOT



Achievement assessment of SETM

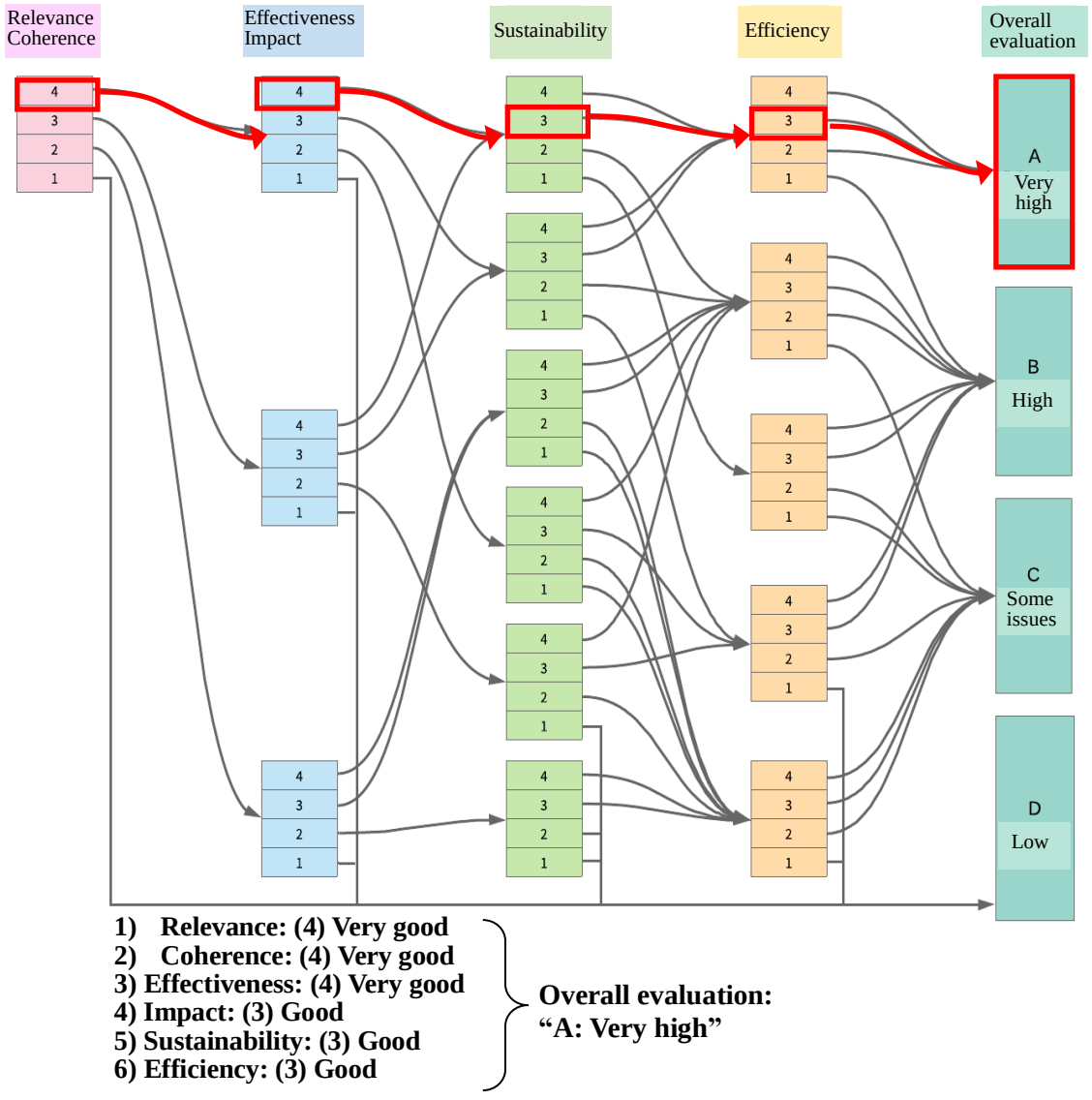
Figure 3-5 Radar Chart of Achievement Assessment of MOT and SETM

Focusing on assessment result of MOT and SETM, bridge repair plan, recording bridge information, and budget funding were improved remarkably. First, MOT, responsible for bridge management, had not planned bridge repair plans so far before this project. However, it is likely that planned bridge management policy contributed to the high score of bridge repair planning, owing to the development of bridge maintenance policy and mid- and long-term bridge management plans using BMS data. With record to recording bridge information, OJT trainings were mainly implemented for SETMs and thus the score increased higher as compared to MOT. SETMs felt that efficiency was much higher using tablet for data recording than paperwork. Budget proposal in this project contributed to increase of budget funding score. This score would be further improved if maintenance budget can be secured, based on the bridge management plan prepared in this project.

