

**JICA's Development Initiative for
Road Asset Management**

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Road Asset Management What is Asset Management ?

What is Asset Management ?

Asset management is a systematic process of deploying, operating, maintaining, upgrading, and disposing of assets, such as stocks, bonds, deposits and savings or the real estate, cost-effectively.



What is Road Asset Management ?

To be adopted asset management method for the operation and maintenance of social infrastructure facilities. A way of thinking to place social infrastructure facilities for assets of the nations, and to carry out the operation and maintenance of the assets effectively, premeditatedly and steadily.

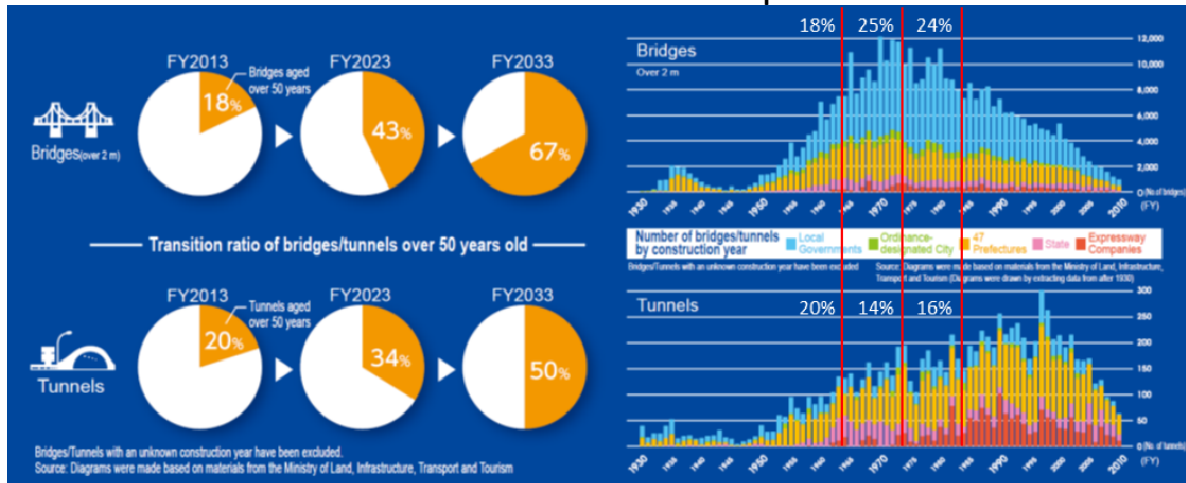


Expected effects for Road Asset Management

- Minimization of maintenance cost and Grasp of the necessary maintenance cost
- Optimization and Equalization of the future investment budget for road sector

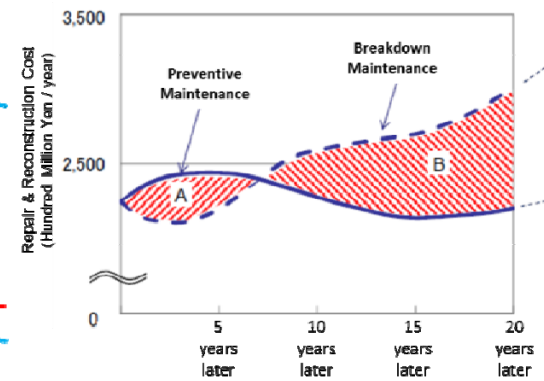
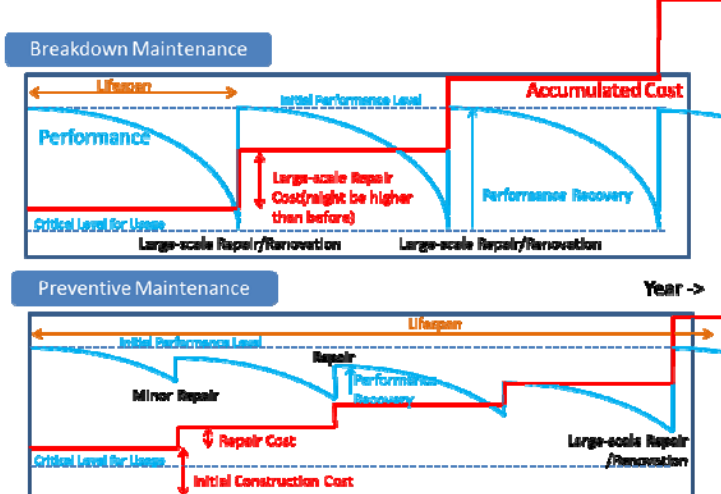
Road Asset Management Road Infrastructure in Japan

Current condition of Road Infrastructure in Japan



How to deal with Aging Infrastructure and the heavy burden of infrastructure maintenance and repairs ?

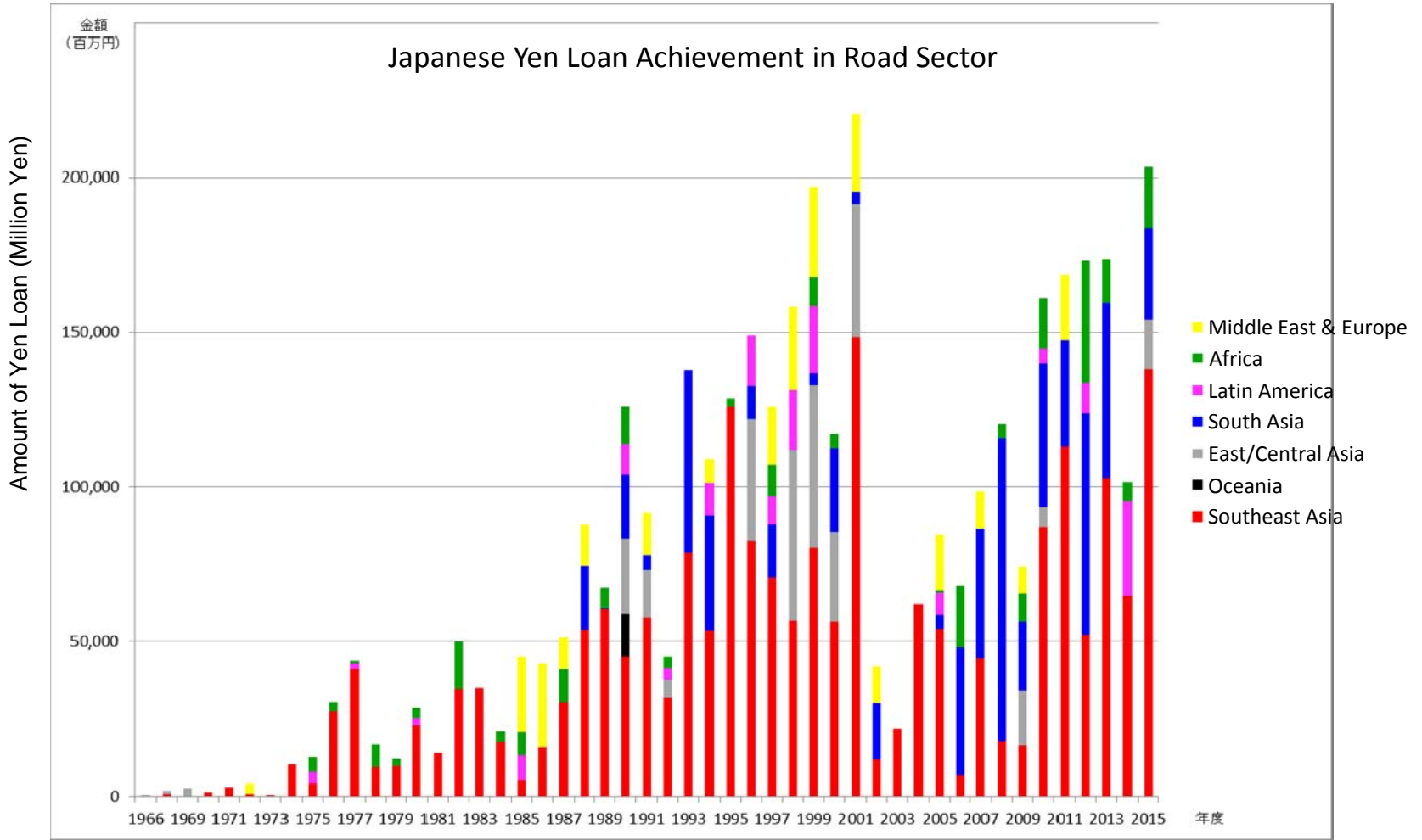
Action for Road Infrastructure in Japan Reduction of Life Cycle Cost through Preventive Maintenance



