Dialogue

Cross-Ministerial Strategic Innovation Promotion Program (SIP) "Infrastructure maintenance, renovation and management" ——Promoting investment cycle for infrastructures by private sectors based on collaboration among government, industry and academia ——

Dialogue participants:

Kazuo KYUMA
Executive member, Council for Science, Technology and Innovation, Japan Cabinet Office

Yozo FUJINO
Fellow, SIP Infrastructure Program Director, and Distinguished Professor, Institute of Advanced Sciences, Yokohama National University

Moderator:

Yoshio Tateishi
Editorial Chairman, Journal of JSCE

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Yozo FUJINO
He graduated from the University of Tokyo in civil engineering in 1972, and completed his master's degree there in 1974. He completed the doctoral program at the University of Waterloo in 1976 (Ph.D.). After serving as assistant at the University of Tokyo Earthquake Research Institute, and as assistant and lecturer at the University of Tsukuba Institute of Structural Engineering, he served as assistant professor at the University of Tokyo Department of Civil Engineering, and became a professor in that department in 1990. He is now a professor emeritus of the University of Tokyo. He assumed his present position in 2014.

Kazuo KYUMA
He graduated from Tokyo Institute of Technology in electronic engineering in 1972, and completed his master's degree and the doctoral program there in 1974, 1977 respectively. He joined Mitsubishi Electric Corporation in 1977. He served in various positions there, including Director of the Advanced Technology R&D Center, Executive Officer, and Vice President. He became a full-time Executive Member of the Council for Science, Technology and Innovation of the Cabinet Office in 2013, and assumed his present position in 2014.

JSCE invited Dr. Kazuo Kyuma, who is an executive member of the Council for Science, Technology and Innovation and chairman of the governing board of the Strategic Innovation Promotion Program (SIP), and Dr. Yozo Fujino, who is Program Director (PD) of the Infrastructure Maintenance, Renovation and Management Program (SIP Infrastructure Program) and a distinguished professor at Yokohama National University, to discuss SIP,

advances in research and development at the SIP Infrastructure Program, and their outlook for the future.

Government ministries and agencies concerned with business development to promote economic revitalization in Japan; collaborative project by industry, academia, and government

Moderator:

First, could you give us an overview of SIP and an explanation of its goals?

Kyuma:

SIP is a program that was created by the Cabinet Office to promote innovations in science and technology, by removing the traditional boundaries of sectors and government ministries. It is led by the Council for Science, Technology and Innovation (CSTI).

At the Prime Minister Abe's inauguration, he declared his intention to promote innovation as a means of restoring Japan to its position as one of the world's leading countries. To accomplish this, it is important to break down the barriers and promote open communication among government ministries and agencies, and among industry, academia, and government. In the industrial sector, companies with good collaboration among their business divisions are strong, while companies that are divided are weak, even if they are large in scale. Therefore, the decision was made to promote this project through collaboration among government ministries and agencies and collaboration among industry, academia, and government.

Leaders play an important role in this. We appointed people representing each field from industry, universities, and other sectors to serve as PDs for comprehensive promotion from basic research to practical applications. SIP is a program that was launched with the strong determination that its scope would go beyond the establishment of basic technologies and human resource development to include business development as well.

The plan was adopted in 2013, and SIP was launched as a five-year program starting the next year. The Cabinet Office budgeted 50 billion yen per year as funding for the promotion of science, technology, and innovation. Of this amount, 17.5 billion yen was earmarked for the medical and health care sector, and the remaining 32.5 billion yen for SIP. Because this is to continue for five years, the total is quite an impressive sum. CSTI has been making its own budget allocations and engaging in the entire process from basic research to practical outcomes.

SIP is addressing issues in a total of 11 areas, including "enhancing resiliency against natural disasters" and "structural materials for innovation." Dr. Fujino is PD for the area of "infrastructure maintenance, renovation, and management technologies."

Expanded use of ICT in infrastructure maintenance can resolve social issues while promoting economic growth

Moderator:

What was the reasoning behind the decision to include infrastructure as one of these issue areas?

Kyuma:

Infrastructure maintenance is important in both resolving social issues and promoting economic growth. For example, when accidents like the Sasago Tunnel collapse and large-scale natural disasters take place, in addition to injuries and loss of life, there are enormous increases in expenditures amid Japan's current financial difficulties. Therefore, it truly serves the national interest to deal with these kinds of problems in advance in order to improve people's safety and security and minimize the damage.