4 Results of Joint Review

4.1 Project Evaluation Based on 6 DAC (Development Assistance Committee) Evaluation Criteria

Project evaluation is conducted based on the six (6) evaluation criteria of the Development Assistance Committee (DAC) of the Organization for Economic Cooperation and Development (OECD) (Relevance, Coherence, Effectiveness, Impact, Sustainability, and Efficiency), using the six (6) evaluation items, namely 1) Relevance, 2) Coherence, 3) Effectiveness, 4) Impact, 5) Sustainability, and 6) Efficiency. The four (4) items are evaluated at four levels, namely "(4) Very high", "(3) High", "(2) Some issues", and "(1) Low". The detailed evaluation results for each evaluation item are shown in Figure 4-1.



(Source: JICA Expert Team)

Figure 4-1 Overall Project Evaluation

4.1.1 Relevance

The relevance of this project is rated as “Very high” based on the following findings:

(1) Consistency with the Tajikistan's Development Policy

In 2016, the Tajikistan government applied a new national development strategy, “The National Development Strategy 2030”, which sets out three (3) main areas (“Strengthening Institutional Capacity”, “Human Resource Development”, and “Improving Quality of Economic Growth and Efficiency of the Real Economy”) together with 12 strategic items. Among these, with regard to the transportation sector, the need for significant rehabilitation and development of local infrastructure, low road density, and poor road quality are identified as major challenges. Also in 2011, Tajikistan developed “The National Target Development Strategy of the Transport Sector of Tajikistan up to 2025”, and as an implementation plan for 2020-2025, the Tajikistan government is aiming to fully rehabilitate and reconstruct international and national roads, and to increase investment in local roads. Furthermore, the Tajikistan government is committed to improving road transport infrastructure for improvement of the national economy, taking advantage of its position as an important commercial transport hub with bordering countries.

Table 4-1 Contribution of This Project to Each Policy

Policies	Goals	Contribution of This Project
The National Development Strategy 2030	・Implement and achieve the 3 main goals ("strengthening institutional capacity", "human resource development", and "improving the quality of economic growth and efficiency of the real economy"). ・Key issues: Need for significant rehabilitation and development of local infrastructure, low road density and poor road quality.	・Conduct periodic bridge inspection, and introduction of preventive maintenance ・Training for SETM/SEHM in rural areas ・Improvement of bridges and surrounding environment by preventive maintenance measures
The National Target Development Strategy of the Transport Sector of Tajikistan up to 2025	・Plan for 2020-2025: To complete rehabilitation and reconstruction of international and national roads, and to increase investment in local roads	・To maintain bridge safety and environment in good condition by preventive maintenance measures. ・Accumulation of bridge inspection data in database ・Training for SETM/SEHM in rural areas

(2) Consistency with the Needs of the Target Group

The target areas of this project are the international and national roads under the jurisdiction of Sughd SETM, Hissor SETM, and Bokhtar SETM, which manages the international highways from the capital Dushanbe to the borders of Kyrgyzstan and Uzbekistan in the north and northwest regions. The target areas were selected from six (6) SETMs in consideration of the status of important routes (international and national roads) and the number of bridges under administration. The target group consisted of relevant officials of the Ministry of Transportation (MOT) and SETM/SEHM responsible for road and bridge maintenance and management, DITI staff, and TTU staff (as the stance of collaborator). Based on the above, the selection of the target area and target group is considered appropriate.

Many of the approximately 2,200 bridges on the roads (total length 14,200 km) managed by MOT were constructed during the Soviet era. The bridges have been deteriorating due to 1) the civil war and economic stagnation after independence in 1991 and 2) the lack of engineers for bridge maintenance and management. Therefore, implementation of planned bridge maintenance and management is

becoming an urgent issue.

This project aims to improve the bridge maintenance and management capacity of MOT, DITI, SETM/SEHM, and TTU through 1) introduction of periodic bridge inspection, 2) preventive maintenance, and 3) development of the medium-term bridge management plan, which meets the needs of Tajikistan.