Amount of Reduction Cost:
5,000 Hundred Million Yen in the next 20 Years
Estimated by Ministry of Land, Infrastructure and Transport

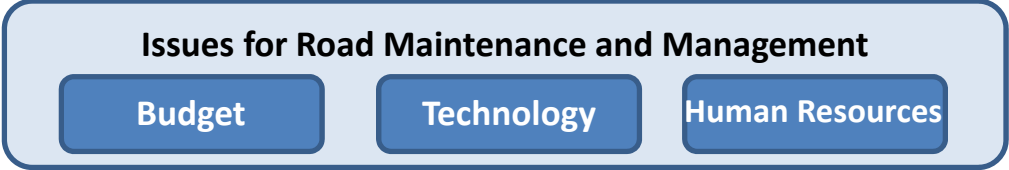
Switch from Breakdown Maintenance to Preventive Maintenance due to Lifetime-Extension (Life Prolongation) of Infrastructures and Reduction of Life Cycle Cost

Road Asset Management Issue in Developing Country

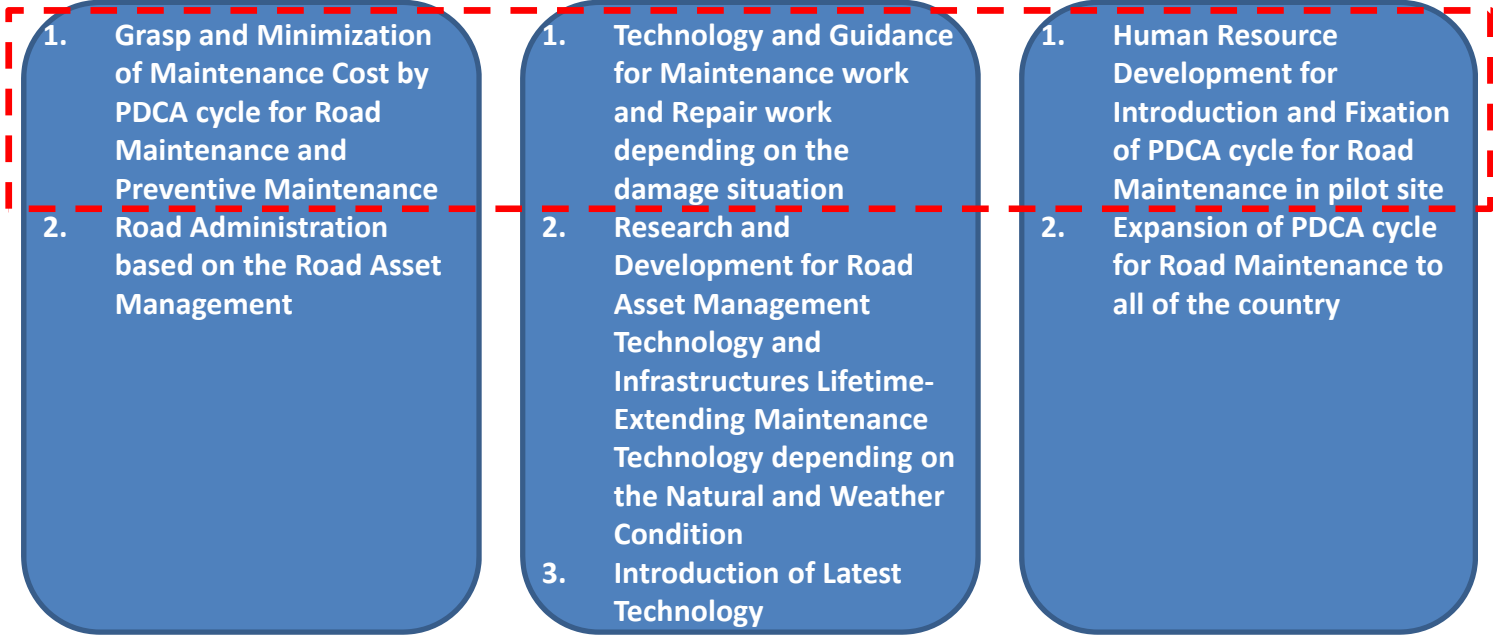


Aging Infrastructure Issues will arise in the Southeast Asia after 20 years like Japan.
Preventive Maintenance will be installed as soon as possible.