In addition, I have high expectations for the industrialization of these infrastructure maintenance techniques. I hope that the maintenance technologies established through SIP will be utilized in industrial development when these technologies are exported to emerging countries that will experience similar needs to those of Japan in the future.

Fujino:

At first, I was surprised when I heard that the Cabinet Office was going to get involved in infrastructure. However, I myself had experienced joint research with private companies in another industry for almost 10 years in the past, and when I found out that this program would involve cross-ministerial collaboration and collaboration among industry, academia, and government, I felt intuitively that this is definitely a subject to be addressed with regard to infrastructure. That was why I applied to become the PD.

Kyuma:

It is not feasible for infrastructure maintenance to be handled by the Ministry of Land, Infrastructure, Transport and Tourism and the construction industry alone. For example, in bridge inspection, a bridge is checked and measured to detect deterioration, the findings are analyzed, and based on the results, a decision is made to continue routine maintenance, perform repairs, or replace the bridge. That series of system operations requires knowledge of not only civil engineering, but also electronic engineering, information engineering, measurement engineering, and materials engineering. That is why it's important to gather top-notch scientists from each area to solve problems together.

The rigor of strict evaluations by a governing board

Moderator:

What is the system by which the results of SIP are evaluated?

Kyuma:

The governing board, which consists of the eight executive members of CSTI, holds meetings as needed with participation from outside experts as well, and provides advice and evaluations in all of the issue areas. I am the chairman of the governing board, and I provide the evaluators with criteria to use in conducting strict evaluations.

The evaluation criteria include specific plans and roadmaps from basic research to practical application, and the evaluators determine whether steady progress is being made in accordance with those guidelines. Budget allocation for the next fiscal year is based on the evaluation results, and programs earning a high score may get a 20% or 30% increase while programs with a low score may see their funding cut by half.

Every PD is highly qualified, and if a PD receives a lower evaluation one year, they will revise their organization based on the evaluation results and advice, improve their

program, and achieve better results by the next year. Therefore, the evaluation mechanism of SIP seems to be functioning well. This is the first national project ever implemented in Japan that provides such thorough evaluation and follow-up for programs.

Moderator:

Have any issue areas actually been discontinued?

Kyuma:

We have never discontinued an entire program, but several projects within the programs have been ended.

This kind of mechanism for strict evaluation is normal in the industrial sector, and companies cannot be successfully managed without it. The areas and roles are clearly defined in SIP, unlike other existing national projects and national R&D programs. The goal should be comprehensive promotion from fundamental research to practical outcomes, and it is important to be tuned into the practical applications of research findings. If a project has no prospects of leading to practical applications, its evaluation will naturally be lower.

Moderator:

Please explain the organizational framework of the SIP Infrastructure Program.

Fujino:

There are about 60 themes under the SIP Infrastructure Program, a much greater number than the other issue areas under SIP (Table 1). That is because it covers such a wide range; for example, just in the area of inspection technologies, the themes include the use of drones and robots and development of new materials. Based on the development of a large number of individual technologies, the concept is ultimately to integrate them in ways that are useful for infrastructure management (Fig. 1).

There are about 1,200 participants, and it's not always easy to properly get one's ideas across to everyone. Therefore, we hold outcome strategy meetings to gather everyone together once every few months and hear each other's status reports. The goal is for the governing board to share the advice and evaluations that we have received in order to strengthen the sense of solidarity and address the issues with serious resolve. Publishing research findings in journals is not the main purpose. To demonstrate that we have spent taxpayers' money effectively, we need to stay focused on practical outcomes and make sure that the research findings are utilized. That has been our approach in the past, and we will continue to maintain this emphasis in the future.

Table 1. List of Themes under the SIP Infrastructure Program
(http://www.jst.go.jp/sip/k07.html)