(3) Optimality of business plan and approach

In Tajikistan, proper maintenance and management of bridges, which are damaged and deteriorating rapidly due to aging, is an extremely important issue for maintaining the safety and reliability of logistics and passenger traffic that support the nation's economy, and the transfer of technology and human resource development necessary for bridge maintenance and management is considered the optimal approach to address these issues. The transfer of technology and human resource development necessary for bridge maintenance and management is considered the best approach to address these issues. In addition, it can be concluded that technology transfer utilizing Japanese technology, which has accumulated world-leading experience in bridge maintenance and management, was a major factor in enhancing the effectiveness of this project.

4.1.2 Coherence

The coherence of this project is rated as "Very high" based on the following findings:

(1) Consistency with the development cooperation policies of the Japanese government and JICA

In the latest Tajikistan Country Assistance Policy (September 2018), under the basic policy of "supporting the development of a country capable of sustainable and stable economic/social development", three (3) priority areas of assistance are listed, namely (1) establishment of economic and industrial development infrastructure, (2) improvement of basic social services, and (3) promotion of stability. Of these 3 priority areas of assistance, the cooperation in the area of economic and industrial development infrastructure includes the development of transportation infrastructure that will contribute to the revitalization and stabilization of the regional economy by strengthening connectivity between domestic cities and regions, Central Asian countries, and Afghanistan for improving logistics. Based on the above, the overall goal of this project (Bridge management on International and Republic roads is improved.) is appropriate and in line with Japan's aid policy.

In addition, JICA expects that the maintenance and renewal of infrastructure structures in developing countries will become a major issue in the future. Therefore, since 2017, JICA has been providing assistance for capacity building of maintenance and renewal technologies for road infrastructure including bridges in a more effective and efficient manner through ongoing establishment of "the Road Asset Management Platform". This project has been implemented under this platform.

(2) Collaboration with JICA's Other Projects and Assistance (synergies etc.)

JICA has been implementing various projects to improve the transportation and logistics network based on the Project Development Plan for Tajikistan, which was released in September 2018. Under "The Project for the Rehabilitation of Kizilkala-Bokhtar Section of Dushanbe-Bokhtar Road" (2019-2023), JICA has ensured safe and smooth traffic flow by rehabilitating the existing 2-lane road, including widening of 2-lane road into 4-lane road. Under "The Project for Capacity Development for Road Disaster Management in the Republic of Tajikistan" (2017-2020), JICA Expert Team assisted capacity improvement of MOT, SETM/SEHM in the project target area to effectively manage road disasters by providing institutional and technical guidance regarding road disaster management. Prior to these projects, JICA has been working to strengthen the road maintenance and management system in Tajikistan through "The Project for Improvement of Road Maintenance (2013 -2016)", grant aid "The Project for Improvement of Equipment for Road Maintenance in Khatlon Region and Districts of

Republican Subordination (2013)", and "The Project for Improvement of Equipment for Road Maintenance in Sughd Region and the Eastern Part of Khatlon Region (2016)".

In order to ensure appropriate maintenance of the facilities constructed through the past Japan's grant aid projects and to further enhance the road maintenance and management system strengthened through the past JICA technical cooperation projects, the technical assistance for bridge maintenance and management provided by this project is expected to have an extremely high synergistic effect.

(3) Coordination with International Frameworks, etc.

It is planned that the BMS developed in this project is to be integrated into RAMS, which is currently being developed by another donor (WB and ADB), scheduled to be completed in 2027 (plan). During the project period, RAMS meetings were held to confirm with WB the details of the BMS developed in this project and the output format of the BMS when it is integrated into the RAMS, and WB's approval was obtained. The main system is to be maintained by WB, and from the start of this project, the software was developed as open source. The bridge information is output in Excel, and the tablet application was built in "swift" and the PC application in "C#". At this stage, only bridge inventory information and data related to inspection results will be imported into RAMS, while data collection and analysis will be performed by BMS using tablet terminals. Furthermore, this project is expected to contribute to smooth transportation in the country and surrounding areas, and to achieve Goal 9 of the Sustainable Development Goals (SDGs) proposed by the United Nations, which is "to build resilient infrastructure, promote inclusive and sustainable industrialization, and promote innovation".