Road Asset Management Issue in the Developing Country



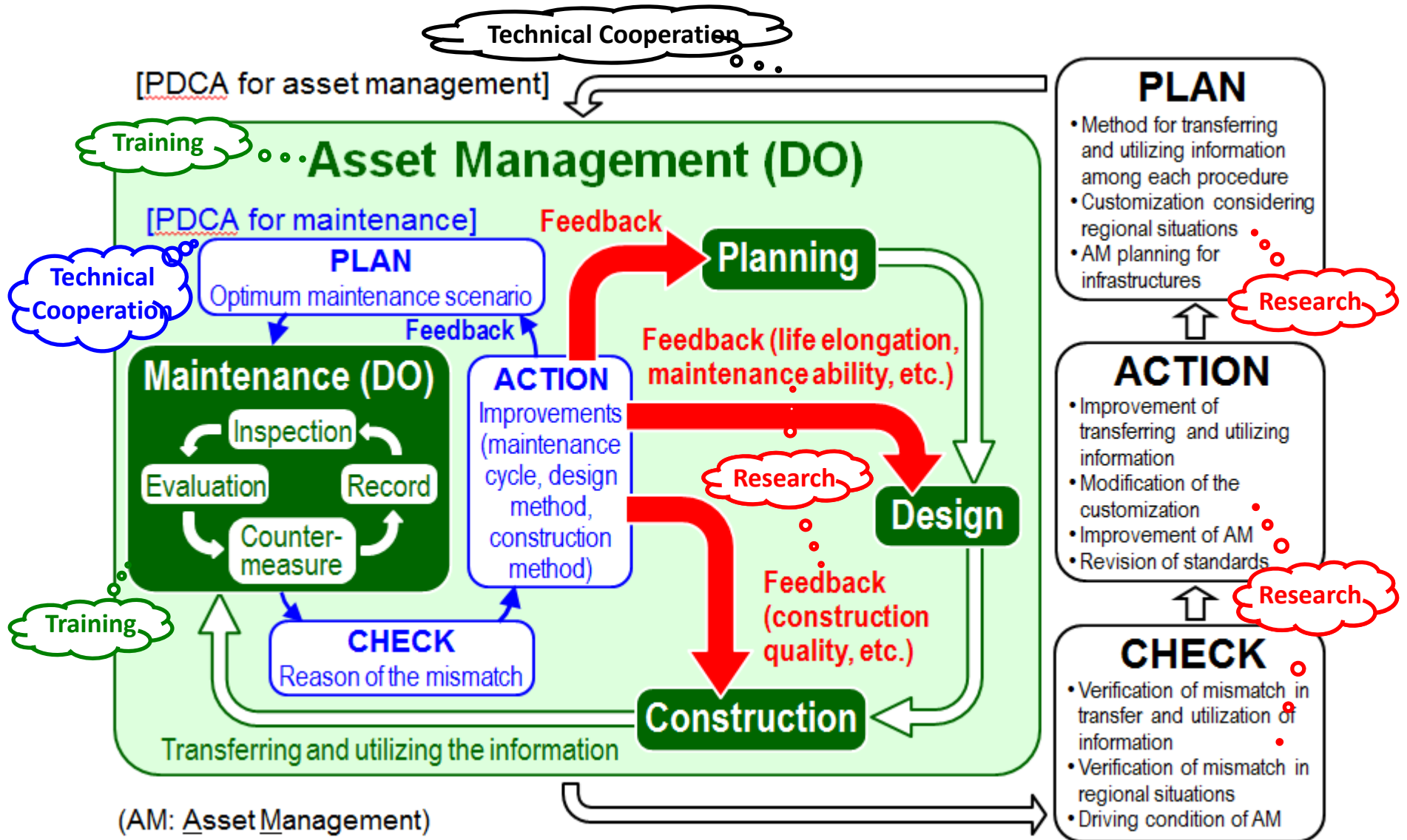
Basic Knowledge and Technology for Road Asset Management acquired by JICA's Technical Cooperation



Number of Technical Cooperation Project for Road/Bridge Maintenance

Status	Southeast Asia	South Asia	Central Asia	Africa	Central and South America	Total
Ongoing	6	5	2	5	1	19
Preparation	1	1		2		4

Road Asset Management Conceptual diagram



(AM: Asset Management)

Source: Introduction of SIP project / Current situation of infrastructure management in Japan and Asia, Kohei NAGAI, Associate Professor, International Center for Urban Safety Engineering (ICUS), Institute of Industrial Science, The University of Tokyo

Road Asset Management

Activities on Road Asset Management in Japan

Cross-ministerial **S**trategic **I**nnovation Promotion **P**rogram: **SIP**

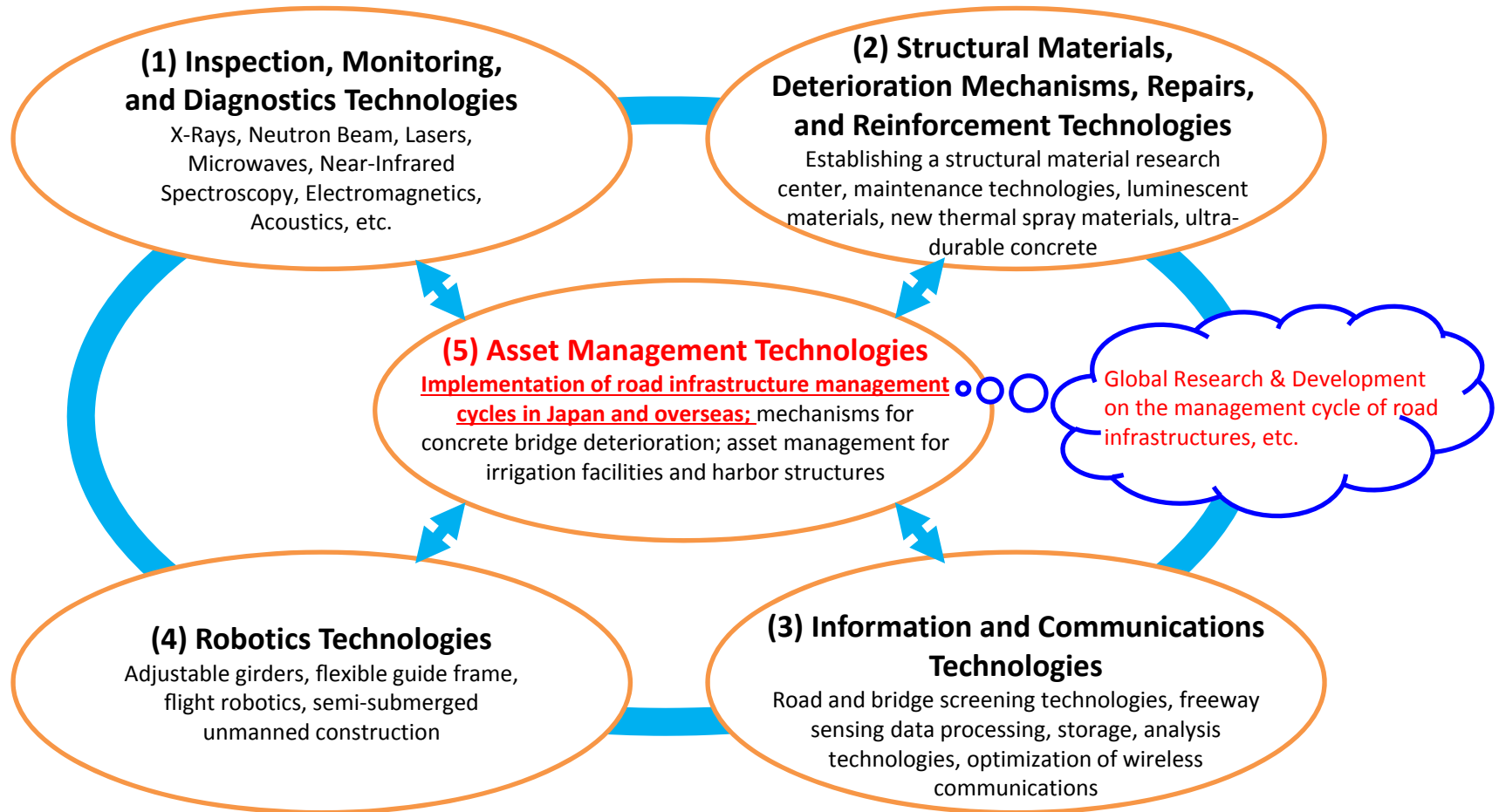
- National project under the Council for Science, Technology and Innovation to promote advancements of science, technology and innovation in Japan
- Promotion of end-to-end research and development, based on collaboration between government, industry and academia, from basic research to practical application and commercialization
- 11 issues that answer critical social needs and offer competitive advantage to Japanese industry and the economy
 - (1) Innovative Combustion Technology
 - (2) Next-Generation Power Electronics
 - (3) Structural Materials for Innovation
 - (4) Energy Carriers
 - (5) Next-Generation Technology for Ocean Resources Exploration
 - (6) Automated Driving System
 - (7) Infrastructure Maintenance, Renovation and Management**
 - (8) Enhancement of Societal Resiliency against Natural Disasters
 - (9) Technologies for Creating Next-Generation Agriculture, Forestry and Fisheries
 - (10) Innovative Design/Manufacturing Technologies
 - (11) Cyber-Security for Critical Infrastructure