	Sub-theme	No.	Research and Development Theme	Principal Investigator (Affiliation)	Managing organization
(1) Inspection, Monitoring and Diagnostics Technologies	(1)-(A)-a	1	Interdisciplinary R&D of NDE Techniques for Innovative Maintenance	Masahiro Ishida (Public Works Research Institute)	JST
		2	Development of the Laser Ultrasonic Visualization Technology for the Degradation Diagnosis of Steel Bridges	Junji Takatsubo (Tsukuba Technology Co., Ltd.)	JST
		3	Ultrasensitive Magnetic Nondestructive Testing for Deterioration Evaluation and Creating a Preservation Plan of Infrastructures	Keiji Tsukada (Okayama University)	JST
		4	R&D of Laser Directive Noncontact Diagnosis System for Maintaining Degraded Infrastructures	Katsumi Midorikawa (RIKEN)	JST
	(1)-(A)-b	5	Development of Automatic Technology on Pavement & Embankment Survey and Evaluation	Atsushi Yashima (Gifu University)	JST
		6	Non-destructive Inspection of Rebar Corrosion in Concrete	Kenji Ikushima (Tokyo University of A&T)	JST
		7	R&D of Backscatter X-ray Imaging System for Concrete Inspection	Hiroyuki Toyokawa (AIST)	JST
		8	R&D of Vibration Imaging Radar	Hitoshi Nohmi (Alouette Technology Inc.)	JST
	(1)-(B)	9	Inner Defects Inspection for Tunnel Lining using Rapidly Scannable Non-contact Radar and Synthetic Soundness Diagnosis System	Toru Yasuda (Pacific Consultants Co., Ltd.)	NEDO
		10	Remote Sensing of Concrete Structure with the High-Sensitive Near-infrared Spectroscopy	Kazuhiro Tsuno (Shutoko Engineering Co., Ltd.)	NEDO
		11	R&D of Learning-Type Hammering Echo Analysis Technology	Masahiro Murakawa (AIST)	NEDO
	(1)-(C)	12	Inspection and Diagnosis System of Port Structure Using Radio Controlled Boat	Tetsuya Ogasawara (Penta-Ocean Construction Co., Ltd.)	NEDO
		13	Development of the Special GPR Including a Chirp Radar in the Survey of a Cavity and a Settlement of the Back-fill Material	Shigeji Yamada (KAWASAKI Geological Engineering Co., Ltd.)	NEDO
		14	Development of the Monitoring System for Port Facilities using Satellite and SONAR	Takeshi Nishihata (Penta-Ocean Construction Co., Ltd.)	NEDO
		15	Monitoring by using Ground-Base Synthetic Aperture Radar and Array-type Ground Penetrating Radar	Motoyuki Sato (Tohoku University)	NEDO
		16	Monitoring System for a Round of Airport Paved Road Inspection, Utilizing a Technique for Detecting Cracks Automatically from High-resolution Images	Toru Hara (Alpha Product Co., Ltd.)	NEDO
		17	R&D of the Crack Detection System for Runways with a 3D Camera and all Direction-moving Robot	Yasuo Kimura (NTT Advanced Technology Corp.)	NEDO
		18	R&D of a Simplified System for Monitoring the Airport Pavement Surfaces Using Maintenance Vehicles	Yusho Ishikawa (The University of Tokyo)	NEDO
	Direct execution by MLIT	19	Development of Wide Area Displacement Monitoring for Early Detection of Deformation or Damage of Civil Engineering Structures using Satellite SAR	Masafumi Kondo (National Institute for Land and Infrastructure Management)	MLIT