4.1.3 Effectiveness

The effectiveness of this project is rated as "Very high" based on the following findings:

(1) Outputs and Achievement of the Project Goals

In this section, JICA Expert Team has evaluated the status of the outputs set in the Project Design Matrix (PDM) and the achievement of the project goals through the outputs. The status of achievement of each output and the project goals are summarized in Table 4-2 and Table 4-3, respectively. From above, it was deemed that all the project outputs and goals would be achieved.

Table 4-2 Status of Achievement of Each Output

Outputs	Indicator	Evaluation
Output-1: Organizational structure for bridge management of MOT, SETMs/SEHMs and DITI is strengthened.	Regulations for Segregation of Duties and Standard Operating Procedures with task demarcation of MOT, SETMs/SEHMs and DITI are approved by MOT.	Achieved
Output-2: Capacities for bridge inventory management, inspection/diagnosis, and maintenance of MOT, SETMs/SEHMs, DITI, and TTU are improved.	BMS is installed for MOT and SETMs, and operated based on the manual.	Achieved
	30 staff have participated in On-the-job trainings and pass the post-training tests.	Achieved
	The technical manuals are approved by MOT.	Achieved
	Pilot maintenance work(s) are implemented for 3 bridges.	Achieved
Output-3: Capacities for bridge management planning of MOT and Model SETMs are improved.	Mid-term Bridge Management Plan is approved by MOT.	Achieved
	Budget proposal(s) for bridge repair works/preventive measures of any scale is submitted to MOF.	Achieved
Output-4: Sustainable system for human resource development on bridge management is strengthened.	Curriculum of bridge engineering course is approved by MOT.	Achieved
	Staff/students that participated in the bridge engineering course pass the final tests.	Achieved

Table 4-3 Status of Achievement of Indicators regarding Project Goals

Indicators	Status of Achievement	
1. Bridge inventories are provided and managed based on the technical manual for 55 % of bridges under MOT jurisdiction.	As of July 2024, acquisition of inventory data was completed for 74% or 1,643 bridges out of the 2,231 bridges under MOT jurisdiction.	Achieved
2. Based on the technical manuals, 55 % of bridges in the Model SETMs/SEHMs are inspected and diagnosed.	As of July 2024, 1,643 bridges (74%) out of 2,231 bridges under model and non-model SETM jurisdiction were inspected and diagnosed.	Achieved
3. Based on the technical manuals, maintenance works are done for 240 bridges in the Model SETMs/SEHMs.	Result of bridge maintenance • Total: 225 bridges (Total: 240 bridges in the end of November 2024) 2022: 60 bridges 2023: 112 bridges 2024: 53 bridges by the end of July (68 bridges have been scheduled to be completed by the end of November 2024)	To be achieved
4. Budget proposal(s) for large-scale repairs/replacement of 3 bridges is submitted to MOF/international donors	Budget proposals for large-scale repairs/replacement of 3 bridges were prepared in July 2024 and it will be submitted by MOT to MOF and/or international donors before November 2024 as per yearly budget procedure.	Achieved

On the other hand, during the project period, 10 engineers who participated in on-the-job training for bridge inspection and BMS left the company from 2022 to 2023. Although it caused a significant impact on project execution, such as taking longer than expected to collect BMS data, the project goals were achieved by continuing to provide technical support through provision of assistance by dispatching project national staff to the training sites. Based on the above, it can be said that the activities and outputs of this project were effective for achieving the project goals.

4.1.4 Impact

The impact of this project is rated as “High” based on the following findings:

(1) Impact on Achievement of Overall Goal

Following achievement of the project goals, it is important to ensure that the project outputs are better understood and implemented within SETM/SEHM and MOT in order to achieve the overall goal. The status of achievement of the overall goal at the end of the project is shown in Table 4-4. Some of the overall goal is already being achieved, which is the result of achievement of the individual outputs and project goals. In particular, proactive initiatives such as the BMT are essential for achievement of the overall goal. Continuation of these activities after completion of the project will further increase possibility of achieving the overall goal.

Table 4-4 Status of Achievement of the Overall Goal

Overall Goal	Achievement Indicator	Status toward the Overall Goal
Bridge management on International and Republic roads is improved.	Bridge inventories are provided and managed based on the technical manual for 100 % of bridges under MOT jurisdiction.	At the end of the project, inventory was completed for 1,643 bridges, or 74% of the 2,231 bridges in MOT jurisdiction.
	Based on the Mid-term Bridge Management Plan and the technical manuals, 100 % of bridges on International/Republican roads are inspected and diagnosed.	At the end of the project, inspection and diagnosis of 727 bridges out of 843 bridges (86%) on international/national roads in 6SETMs were conducted in accordance with the medium-term bridge maintenance plan and the technical manual.