How to Deal with an Aging Infrastructure and the heavy burden of infrastructure maintenance and repairs serious needs in our society?
How to do for Safe, Secure and Sustainable Infrastructure Systems?

Source: Cabinet Office HP, Brouchure about SIP
http://www8.cao.go.jp/cstp/panhu/sip_english/sip_en.html

Road Asset Management
SIP: Infrastructure Maintenance, Renovation and Management

5 Research and Development Topics, and 71 themes (as of Jan. 2017)



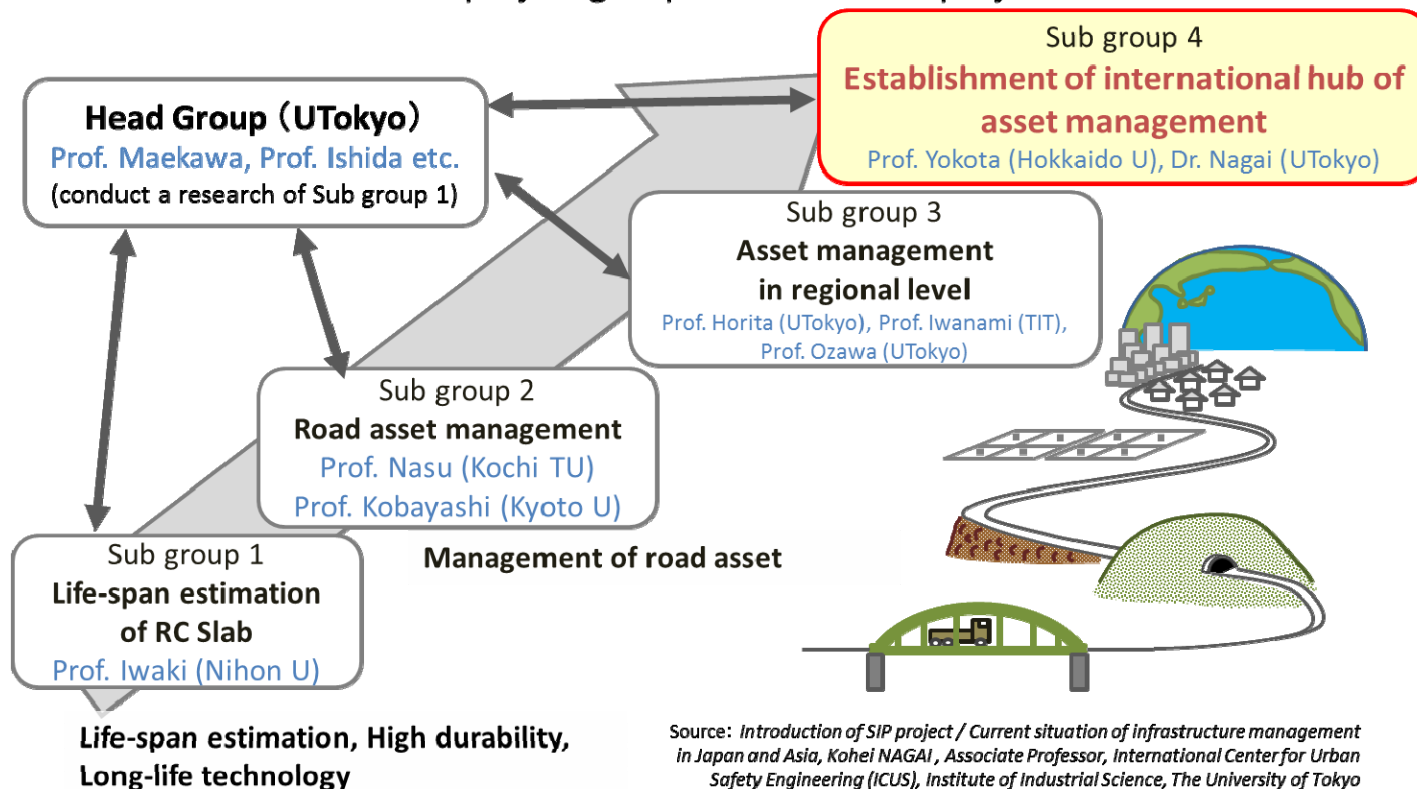
Source: Cabinet Office HP, Brouchure about SIP
http://www8.cao.go.jp/cstp/panhu/sip_english/sip_en.html

Road Asset Management Collaboration with SIP

Collaboration Case1 : Global Research & Development on the management cycle of road infrastructures

Objectives: To develop various technologies to reduce the life cycle cost of road infrastructures. This research covers whole maintenance processes such as Inspection, Performance verification, repair & strengthening and renewal.
To develop a maintenance system for infrastructures in municipalities
To implement the developed technologies for domestic road infrastructures and municipalities, and to export the developed systems abroad

- PDCA cycles of maintenance in the levels of Bridges, road, region.
- One head and four sub-project groups are set in this project.




Source: Introduction of SIP project / Current situation of infrastructure management in Japan and Asia, Kohei NAGAI, Associate Professor, International Center for Urban Safety Engineering (ICUS), Institute of Industrial Science, The University of Tokyo

Road Asset Management Collaboration with SIP

Collaboration Case1 : Global Research & Development on the management cycle of road infrastructures

R&D Topics: Asset Management Technologies
R&D Theme: Global R&D on the management cycle of road infrastructures
Principal Investigator: Koichi Maekawa (Professor, The University of Tokyo)
Collaborative Research Groups: Nihon Univ., C.E. Management Integrated Laboratory Co., Ltd., NIPPO Corp., East Nippon Expressway Co., Ltd., Metropolitan Expressway Co., Ltd., Yokohama National Univ., Tohoku Univ., Kyoto Univ., Osaka Univ., Kochi Univ., Tec., National Inst. Tec. Kochi Coll., Tokyo Inst. Tec., Tohoku Univ., JSCE, Hokkaido Univ., Shinshu Eng. Co. Ltd., Highway Tec. KC, Kyushu Univ.