		20	Understanding the Scouring Situation by ALB (Airborne Laser Bathymetry)	Hiroaki Sakashita (PASCO Corp.)	MLIT
		21	R&D of Monitoring System for Bridge Performance Assessment Based on Vibration Mode Analysis	Tadao Kawai (Osaka City University)	MLIT
		22	Creation of Monitoring System using Equipment with Robotic Camera and etc. for Bridge Inspection	Yasuhisa Fujiwara (Sumitomo Mitsui Construction Co., Ltd.)	MLIT
		23	R&D of Quantitative Evaluation System of Cracks on Distant Slabs by Digital Image Analysis Technology	Kenichi Horiguchi (Taisei Corp.)	MLIT
		24	Field Validation of the Continuous Remote Monitoring System with Power saving Wireless Sensor	Hideshi Nishida (Omron Social Solutions Co., Ltd.)	MLIT
		25	R&D of the Technology which Monitors the Displacement Rate of an Artificial Structure with High Accuracy and Efficiency	Minoru Murata (NEC Corp.)	MLIT
		26	R&D of Monitoring System for Detecting Surface Failure by pore Pressure Sensor with Inclinometer	Yasunori Shoji (OYO Corp.)	MLIT
		27	R&D of Early Warning Monitoring System of Slope Failure using Multi-point Tilt Change and Volumetric Water Content	Lin Wang (Chuo Kaihatsu Corp.)	MLIT
		28	Mole (Small Animals) Hole Detection System Attached to Large Weeding Machine	Kiyoshi Suzuki (Aero Asahi Corp.)	MLIT
		29	Electric Resistivity Monitoring System for the State of Water Contents in River Levee	Hideki Saito (OYO Corp.)	MLIT
		30	R&D of Monitoring System Including a Detection of River Levee Deformation	Shunsuke Sako (Japan Institute of Country-ology and Engineering, General Incorporated Foundation)	MLIT
		31	Effective Use of Satellite SAR Observation for River Embankment	Takeshi Katayama (Infrastructure Development Institute)	MLIT
		32	Monitoring System for Internal State of River Levee utilizing Geophysical Exploration and Ground Water Observation	Akira Shinsei (OYO Corp.)	MLIT
		33	Improvement for More Advanced and Efficient Road Structure Maintenance using Monitoring Technology	Atsushi Homma (Research Association for Infrastructure Monitoring System)	MLIT
		34	Maintenance and Management of Social Infrastructure utilizing IT (Inspections, Diagnosis)	Ministry of Land, Infrastructure, Transport and Tourism	MLIT
(2) Structural Materials, Deterioration Mechanisms, Repairs, and Reinforcement Technologies	Sub-theme	No.	Research and Development Theme	Principal Investigator (Affiliation)	Managing organization
	(2)-(A)	35	Deterioration Mechanism of Infrastructures and Materials Technology for Efficient Maintenance	Koichi Tsuchiya(NIMS)	JST
	(2)-(B)	36	Developing Hybrid Mechanoluminescence Materials for Visualization of Structural Health	Chao-Nan Xu (AIST)	JST
	(2)-(C)	37	Technology of Repairing the Corrosion Damage and Deterioration to Steel Structures using Newly Developed Flame Coating Material	Kenji Higashi (Osaka Prefecture University)	JST
	(2)-(D)	38	Precast Practical Application of PCa with Super-High Durability Concrete	Toshiki Ayano (Okayama University)	NEDO