Overall Goal	Achievement Indicator	Status toward the Overall Goal
	Based on the Mid-term Bridge Management Plan and the technical manuals, 20 bridges are repaired annually.	In the medium-term bridge management plan (2025-2029) developed in this project, 3 to 4 bridges will be repaired annually nationwide. In the long-term bridge management plan (2025-2034), 28 to 29 bridges will be repaired annually nationwide.
	Based on the feedback of bridge management activities, the Mid-term Bridge Management Plan is revised.	It was agreed with MOT that the bridge management plan will be updated periodically in accordance with the Basic Approach for Bridge Management.

(2) Other Impacts

The following other impacts were identified. Thus, impact of the project has been extended, in addition to improvement of bridge management capacity of C/P as follows:

- Proper maintenance and management of bridges has a significant impact on the social economy and local industries, as it leads to reduced maintenance costs, traffic safety, savings in driving costs, and reduced driving time.
- Two (2) dissemination seminars were held, inviting officials from relevant ministries and agencies including the Ministry of Finance, other donors, university officials, and local residents, to educate them on bridge maintenance and management. The seminars contributed to formation of channels between C/P and the relevant agencies.
- With regard to BMS introduced in this project, comments were given by IT engineers on the possibility of further sophistication (increase of data types, additional functions, cloud storage, etc.) at the time of integrating it with RAMS. In this way, through joint work with JICA expert team, the Tajikistan side was able to proactively examine content of the BMS, which led to creation of an environment where they can consider operation and update of the system on their own in the future.

4.1.5 Sustainability

Sustainability of this project is rated as “High” based on the following findings:

(1) Policy and Institutional Aspects

Current Tajikistan government policy and growth strategy focuses on the improvement of road transport infrastructure. This policy is not expected to change in the foreseeable future because the demand for infrastructure improvement in the country is expected to continue to increase. In addition, MOT is expected to strengthen bridge maintenance and management more because MOT aims to strengthen road asset management in Tajikistan in collaboration with WB and ADB.

(2) Organizational and Technical Aspects

Through the activities of this project, manuals and databases have been developed, and the knowledge and skills of C/Ps related to bridge maintenance have improved. The results achieved in this project have laid the foundation for MOT to continue to accumulate its knowledge and skills in the future.

In terms of organization, the BMT has been organized through this project, and based on Outcome 1, the MOT and all SETM/SEHMs are now discussing the assignment of bridge maintenance technicians. Furthermore, MOT and TTU have agreed to cooperate in the ongoing operation of the Bridge Maintenance Engineer Training Course, which will be held once a year, and is expected to contribute greatly to the training of future bridge engineers by MOT and TTU.

BMS, other systems and manuals introduced in the project are also expected to be used continuously

because JICA Expert Team and C/P have collaboratively discussed and created them with the aim of creating systems and manuals that are easy to edit and update with sustainability in mind from the beginning of the project.

(3) Financial Aspects

In order to ensure that bridge maintenance and management is carried out by MOT after completion of the Project, it is necessary to secure a reasonable budget for bridge maintenance and management. Securing the budget has been a major bottleneck in road asset management in Tajikistan for many years and the Output3 of the Project was an activity focused precisely on this point.

It is highly expected that the necessary budget for bridge maintenance will be secured in the future as the budget amount estimated in the 5-year mid-term maintenance plan is well within the overall maintenance budget for the road facilities although the amount is more than double the bridge maintenance budget currently allocated to the MOT, as the awareness on the importance of bridge maintenance is increasing in both the MOT and in the Government of Tajikistan, and as the Project has enabled MOT staff to formulate a persuasive budget plan based on actual data. Furthermore, the technical transfer for the budget proposal document will contribute to increment of the supports for bridge replacement and rehabilitation from international organizations.

4.1.6 Efficiency

Efficiency of this project is rated as “High” based on the following findings:

(1) Efficiency of inputs of JICA Experts

Inputs of JICA Expert Team to project activities were done as planned. During the project period, although some experts were required to be quarantined, take PCR tests, and get COVID-19 vaccine, inputs were completed as originally planned, utilizing remote online meetings or support from national staff.