R&D Objectives and Subjects

Objectives

R&D of Innovative hardware and software: We are developing various technologies to reduce the life cycle cost of road infrastructures. Our research covers whole maintenance processes such as Inspection, Performance verification, repair & strengthening and renewal.

R&D of management system: We are also developing a maintenance system for infrastructures in municipalities.

Implementation at home and abroad is our final goal. Developed technologies are implemented for domestic road infrastructures and municipalities. The scheme will be prepared to export the developed system.

Subjects

Key technologies for road maintenance: 3-D radar, Multi-scale simulation, Data assimilation, Survival analysis, Durable bridge decks, Water jets, Surface finishers, Water proofing material, Pre-cast bridge decks, Quality control system

Maintenance system for administrator: Asset management system, Management database, Education system, PDCA cycle of maintenance, Bidding model & Contract model, Business model

Exportation: Preparation of ISO on the maintenance of concrete structures, Formulation of international hubs in other Asian countries, Information transmission

Current Accomplishments (2/2)

R&D of Maintenance systems for road administrator and municipalities

Asset management system for road administrator

- Kyoto model (Pavement & Bridges) → Installed in Kyoto pref. & Vietnam
- Osaka model (Bridges) → Used in Hanshin Expressway Co., Ltd.
- Kochi model (Bridges) → Installed in Kochi pref. & Indonesia

Bidding and contract system for municipalities

OPCET, JSCE Research committee on the implementation of asset management system

The academic society supports the installation of asset management in municipalities

Kaizen cycle in maintenance

Improvement in education & inspection system to reduce inspection error

Pilot program map

Cooperation between municipalities and local universities

- Niigata city (JSCE)
- Fuji city (JSCE)
- Kuwana city (JSCE)
- Kyoto pref. (KUT)
- Kochi pref. (KUT)
- Sabetsu-cho (JSCE)
- Tsushima city
- Sakuragawa city
- Kanuisi city (Takuba Univ.)
- Kashiwa city (TU)
- City of Ota (ITTEC)
- Machida city (JSCE)

Current Accomplishments (1/2)

R&D of various technologies for bridge decks

Subject 1: Maintenance of existing bridge decks under severe conditions

- Life prediction
- Performance
- Priority Action
- Inspection data analysis
- Survival analysis (UT)
- NDT
- 3D radar (CEDK, UT)
- Evaluation
- Multi-scale analysis (UT)
- Repair
- Water jet (NIPPO)
- Water proof material (Shutoko)
- Implementation
- Cold area (NEXCO-e, MLIT)
- Heavy traffic area (Shutoko)

Subject 2: Construction of a Durable bridge deck under severe conditions

- De-icing salt
- Heavy traffic
- Durable material
- Supplemental material (UT, NU) (fly ash, BFS, expansive agent)
- Construction accuracy
- Surface finisher (NIPPO)
- Quality verification
- Surface absorption test (NUT)
- Implementation
- [New] Recovery from earthquakes in Tohoku and Kanamori (MLIT, KUT)
- [Renewal] Precast PC deck (NU)

Other technologies:

- Ranking by survival analysis
- Medical statistics are supported to bridge inspection
- High speed scanning with 3D radar. Signal analysis finds damage inside bridge decks.
- Visual inspection
- Simulation
- Remainder life prediction by data assimilation
- Water jet machine
- Effective & quiet
- Inspected depth
- Water proof material of high penetration

Effective maintenance of bridge decks

Goals

Implementation at home and abroad

Cutting edge technologies for the maintenance of road infrastructures

- 3D radar
- Multi scale analysis
- Data assimilation
- Survival analysis
- Durable bridge decks
- Water jet machines
- Water proof materials
- Surface finishers
- Water absorption tests
- Quality control systems

- Trial operations
- Lengthen the track record (Shutoko, NEXCO, National road)

Standardization Standard, Guideline

Widespread use of technologies

Maintenance system for road infrastructures

- Asset management
- Bidding & Contract system
- Kaizen cycle
- Education
- Analysis
- Database

- Trial operations
- Lengthen the track record (Hanshin expressway, Municipalities)

Widespread throughout Japan

International hubs in Asia (Hokkaido Univ., Tokyo Univ.)

2015: SIP office was opened

2016: Inspection

Exportation of SIP technologies

- International networking
- Infra report, Asia version
- Education program
- International standard

Thailand: Seminar, Inspection

Vietnam: Seminar, Educational tour, Lectures about the maintenance in University

Myanmar: Inspection, Monitoring, Bridge database

Cambodia: Seminar, Inspection demonstration, Translation of Japanese Standards

Hub, Seminar, Information center, Current status of infrastructures

Training facilities for visual inspection, Proposal, V&V of proposing standard

Road Asset Management Activities in Japanese Local Government

Human Resource Development “Michi-Mori (Road Maintenance Engineer)” Project in Nagasaki Prefecture

- Nagasaki Prefecture, which is a tourism promoting prefecture, has many tourist attractions in a peninsula or remote island.
- **The deterioration of infrastructures** such as a bridge crossing a sea or harbor infrastructure **are progressing**.
- Nagasaki Pref. faces **problems such as lack of construction / maintenance cost, lack of engineer**.
- **Nagasaki Pref. is working on switch from breakdown maintenance to preventive maintenance of infrastructures to keep them in good condition.**
- Nagasaki University established “**Infrastructures Lifetime-Extending Maintenance Research Center**” in Jan, 2007 to promote the research and development with Nagasaki Prefecture, cities, towns, and local companies.
- Nagasaki Univ. trains “Michi-Mori (Road Maintenance Engineers)”, which are concerned with reconstruction / lifetime-extending maintenance method of infrastructures, under the cooperation with Nagasaki Pref..
- Research and Development of Implementation in Society of Innovative Advanced Technology for Civil Infrastructure Maintenance by Nagasaki Univ. was adopted as a SIP project in Aug. 2016.
- Nagasaki Univ. is implementing JICA’s Group & Region Focused Training “Bridge Maintenance” from JFY 2015 to JFY 2017.