(3) Information and Communications Technologies	Sub-theme	No.	Research and Development Theme	Principal Investigator (Affiliation)	Managing organization
	(3)-(A)	39	Research, Development, and Social Implementation of Screening Technologies on Pavement and Bridges based on Large-scale Sensor Information Fusion toward Preventive Maintenance of Infrastructure	Masataka Ieiri (JIP Techno Science Co., Inc.)	JST
		40	R&D on Technologies for Collecting, Transmitting, and Processing Sensing Data of Civil Infrastructures (Underground Structures)	Shuichi Yoshino (NTT)	JST
	(3)-(B)	41	R&D of Integrated Data Management Platform for Civil Infrastructure Sensing	Jun Adachi (National Institute of Informatics)	NEDO
		42	Development of Technologies on Wide Variety of Data Processing, Storage, Analysis and Application to Achieve Advanced Infrastructure Management	Isao Ueda (East Nippon Expressway Co., Ltd.)	NEDO
		43	R&D on Data Store/Management/Utilization Technologies for a Variety of Data Relating to Maintenance and Replacement of Civil Infrastructures	Toshihiro Kujirai (Hitachi, Ltd.)	NEDO
(4) Robotics Technologies	Sub-theme	No.	Research and Development Theme	Principal Investigator (Affiliation)	Managing organization
	(4)-(A)	44	Development of Infrastructure Inspection System using Semi-autonomous Multi-copter equipped with Flexible Electrostatic Adhesive Device	Tadahiro Hasegawa (Shibaura Institute of Technology)	JST
		45	R&D of Diagnostic Technology Based on Measurement and Analysis by Multi-copter	Toshio Fukuda (Meijo University)	JST
		46	Development of Intuitive Teleoperation Robot using the Human Measurement	Shigeki Sugano (Waseda University)	JST
	(4)-(B)	47	Development of Bridge Inspection Robot System Supported by the Provisional and Flexible Scaffolding Structure	Shigeo Hirose (HiBot Corp.)	NEDO
		48	R&D of Flying Robot for Bridge/Tunnel Inspection	Toshihiro Nishizawa (NEC Corp.)	NEDO
		49	R&D of the Variable Guide Frame Vehicle for Inspection of Tunnel	Satoru Nakamura (Tokyu Construction)	NEDO
		50	Development of Unmanned Aerial Vehicles for Observing and Hammering Aged Bridges at Short Range	Kazunori Ohno (Tohoku University)	NEDO
		51	R&D of a Multicopter-based Inspection Robotic System with Visual Observation and Hammering Test Devices	Hideki Wada (Shinnippon Nondestructive Inspection Co., Ltd.)	NEDO
		52	Development of a Bridge Inspection Support Robot System that uses Proximity-images with Geotag and a Two-wheeled Flying Robot	Naoyuki Sawasaki (Fujitsu Ltd.)	NEDO
		53	New Development of Unmanned Construction ～Realization of Remote Operated Working System in Shallow Water Area～	Shin'ichi Yuta (New Unmanned Construction Technology Research Association)	NEDO
	Direct execution by MLIT	54	Research and Development of Infrastructure Structures and Inspection Devices for Advanced Inspection of Civil Infrastructure	Kenichi Fujino (Public Works Research Institute)	MLIT
		55	Research and Development Concerning Mechanized Mobile Object Inspection Methods and Structure Forms that Aim to Save Energy and Improve Accuracy of Inspection	(Changed to Joint Research with the Public Works Research Institute)	MLIT
		56	Establish an Unification System of Robotics Information for Civil Infrastructure	Ministry of Land, Infrastructure, Transport and Tourism	MLIT
(5) Asset Management Technologies	Sub-theme	No.	Research and Development Theme	Principal Investigator (Affiliation)	Managing organization
	(5)-(A)	57	Global R&D on the Management Cycle of Road Infrastructures	Koichi Maekawa (The University of Tokyo)	JST *
		58	Resolution of Early-aged Deterioration Mechanism & Development of Total Management System Based on Evaluation for Material and Structure Quality Performance	Kazuyuki Torii (Kanazawa University)	JST *
	(5)-(B)	59	Development of Life-cycle Management System for Port and Harbour Facilities - Integrated Framework from Inspection to Assessment	Ema Kato (National Institute of Maritime, Port and Aviation Technology)	JST
		60	R&D of Development of Strategic Asset Management Technologies for Trunk Agricultural Water Facilities	Isamu Nakajima (National Agriculture and Food Research Organization)	JST
	Regional implementation support team (including *)				
	(5)-(C)-a	61	Research on Regional Cooperation for Applications of Asset Management for Civil Infrastructures	Yasushi Takamatsu (Hokkaido University)	JST
		62	Conversion to a Regional-Autonomous System as Next-Generation Water Infrastructure Management	Ken Ushijima (Hokkaido Research Organization)	JST
		63	Establishment and Promotion of the Tohoku Infrastructure Management Platform	Makoto Hisada (Tohoku University)	JST
		64	Implementation of Effective SIP Maintenance Technologies by the ME Network	Keitetsu Rokugo (Gifu University)	JST
		65	Framework of Infrastructure Maintenance in Kansai/Hiroshima Regions and Actual Deployment of New Technologies	Hitoshi Furuta (Kansai University)	JST
		66	Development of Civil Infrastructure Maintenance Systems for Local Governments Through Multi-Phased Diagnosis	Tamotsu Kuroda (Tottori University)	JST
		67	Development of Local Government Support Systems Focusing on Risks of Serious Accidents	Pang-jo Chun (Ehime University)	JST
		68	Research and Development of Implementation in Society of Innovative Advanced Technology for Civil Infrastructure Maintenance	Hiroshi Matsuda (Nagasaki University)	JST
		69	Development of Bridge Maintenance Technologies for Subtropical Islands and Training Diagnostic Experts	Yasunori Arizumi (University of the Ryukyus)	JST
	(5)-(C)-b①	70	Development of Models for Improving Service Life of Civil Infrastructures Through Cooperation between Business Administration, Science and Engineering, and Economics	Atsuomi Obayashi (Keio University)	JST
	(5)-(C)-b②	71	Research and Development Concerning Introduction of Asset Management Technologies to Local Governments, etc.	Toshihiko Doi (Japan Foundation for Regional Vitalization)	JST