(2) Efficiency of inputs of Tajikistan side

With the establishment and utilization of the BMT, each BMT member was aware of his roles and responsibilities and actively participated in activities to support SETM/SEHM in achieving each project output. Furthermore, BMT members took the initiative in providing on-the-job training, and took the initiative in disseminating the technology themselves at the Bridge Maintenance and Management Engineer Training Course and the Dissemination Seminar. In addition, Tajikistan side provided the project office as planned, and this contributed to completion of the project.

(3) Effect of Technology Dissemination

Total days and participants of the seminar became 168 days and 2,212 persons, respectively. Through the bridge engineering course, the project was able to disseminate the content of bridge maintenance not only to MOT officials but also to TTU students. 19 staffs from MOT and 12 students from TTU participated in the bridge engineering course in 2023, and certificate of completion were awarded. In addition, 15 MOT officials and 12 TTU students participated in the course in 2024, and certificate of completion were awarded as well. In addition to the engineers currently working for MOT/SETM/SEHM, the technology was disseminated to the next generation who could be responsible for bridge maintenance and management in Tajikistan in the future. It is expected that implementation of bridge maintenance was disseminated to wider generations through the persons who completed the course. Furthermore, the certificates were awarded at the 8th JCC to 75 participants who completed OJT in bridge inspection, diagnosis, and repair, and priority will be given to those who complete the OJT or bridge maintenance and management engineer training course for this project in the future. It is expected that MOT and TTU will ensure the sustainability of this engineering course, and that the skills acquired through the course’s graduates will be disseminated to a wide range of generations.

4.2 Project External Factors and Project Risk Management

The following 4 points were set as important assumptions for achievement of outputs and project purpose before the beginning of the project. Although some of them occurred during the project, they did not affect the project progress significantly.

(1) Tajik Government policies on road and bridge management does not change drastically.

During the project, the Tajik Government policies on road and bridge management did not change drastically.

(2) Officials trained in the project continues to work in the area of expertise.

10 officials who participated in OJT of bridge inspection and BMS left the government from 2022 to 2023. This had a significant impact on project progress, as it took longer than expected to collect BMS data. Continuous employment of government officials is required to implement road and bridge maintenance activities sustainably in the future.

(3) There is no restriction on overseas travel or on-site activities such that implementation of the project activities is prevented.

The Government of Tajikistan, through the Republican Headquarters for the Prevention of the Spread of New Coronavirus Infections, implemented waterfront measures on February 8, 2022. Since March 7, 2022, almost all the regulations were set free, including mandatory mask wearing in public places and a temporary ban on traditional ceremonies. Most of the people have been living without masks since then. Although the presentation of vaccination certificates for new coronavirus infection at Dushanbe International Airport was in place until November 2022, after which the quarantine regime was changed to the same as in Japan. During the project period, although some experts were required to be quarantined, take PCR tests and get COVID-19 vaccine, there is no restriction on the overseas travel.

4.3 Lessons Learned and Issues Obtained

The followings are lessons learned and issues obtained from implementing the project:

(1) Establishment of Project Ownership

C/P members participated in trainings and seminars aggressively in this project. In addition, establishing project ownership by conducting regular BMT meetings with C/P's positivity and cooperation resulted in achievement of outputs. It was decided that regular BMT meetings would be held so that the project effect can continue for a long time after completing the project. As mentioned above, it is important to improve the capacity of C/P through collaborative work, with respect for independence of C/P, and the process of technology transfer should draw out their ownership, so that they can utilize their own capacity in the future.

(2) Preventing Turnover of Engineers

According to the result of detailed planning survey in 2021, it was revealed that turnover had been caused by (1) Lack of organization for bridge maintenance and management, and (2) limited career path for bridge engineers. The followings are issues and suggestions:

1) Lack of organization for bridge maintenance and management

Although the SETMs and SEHMs recognize the importance of having a dedicated person in charge of bridge maintenance and management, there are road engineers but limited bridge engineers. According to SETMs, road engineers handle bridge maintenance and management concurrently, and there is a limited position or organization dedicated to bridges. This is one of the reasons for the limited training opportunities for bridge engineers. The limited organization for bridge maintenance and management has led to a vicious cycle in which bridge engineers cannot be trained, in which a shortage of engineers becomes normal, and in which the assignment of dedicated bridge personnel is difficult to

approve. To improve the above situation, a position or organization dedicated to bridges needs to be established.