Source: Infrastructures Lifetime-Extending Maintenance Research Center, Nagasaki University Graduate School of Engineering, <http://ilem.jp/outline/>



Collaboration Case 2: Research and Development of Implementation in Society of Innovative Advanced Technology for Civil Infrastructure Maintenance

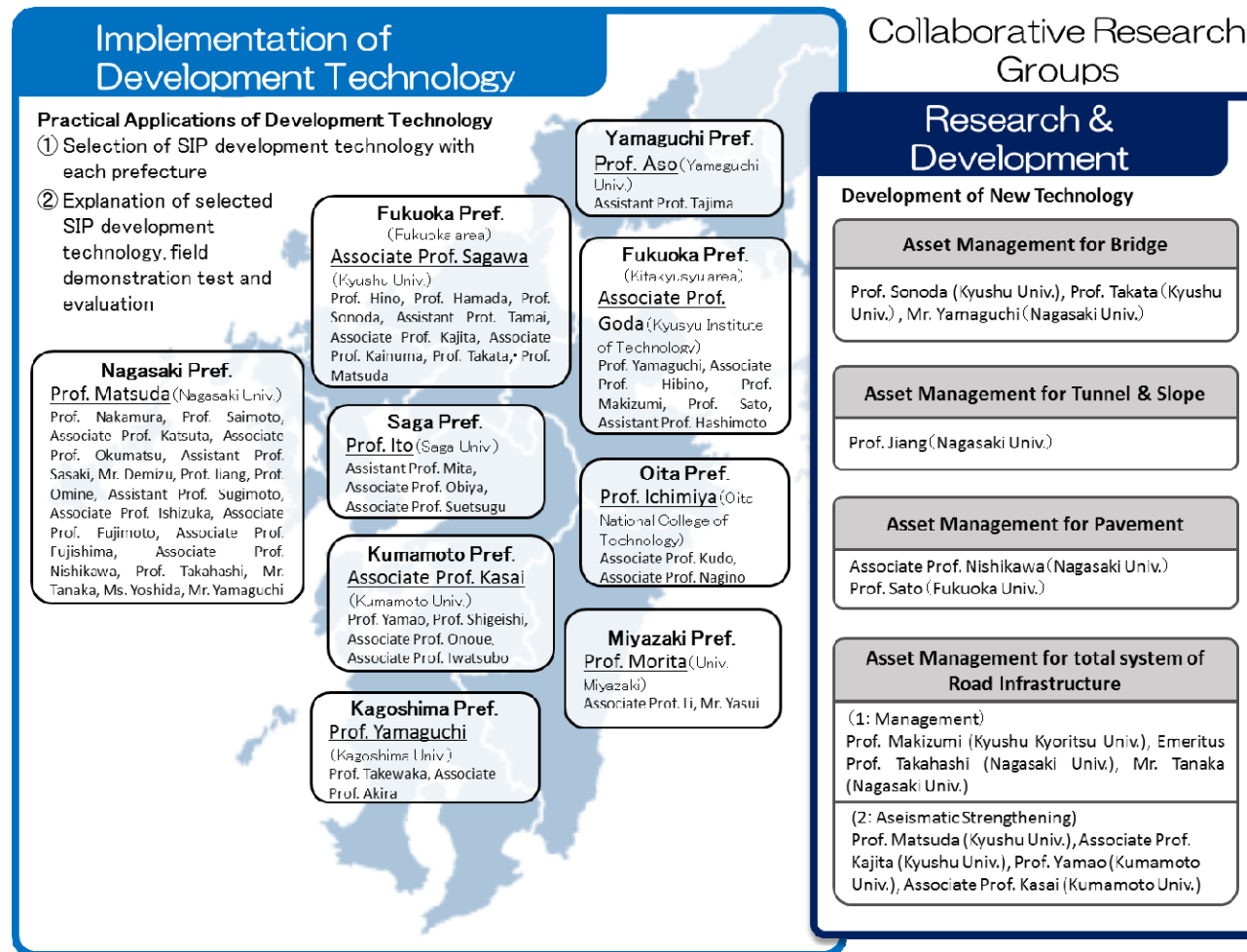
Nagasaki Univ.: Notable experience of advanced research and development for infrastructures lifetime-extending maintenance, human resource development (Michi-Mori project) collaborated with local government, technical advisor for bridge maintenance training

Road Asset Management Collaboration with SIP

Collaboration Case 2: Research and Development of Implementation in Society of Innovative Advanced Technology for Civil Infrastructure Maintenance

Objectives: To grasp needs of the local government and area construction industry about maintenance of public infrastructure facilities in Kyushu Island and Yamaguchi Pref.

To build structure to introduce a new technology through the holding of field demonstration test on SIP development technology



Road Asset Management Collaboration with SIP

JICA collaborates with SIP researchers, who research and develop the most advanced technology for road asset management in Japan, to develop Road Asset Management System (including human resource development) in developing countries. JICA will provide not only technical instruction and advice but also introduction of advanced technology and systems to developing countries through research and development under SIP researchers in Japan.

Project Organization -Infrastructure Maintenance, Renovation and Management-

Program Director



Yozo Fujino
Yokohama National University

* In Japanese syllabary order
* Affiliations are as of December 2016

Sub-PDs



Advisory Committee



Executive Secretaries



Government Ministries



Funding Agencies / Related Ministry



Research Units



List of Research and Development Themes -Infrastructure Maintenance, Renovation and Management-