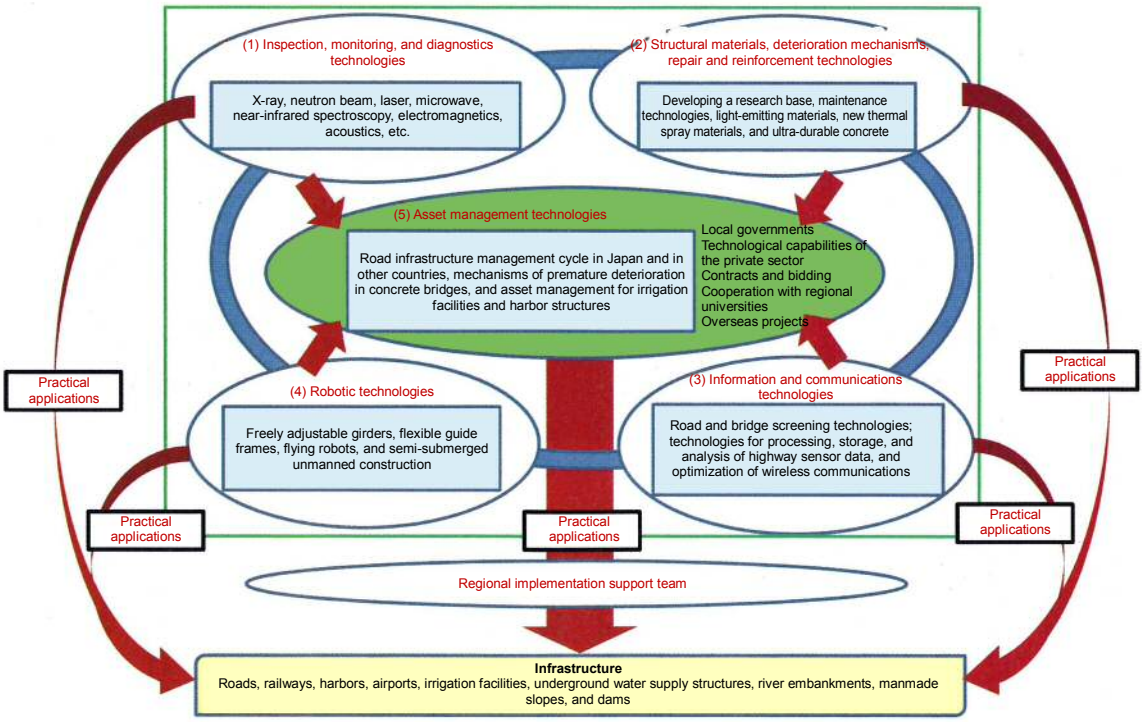

Fig. 1. Relationships among R&D topics in the SIP Infrastructure Program

Development of "Society 5.0" (super-smart society) by integrating cyberspace with physical space

Moderator:

Looking back on the past three years, how would you describe the progress that has been made?

Kyuma:

Overall, I think that the results have generally been in line with our expectations.

However, even though the budget of SIP is large, it still only accounts for a few percentage points of the national budget. I recognize that the challenge in the future will be to expand this kind of program throughout Japan.

Fujino:

I feel that the effort we have put into overcoming difficulties in the SIP Infrastructure Program has been worthwhile. For example, a drone for use in bridge inspection initially would fall in the slightest wind, but after repeated improvements by the developers, it is now stable even at a wind speed of 10 m/s. It's good news that the Ministry of Land, Infrastructure, Transport and Tourism is considering a system that would use this technology to support inspections. This is creating a positive cycle, in the sense that technological development is being advanced and practical applications are gradually emerging.

Moreover, the evolution of science and technology is being absorbed better than we had anticipated in some respects. SIP is not characterized by a rigid approach of only pursuing its initial goals; instead, we can adapt to changes in society and technology by

changing the content and goals of development. For example, we did not initially consider using artificial intelligence (AI), but there is already a new move to incorporate AI into technologies to make them easier to use.

Kyuma:

As you know, the Fifth Science and Technology Basic Plan was started last April. The plan was developed cooperatively by government ministries, industry, and academia, with CSTI playing a central role. This is the first time that industry has participated fully in formulating the basic plan.

The plan makes the proposal of "Society 5.0" as a fifth kind of society after the hunter-gatherer society, agricultural society, industrial society, and information society. This is the new concept of making maximal use of information and communications technologies (ICT) in order to build a human-centered society by combining economic growth with resolution of issues in society. This will be achieved by integrating cyberspace and physical space (the real world) to create new value in industry and social systems.

In Society 5.0, our society will be able to provide the necessary products and services to the people who need them, at the times when they need them, and in the required amounts. This "super-smart society" is defined as a society where all people can obtain high-quality services and live a vibrant and comfortable life, regardless of differences such as age, sex, region, and language.

ICT will be the key to success. Databases and information processing technologies such as AI will be developed as the two fundamental components for realizing Society 5.0. As sensor data is obtained from physical spaces, it will be analyzed and the results will be fed back into physical spaces to control robots and equipment and help to guide human behavior, resulting in cyber-physical systems. An important task for the future will be to identify the useful portions of vast amounts of data and arrange them into new unified data formats (Fig. 2).