As an improvement plan, the project suggested in output 1 “the report on Organizational Structure for Bridge Management” and establishment of department responsible for bridge maintenance in MOT and SETMs and assignment of bridge engineers.

2) Limited career path for bridge engineers

Although graduates of TTU’s bridge engineering course have entered SETMs and SEHMs, these organizations have limited opportunities to gain advanced practical experience regarding bridge management after employment because there are limited organizations dedicated to bridge maintenance and management. Since there is a limited system or organization that issues qualification certificates or licenses to engineers with skills and experience, objective evaluation of bridge engineer’s skill is difficult as well. In addition, career paths to enhance professional skills and experience as bridge engineers are unclear. Moreover, there is a shortage of bridge engineers because it is difficult for engineers to envision a career path for bridge engineers within the MOT. SETMs and SEHMs need assistance from DITI in bridge inspection, diagnosis, and repair planning, but even DITI faces the problem of trained engineers’ leaving their positions for higher salaries. In order to improve and maintain the MOT's bridge maintenance system, it is necessary to clarify the career paths that bridge engineers can take and establish a system to evaluate their skills and experience properly.

As an improvement plan, the project suggested output 1 “the report on Organizational Structure for Bridge Management” to clarify career paths for bridge engineers and establish the system to evaluate experience and skills of bridge engineers.

5 For the Achievement of Overall Goal after the Project Completion

5.1 Prospects for Achieving the Overall Goal

Based on discussions with the JICA Expert Team and key C/P members, the current status at the time of project completion and the prospects for achieving the project overall goal after the project completion are summarized as follows:

- Established a system to collect inventory and inspection information on bridges managed by MOT via tablet terminals, and to develop and manage BMS.
- Through the project, standards and technical documents appropriate to the climatic conditions, environment, organization, human resources and budget in Tajikistan were updated and introduced. Based on these, pilot projects were planned and implemented.
- As a result of evaluation of the implemented pilot project, JICA Expert Team confirmed that the construction implementation process and quality control test results were favorable.
- The BMT was established as a cross-organizational task force, and meetings were held regularly to enable cross-organizational collaboration, which also contributed to the improvement of bridge maintenance and management techniques throughout the C/P.
- The C/P agreed in the final JCC to continue taking inventories and conducting inspections and diagnostics after the completion of the project.
- It was also agreed with the C/P that if the medium-term bridge maintenance management plan needs to be revised, the C/P will revise the plan accordingly, and that 20 bridges will be repaired per one year.
- It was agreed that the BMT will continue to meet after the completion of the project and continue to discuss technical issues related to bridge maintenance and management. The BMT members were selected from key engineers from MOT, SETM, DITI, and TTU, and the roles of each member were clearly defined.

Based on the above, it is expected that bridge maintenance and management activities will be carried out appropriately after the completion of the project, and that the project overall goal can be fully achieved.

5.2 Plan for Achieving the Overall Goal

Through the Project, the lack of skills in bridge inspection and diagnosis, as well as the lack of know-how on maintenance planning were improved. In addition, the policies on the organizational structure and the human resource development required for sustainable bridge management were confirmed. Based on these results, the action plan to achieve the project overall goal has been formulated as shown in Table 5-1.

Table 5-1 The Action Plan for the Project Overall Goal

Overall Goal: Bridge management on International and Republic roads is improved.	
Indicator	**Action Plan**
Bridge inventories are provided and managed based on the technical manual for 100 % of bridges under MOT jurisdiction.	- Fixing the budget required for the inventory - Assigning a person in charge (bridge engineer)
Based on the Mid-term Bridge Management Plan and the technical manuals, 100 % of bridges on International/Republican roads are inspected and diagnosed.	- Update of bridge inventory information - Fixing budget necessary for bridge inspections - Assigning a person in charge (bridge engineer)

Overall Goal: Bridge management on International and Republic roads is improved.	
Indicator	**Action Plan**
Based on the Mid-term Bridge Management Plan and the technical manuals, 20 bridges are repaired annually.	- Ensuring implementation of periodic bridge inspection - Fixing the budget for bridge repair - Assigning a person in charge (bridge engineer)
Based on the feedback of bridge management activities, the Mid-term Bridge Management Plan is revised.	- Continuous storage of inspection and repair data - Assignment of bridge engineers - Preparation of document to explain necessity for increase of bridge maintenance budget