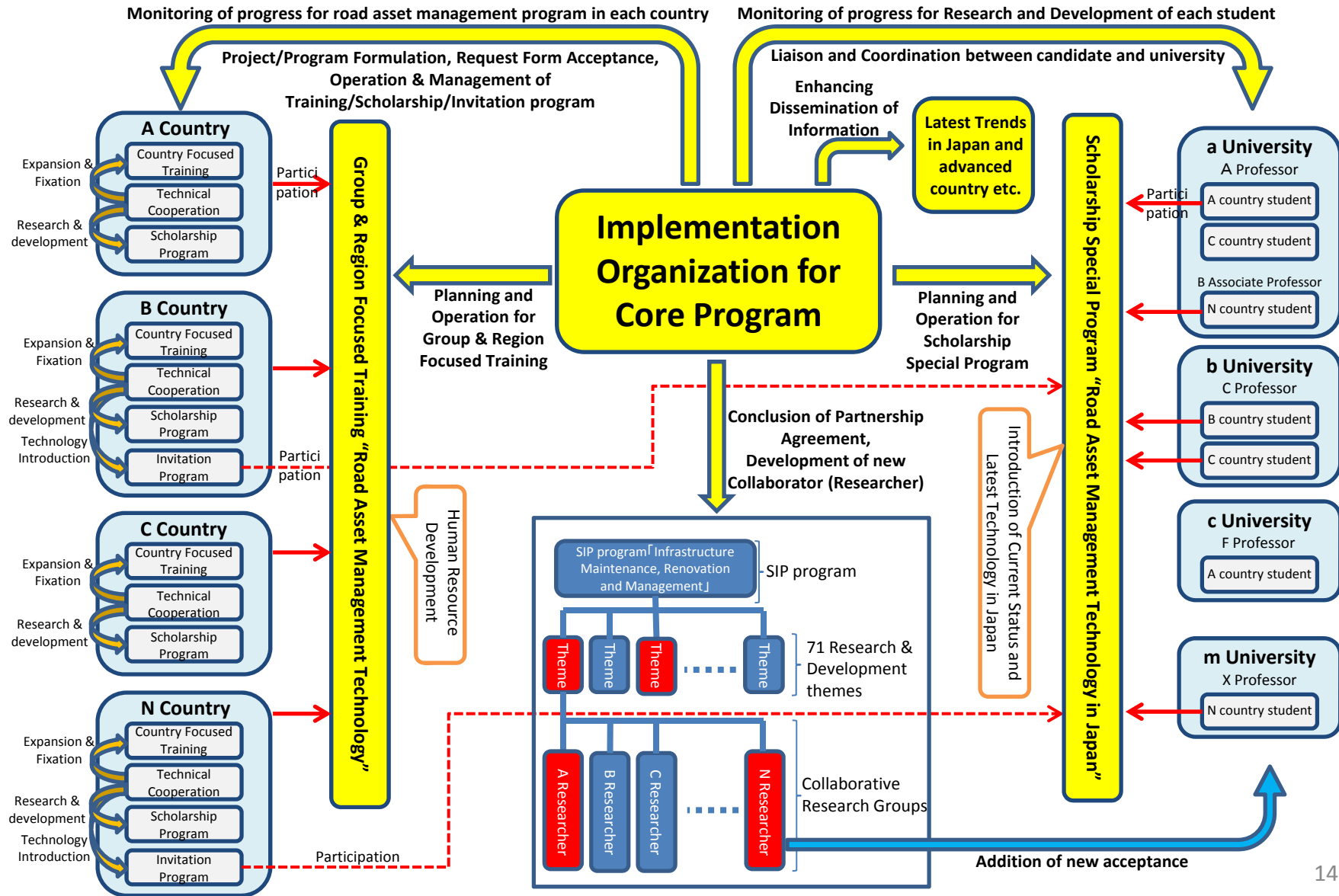
No.	Research and Development Theme	Principal Investigator (Affiliation)
1	Interdisciplinary R&D of NDE Techniques for Innovative Maintenance	Masahito Ishida/Public Works Research Institute
2	Development of Real-time Ultrasonic Visualization Technology for the Degradation Diagnosis of Steel Bridges	Jung Takahara/Tokai University Research Institute
3	Ultrasonic Magnetic Nondestructive Testing for Detection, Evaluation and Grading of Preservation Plan of Infrastructures	Koji Tsukada/Chugai University
4	R&D of Laser Directive Noncontact Diagnosis System for Maintaining Degraded Infrastructures	Kabunso Midorikawa/RIKEN
5	Development of Automatic Technology on Pavement & Environment Survey and Evaluation	Kazuhiko Yamashita/Civil University
6	Non-destructive Inspection of Water Concrete in Concrete	Kang Junghwan/Seoul University (KAIST)
7	R&D of Backscatter X-ray Imaging System for Concrete Inspection	Hiroaki Toyokawa/AIST
8	R&D of Vibration Imaging Radar	Hiroaki Nakano/Advante Technology Inc.
9	New Camera Inspection for Lane Using Rapidly Scanning Noncontact Radar and Synthetic Surroundings Display System	Toku Yasuda/National Institute of Advanced Industrial Science and Technology (AIST)
10	Remote Sensing of Concrete Structure with the High-Sensitive Near-infrared Spectroscopy	Kazuhiko Yumoto/Shueisha Engineering Co., Ltd.
11	R&D of Learning-Type Hammering Echo Analysis Technology	Masahito Murakawa/AIST
12	Inspection and Diagnosis System of Part Structure Using Radio Controlled Boat	Tetsuya Ogasawara/Sumitomo Metal Construction Co., Ltd.
13	Development of the Smart GPR Including a Chip Radar in the Survey of a Cavity and a Settlement of the Backfill Material	Shoji Yamada/KAWASUMI Geological Engineering Co., Ltd.
14	Development of the Monitoring System for Port Facilities Using Satellite and SONAR	Takashi Nishitani/Penta-Ocean Construction Co., Ltd.
15	Monitoring by using Ground-based Synthetic Aperture Radar and Airborne Ground Penetrating Radar	Mitsuyuki Saito/Tokai University
16	Monitoring System for Road (Shoulder) Hole Inspection, Shoring, and Repair Using Automatic Hole Inspection Image	Toku Yasuda/Product Co., Ltd.
17	R&D of the Crack Detection System for Runways with a 3D Camera and an Orientation-rectifying Robot	Yasuo Kimura/NTT Advanced Technology Corp.
18	R&D of a Simplified System for Monitoring the Airport Pavement Surface Using Maintenance Vehicles	Yusaku Ishikawa/The University of Tokyo
19	Development of Risk-based Decision Making for Early Detection/Correction of Damage of Civil Engineering Structures using Mobile DR	Naoki Ono/National Institute of Land and Infrastructure Management
20	Understanding the Seismic Situation by ABE (Artificial Neural Network)	Hiroaki Sakahara/PASCO Corp.
21	R&D of Monitoring System for Bridge Performance Assessment Based on Vibration Mode Analysis	Tatsuo Kawata/Chiba City University
22	Creation of Monitoring System Using with Mobile Camera and etc. for Bridge Inspection	Tetsuya Fujimori/Sumitomo Metal Construction Co., Ltd.
23	R&D of Quantitative Evaluation System of Cracks on Diaphragm Girders by Digital Image Analysis Technology	Naohiro Higuchi/Taisei Corp.
24	Field Validation of the Continuous Remote Monitoring System with Power saving Wireless Sensor	Hiroaki Nakano/Onion Social Solutions Co., Ltd.
25	R&D of the Technology which Monitors the Degradation Rate of an Asphalt Structure with High Accuracy and Efficiency	Minoru Maruyama/NEC Corp.
26	R&D of Monitoring System for Detecting Surface Failure by using Pressure Sensor and Inclinometer	Yasuoaki Shoji/OYO Corp.
27	R&D of Early Warning Monitoring System of Slope Failure using Multi-sensor Data Change and Volumetric Water Content	Lin Wang/Chun Kakuha Co., Ltd.
28	Mass Small-Area High Resolution System Attached to Large Wearing Machine	Kiyoshi Suzuki/Aomi Asahi Corp.
29	Electric Resonance Monitoring System for the State of Water Contents in River Levees	Hiroaki SAKAMOTO Corp.
30	R&D of Monitoring System Including a Detection of River Levee Defection	Shinji Kitayama/University of Tsukuba
31	Effective Use of Satellite SAR Observation for River Embankment	Takashi Katsuyama/Infrastructure Development Institute
32	Monitoring System for Internal State of River Levees using Geophysical Exploration and Ground Water Observation	Akiyo Shimizu/OYO Corp.
33	Improvement for More Advanced and Efficient Road Structure Maintenance using Monitoring Technology	Naoki Homma/Research Association for Infrastructure Monitoring System
34	Maintenance and Management of Social Infrastructure utilizing IT (Inspection, Diagnosis)	Ministry of Land, Infrastructure, Transport and Tourism
(2) Structural Analysis, Design, and Reinforcement Technology		
35	Development of Mechanism of Infrastructures and Materials Technology for Efficient Maintenance	Kunishi Toshihiro/NEDO
36	Developing Hybrid Mechanism-based Materials for Visualization of Structural Health	Chao-Nian Kuo/AIST
37	Technology of Repairing the Concrete Damage and Detachment to Steel Structures using Newly Developed Flame Coating Material	Naoki Higashi/Chiba Prefecture University
38	Practical Practical Application of PCA Repair System for Concrete Cracks	Toshiaki Aguiwa/Osumi University
(3) Information and Communications Technologies		
39	Search, Update and Information Using Mobile on Edge Sensor (Edge Sensor-based Information Search and Update)	Masataka Saito/NTT Research Science Co., Inc.
40	R&D on Technologies for Collecting, Transmitting, and Processing Sensing Data of Civil Infrastructures (Unmanned Structures)	Shunichi Yamashita/NTT
41	R&D of Integrated Data Management Platform for Civil Infrastructure Smart City	Jun-ichi National Institute of Information and Communications Technology