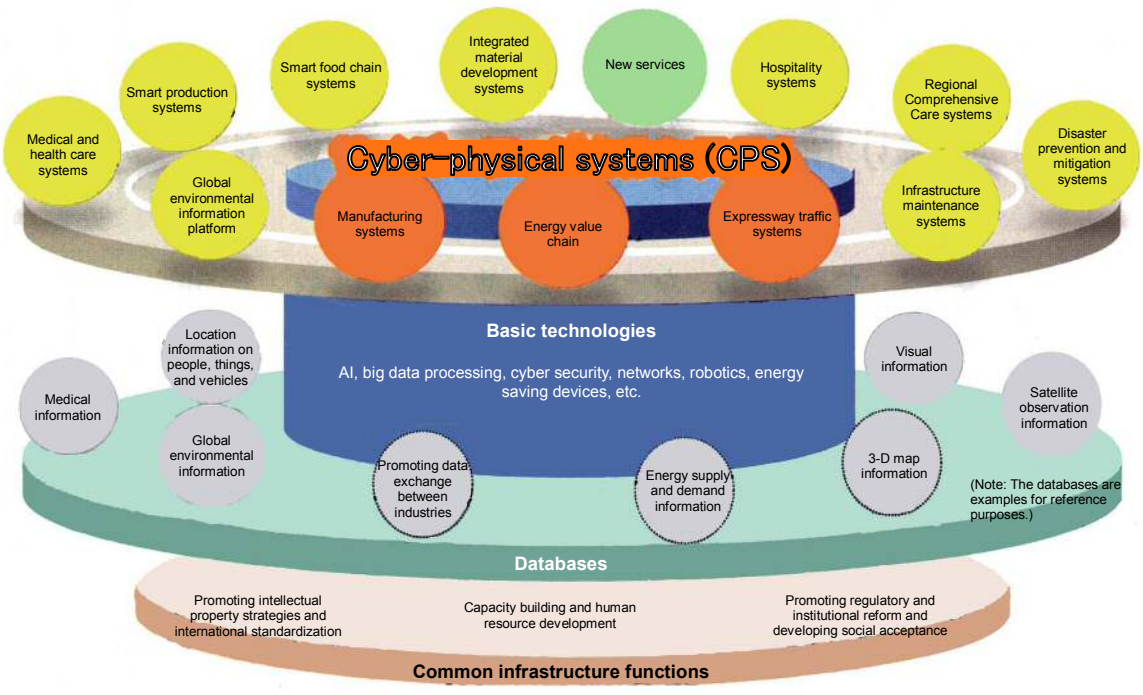

Fig. 2. Building a platform for "Society 5.0"

Fujino:

Self-driving vehicles and disaster prevention, mitigation, and resilience are some of the areas of infrastructure that are closely related to the Internet of Things (IoT). For example, map data is needed when driving a car, but it is not very cost-effective to develop map data only for the sake of driving. The value of map data can be increased by adding various types of information, so that it can also be used for other purposes such as infrastructure maintenance and disaster evacuation. This results in a positive cycle where value is increased, resulting in greater numbers of users. Collaboration among SIP programs is also important in this sense.

Certification of new technologies and developing a base for ongoing practical applications

Moderator:

What steps will be taken during the two remaining years in the SIP Infrastructure Program to promote practical applications?

Fujino:

The Ministry of Land, Infrastructure, Transport and Tourism this year began considering the establishment of a technology certification program that would apply not only to SIP but to all new technologies. It is difficult for a new technology to be adopted in the real world unless its reliability is guaranteed. People from the Ministry of Land, Infrastructure, Transport and Tourism participated in our group, and as a result of this communication, they have also recognized the need for technology certification. I anticipate that our technologies will be applied more widely after receiving this kind of certification.

Another measure involves the Regional Implementation Support Teams which were adopted last year. Local governments are responsible for managing about 80% of infrastructure, and to promote the adoption of technologies developed by SIP, it is important to take regional circumstances into consideration. In the past, universities and other institutions have cooperated with local governments in their own regions to extend the usable lifetime of infrastructure; and we have created a mechanism by which these universities can provide technical support to local governments.

Of course, it is essential to develop technologies that they will actually want to use, rather than simply assuming that they will use anything we develop. For that reason, in an effort to incorporate the views of users, local general contractors and construction consultants have been invited to participate in the development teams.

We are encouraging local governments to try out a variety of approaches to keep expanding the possibilities. My hope is that a small stream of various types of technologies will have begun to flow by the end of the SIP period, and that this stream will eventually grow into a great river.

Kyuma:

I have asked all the PDs to establish a base for the ongoing research and development. For example, if the base is established at the National Research Laboratory, the government should provide grants for administrative and operating expenses, and its

efforts will be able to continue. Without this sort of base, the next project would have to be started from zero again.