5.3 Recommendations for the Tajikistan Side

(1) Accumulation and Analysis of Bridge Inspection Records

While it is important to conduct bridge inspection every year using the proper inspection and evaluation methods specified in the manual, the accumulation and analysis of these data is extremely important for improving the bridge maintenance and management cycle in the future. Information that can only be obtained through the accumulation of data over time, such as trends, factors, and deterioration rates of various types of damage, is indispensable for subsequent strategic bridge maintenance and management planning. It is important not only to simply repeat inspections, but also to use the accumulated data to analyze problems in design and construction, as well as deterioration factors caused by external factors such as the effects of scouring. It is recommended to utilize the tools developed in this project, carefully accumulate and analyze inspection/diagnosis records, and review bridge maintenance and management policies from the viewpoint of bridge engineering.

(2) Continuous Human Resources Development

Although SETM and SEHM recognize the importance of having a dedicated person in charge of bridge maintenance, there are road engineers except for few bridge engineers. According to SETM, bridge maintenance is concurrently handled by road engineers, and there is no dedicated bridge maintenance position or organization. However, it is a significant change that MOT has started to consider training bridge maintenance engineers and assigning human resources to each SETM/SEHM through this project. We look forward to the continued training of bridge engineers who will lead Tajikistan in the future.

(3) Increase of Bridge Maintenance and Management Budget

At present, one of the major impediments to the sustainability of bridge maintenance activities of MOT is the lack of budget. In addition, road maintenance accounts for the majority of the MOT's maintenance budget, and the budget allocated to bridge maintenance is extremely small. Since it is not easy to change this environment in a short period of time, it is necessary to carefully explain the effectiveness of bridge maintenance and the economic benefits of preventive maintenance by accumulating bridge inspection and repair data, and to make efforts to obtain a national consensus on the increase of bridge maintenance and management budget. To this end, it is important to accumulate and analyze bridge inspection data, and to prepare highly persuasive basic data and explanatory materials, utilizing bridge inspection data, for expansion of bridge maintenance and management budget.

(4) Development of a Legal Framework for Bridge Maintenance and Management

The frequency of bridge inspection and the policy for actions to be taken in response to bridge diagnosis results are described in the manuals developed in this project. On the other hand, in order to make these technical rules enforceable, it is also necessary to develop a legal framework. In particular, from the perspective of ensuring the safety of road users, it is also important to ensure that the frequency of bridge inventory information updates and inspections is legally mandated as a minimum task to be carried out and to ensure its implementation.

5.4 Monitoring Plan from the End of the Project to Ex-post Evaluation

After the project is completed, it is recommended that periodic monitoring of bridge conditions be conducted for the ex-post evaluation of this project as shown in Table 5-2.

Table 5-2 Monitoring Plan (Proposal)

【Overall Goal】
Bridge management on International and Republic roads is improved.

【Indicators】
a) Bridge inventories are provided and managed based on the technical manual for 100 % of bridges under MOT jurisdiction.
b) Based on the Mid-term Bridge Management Plan and the technical manuals, 100 % of bridges on International/Republican roads are inspected and diagnosed.
c) Based on the Mid-term Bridge Management Plan and the technical manuals, 20 bridges are repaired annually
d) Based on the feedback of bridge management activities, the Mid-term Bridge Management Plan is revised.

【Verification method】
a) Inventory
b) Inspection record
c) As-built drawings
d) Revised Medium-Term Bridge Maintenance Plan

【Status of achievement】Numerical targets after project completion

Months and years	**November 2025**	**November 2026**	**November 2027**
Indicator a)	*Target value：85%*	*Target value：100%*	*Target value：100%*
	Actual value：****%**	Actual value：****%**	Actual value：****%**
Indicator b)	*Target value：95%*	*Target value：100%*	*Target value：100%*
	c：****%**	Actual value：****%**	Actual value：****%**
Indicator c)	*Target value：20bridges per year*		
	Actual value：**** bridges**	Actual value：**** bridges**	Actual value：**** bridges**
Indicator d)	*Goal：Revision of mid-term bridge maintenance plan based on feedback from bridge maintenance activities*		
	Actual：	Actual：	Actual：