42	Development of Technologies on Wide Variety of Data Processing, Storage, Analysis and Application to Allow Advanced Infrastructure Management	Naoki Ueda/National Institute of Information and Communications Technology
43	R&D on Data Storage/Management/Utilization Technologies for a Variety of Data Relating to Maintenance and Repairment of Civil Infrastructures	Toshihiro Kugata/Hitachi, Ltd.
(4) Robotics Technologies		
44	Development of Infrastructure Inspection System using Semi-autonomous Multi-robot equipped with Flexible Self-driving/Drive Device	Tadashi Hasegawa/NTT Institute of Technology
45	R&D of Diagnostic Technology Based on Measurement and Analysis for Multi-robot	Toshiyuki Kudo/Mech-U-Unit
46	Development of Intuitive Teleoperation Robot using the Human Measurement	Shigenori Ego/Waseda University
47	Development of Bridge Inspection Robot System Supported by the Provision and Flexible Scaffolding Structure	Shigenori Hasegawa/NTT Corp.
48	R&D of Flying Robot for Bridge Tunnel Inspection	Toshiyuki Nakamura/NEC Corp.
49	R&D of the Vehicle Guide Frame Vehicle for Inspection of Tunnel	Satoru Nakamura/Tokai Construction
50	Development of Unmanned Aerial Vehicles for Observing and Monitoring Aged Bridges at Short Range	Kazumasa Ohno/Tokai University
51	R&D of a Multi-robot System with Visual Observation and Monitoring Tool Device	Hiroaki Watanabe/Nondestructive Testing Inspection Co., Ltd.
52	Development of Bridge Inspection Support Robot System that uses Priority Charging with Charging and Two-wheeled Driving Robot	Hiroaki Sawashita/Hitachi, Ltd.
53	New Development of Unmanned Construction - Realization of Remote Operated Working System in Shallow Water Area-	Shinichi Yabuta/Unmanned Construction Technology Research Association
54	Research and Development of Infrastructure Structures and Inspection Devices for Advanced Inspection of Civil Infrastructures	Kazuyuki Iijima/Waseda University
55	Research and Development of Remote-based Real-time Data Transfer Method and Breakdown Data Log using Drone-based Inspection	Shinichi Yabuta and Research with Public Works Research Institute
56	Establish a Utilization System of Robotics Information for Civil Infrastructures	Ministry of Land, Infrastructure, Transport and Tourism
(5) Asset Management Technologies		
57	Research on the Management Cycle of Road Infrastructures	Shinichi Yamashita/University of Tsukuba
58	Realization of the Management Cycle of Road Infrastructures by using Smart Road to Monitor and Control Traffic Flow	Kazuhiko Yamashita/National Institute of Information and Communications Technology
59	Development of the Cycle Management System for Road and Highway Facilities - Integrated Framework from Inspection to Assessment	Osamu Nishimura/Institute of Materials and Chemical Technology
60	R&D of Development of Strategic Asset Management Technologies for Trans-Agriculture Water Facilities	Yasuo Nakamura/National Agriculture and Food Research Organization
61	Research on Regional Cooperation for Applications of Asset Management for Civil Infrastructures	Yasuhiro Takematsu/Hokkaido University
62	Development of a Regional Autonomous System as Next-generation Water Infrastructure Management	Ran Uchiyama/Hokkaido Research Organization
63	Establishment and Promotion of the "Public Infrastructure Management Platform"	Manabu Hasegawa/Tokai University
64	Implementation of Effective SIP Maintenance Technologies by the MR Network	Yoshitaka Nakamura/Tokai University
65	Development of Infrastructure Maintenance in Korean-Honshu Regions and Actual Deployment of New Technologies	Hiroaki Furuta/Kanazawa University
66	Development of Civil Infrastructure Maintenance Systems for Local Governments through Multi-phase Diagnosis	Yamamoto Kazuo/Tokai University
67	Development of Local Government Support System (Based on Smart City)	Shinichi Yamashita/University of Tsukuba
68	Research and Development of Infrastructure - Equity of resource Allocation Technology for Civil Infrastructure Maintenance	Hiroaki Nakano/Chiba University
69	Development of Bridge Maintenance Technologies for Suburban Islands and Training Diagnostic Experts	Yasunori Arima/University of the Ryukyus
70	Research on the Technology for Improving the Maintenance Management System and Improving the Efficiency of Maintenance	Naoki Homma/Research Association for Infrastructure Monitoring System
71	Research and Development Concerning Introduction of Asset Management Technologies to Local Governments, etc.	Toshihiko Odo/Japan Foundation for Regional Vitalization

Collaborative Research and Development Theme

- Global Research and Development on the Management Cycle of Road Infrastructures
- Research and Development of Implementation in Society of Innovative Advanced Technology for Civil Infrastructure Maintenance
- Research, Development, and Social Implementation of Screening Technologies on Pavement and Bridges based on Large-scale Sensor Information Fusion toward Preventive Maintenance of Infrastructure

13

Road Asset Management Operation and Management System



Road Asset Management Target Country/Area

Basic Policy: Input Scholarship program and Country focused Training after the completion of JICA's Technical Cooperation Project, which provides basic knowledge and technology for Road Asset Management (PDCA cycle for Maintenance) to developing country

JFY2017: Trial case

Cambodia and Lao PDR: Scholarship program

Vietnam: Country focused Training “ Road Asset Management Training”

JFY2018: Full-scale start

Philippines, Bangladesh, Pakistan and Ethiopia: Scholarship program / Country focused Training

Mongolia and Egypt: Scholarship program

JFY2019:

Myanmar, Bhutan, Kyrgyzstan, Kenya: Scholarship program / Country focused Training

Thank you for your kind attention.