Creating a social movement out of the SIP Infrastructure Project; promoting a positive cycle of investment led by the private sector

Moderator:

I have heard about the concept of a new type of SIP. Please explain what that is.

Kyuma:

The new type of SIP is called the Public/Private R&D Investment Strategic Expansion PrograM (PRISM). SIP has been highly evaluated by industry, because this is a national project that is focused on the needs of industry and seriously engaged in the pursuit of practical applications. The first purpose of PRISM is to expand SIP-style management to other government ministries and agencies, instead of being only a program of CSTI.

The second purpose is to expand public-private R&D investment. As you know, Prime Minister Abe has set the goal of boosting GDP to 600 trillion yen. We have proposed in the Science and Technology Basic Plan that R&D investment should be equal to at least 4% of GDP. Of this amount, 3% is to be private investment and the remaining 1% is to be funded by the national government. However, this level of investment has not been reached. To promote greater levels of investment, this second point is intended to expand joint investment by the public and private sectors.

The third purpose is to promote Society 5.0, which we discussed earlier. PRISM will be launched in the coming fiscal year with these goals.

In FY 2018, the first year of PRISM, issues in three target areas will begin to be addressed. These three areas are basic technologies in cyberspace; basic technologies in physical space; and innovative technologies for construction and infrastructure maintenance and disaster prevention and mitigation. There are 10 other candidate target areas as well, and ways to address these are being studied, including the next phase of SIP which is scheduled to begin in FY 2019. Of course, I expect that a portion of the program that is currently led by Dr. Fujino will be taken over by PRISM and efforts toward practical applications will continue.

Moderator:

What is your outlook for the future after the end of the SIP Infrastructure Program, including its relationship to subsequent projects?

Fujino:

I am very glad that the Cabinet Office sees infrastructure as an important priority, and I am also glad that the fruits of our labor so far will be carried over into the next SIP. However, the crucial time for civil engineering is now. The challenge is whether we in the field of civil engineering will be able to engage in collaboration with people from other fields to refine civil engineering technologies. If this is not successful, I think one might as well abandon projects such as SIP that are promoted by the Cabinet Office.

Koi Furuichi, the first president of JSCE, stated that the scope of research should be expanded both vertically and horizontally with civil engineering at its core. The same applies to the innovations of SIP. I believe this is very important.

Kyuma:

To take the standpoint of promoting the national interest through industry, I believe that Japan should seek to create further added value through the use of ICT, in addition to comprehensive development of strong industries including civil engineering. This will involve the introduction of AI in the civil engineering and construction industry. In the next stage, I believe that the establishment of cyber-physical systems should be pursued.

Fujino:

It is important to establish a mechanism whereby the private sector can invest in infrastructure R&D and benefit from its investment. That will result in a cash flow that is not dependent on government funding. It is necessary to expand the SIP Infrastructure Program as a movement that involves the Ministry of Land, Infrastructure, Transport and Tourism and local governments, creating an opportunity for change in administrative workings. I hope that when we look back on it in 10 years, we will be able to say that the SIP Infrastructure Program was the turning point for civil engineering.

Kyuma:

If government ministries and agencies revise their budget allocations and invest in ICT as a priority, production efficiency will increase in all industries and costs will decline, creating more room in the budget. That will enhance motivation for local infrastructure investment. Meanwhile, it is also necessary to train construction workers to improve their ICT literacy. It is important to pursue these kinds of efforts on multiple fronts simultaneously.

If this is done, Japan's finances should improve. If the national and local governments invest more in infrastructure maintenance than they have in the past, it will improve the financial flow to industry in general. I truly hope that the civil engineering and the construction industry will take the lead in this positive cycle.

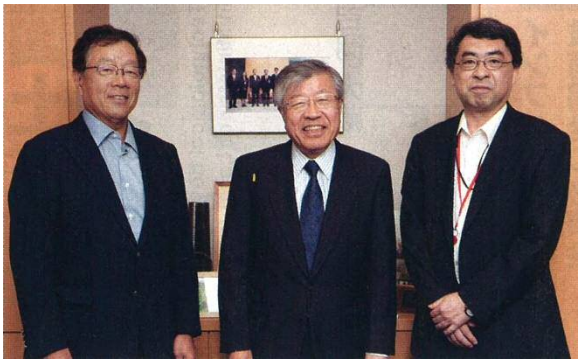

Photo 1 From left: Dr. Fujino, Dr. Kyuma, and Dr. Tateishi

[Article by Mie Mikami]

[Photos by Takuya Omura]

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