Dialogue

Commercialization/industrialization and regional implementation of technology developed by “Infrastructure maintenance, renovation and management” of Cross-Ministerial Strategic Innovation Promotion Program (SIP)

Symposium members:

Keitetsu ROKUGO
Fellow; professor emeritus of civil engineering, Faculty of Engineering, Gifu University

Hiroshi MATSUDA
Member; professor of structural engineering, Systems Science Department, Nagasaki University Graduate School of Engineering

Ken USHIJIMA
Member; chief researcher, Northern Regional Building Research Institute, Hokkaido Research Organization

Makoto HISADA
Member; professor of engineering, Tohoku University Graduate School of Engineering

Pang-jo CHUN
Member; associate professor, Ehime University Graduate School of Science and Engineering

Tetsuhiro SHIMOZATO
Member; associate professor of civil engineering, Faculty of Engineering, University of the Ryukyus

Tatsushi YASUHARA
Member; director for regional planning and networking, policy planning and coordination division for public works project, policy bureau, Ministry of Land, Infrastructure, Transport and Tourism

Moderator:

Yusaku OKADA
SIP Infrastructure Sub-program Director (SPD); professor of administration engineering, Keio University Faculty of Science and Technology

Thursday, April 27, 2017, 12:00 – 2:00 p.m.
Yayoi Auditorium conference room, the University of Tokyo

Strategies on practical outcomes for developed technologies are an important task for the SIP Infrastructure Program. Applicants have been selected to participate in Regional Implementation Support Teams, and these teams have begun promoting utilization of the developed technologies in ways that are suited to regional characteristics, with the cooperation of local governments and universities in their areas. Representatives from each team gathered with representatives of the Ministry of Land, Infrastructure, Transport and Tourism, led by the National Council for Infrastructure Maintenance, to discuss measures to ensure precision and efficiency in infrastructure maintenance.

Keitetsu ROKUGO

He was born in Hiroshima in 1950. After graduating from the Kyoto University Department of Civil Engineering, he completed graduate school and became an assistant there. He joined Gifu University in 1980 and served as a lecturer, associate professor, professor, and department chair. Upon his retirement in 2016, he was named professor emeritus. His specialties are concrete engineering and maintenance engineering.

Hiroshi MATSUDA

He was born in Isahaya, Nagasaki Prefecture, in 1957. After graduate studies in development civil engineering at Kyushu Institute of Technology, he joined University of Nagasaki in 1982 and served as an assistant, lecturer, and associate professor before assuming his current position in 2003. Since 2007, he has also served as director of the Infrastructure Lifetime Extending Maintenance Research Center. His specialties are structural engineering and maintenance engineering.

Ken USHIJIMA

He was born in Saitama in 1975. He completed the doctoral program at Tokyo Institute of Technology in 2007. After working at the Dam Water Resources and Environment Center and serving as assistant professor at Hokkaido University, he assumed his present position in 2015. His research focuses on sustainable water and sanitation infrastructure from a regional management perspective.

Makoto HISADA

After graduating from Kyoto University in 1990, he worked at Konoike Construction Co., then served as assistant at Tokyo Institute of Technology, associate professor at Niigata University, senior researcher at the Public Works Research Institute, and associate professor at Tohoku University before assuming his current position. He has been director of the Infrastructure Management Research Center in the Graduate School of Engineering since 2014.

Pang-jo CHUN

He graduated from the Department of Civil Engineering, University of Tokyo in 2003, obtained his Ph.D. at Wayne State University in 2010, and became an associate professor at the Ehime University Graduate School of Science and Engineering (present position). His specialties are structural mechanics, maintenance engineering, and civil engineering information science.

Tetsuhiro SHIMOZATO

He graduated from the Department of Civil Engineering, University of the Ryukyus in 1991, and completed the master's program in structural engineering at the University of the Ryukyus Graduate School of Engineering in 1993. He joined the Metropolitan Expressway Company in April of the same here and worked there for 15 years before assuming his present position in 2007. Ph.D. (engineering). His specialties are steel structural engineering, bridge engineering, and maintenance engineering (fatigue and corrosion protection).

Tatsushi YASUHARA

He was born in 1971, and began working for the Ministry of Construction in 1995. He served as director of Yamato River Office, deputy director of planning at the Kinki Regional Bureau, and chief researcher of the River Foundation Strategic Maintenance Institute before assuming his present position.

Yusaku OKADA

He graduated from Keio University and completed the doctoral program in engineering at the Keio University Graduate School of Science and Technology. Ph.D. (engineering). He became an assistant in the Department of Administration Engineering at Keio University in 1990, and assumed his present position in 2007. His specialties are human factors, safety management, and technology management.

The Regional Implementation Support Teams were organized with three primary aims. The first is to introduce new technologies for practical use and refine these technologies to take them from being merely usable to a point where practitioners actually want to use them. These teams are expected to play the role of obtaining the views of a wide range of end users and providing the development teams with accurate information on practical applications for the developed technologies.

The second is to provide support in surveys, development, and trials aimed at establishing a business environment for suitable market development in the introduction of various technologies, especially new technologies, for use in infrastructure maintenance. Collaboration with the Ministry of Land, Infrastructure, Transport and Tourism is being considered in this area.

And the third is to establish asset management systems that are suited to regional characteristics in order to form the basis for activities that can contribute to extending the usable lifetime of infrastructure and strengthening Japan's future infrastructure.

Issues and proposals related to infrastructure maintenance will be identified with SIP as the starting point, but the aim is to establish mechanisms by which the regions can address issues of infrastructure maintenance on their own even after SIP has ended, as well as mechanisms to support collaboration so that the regions can help each other.

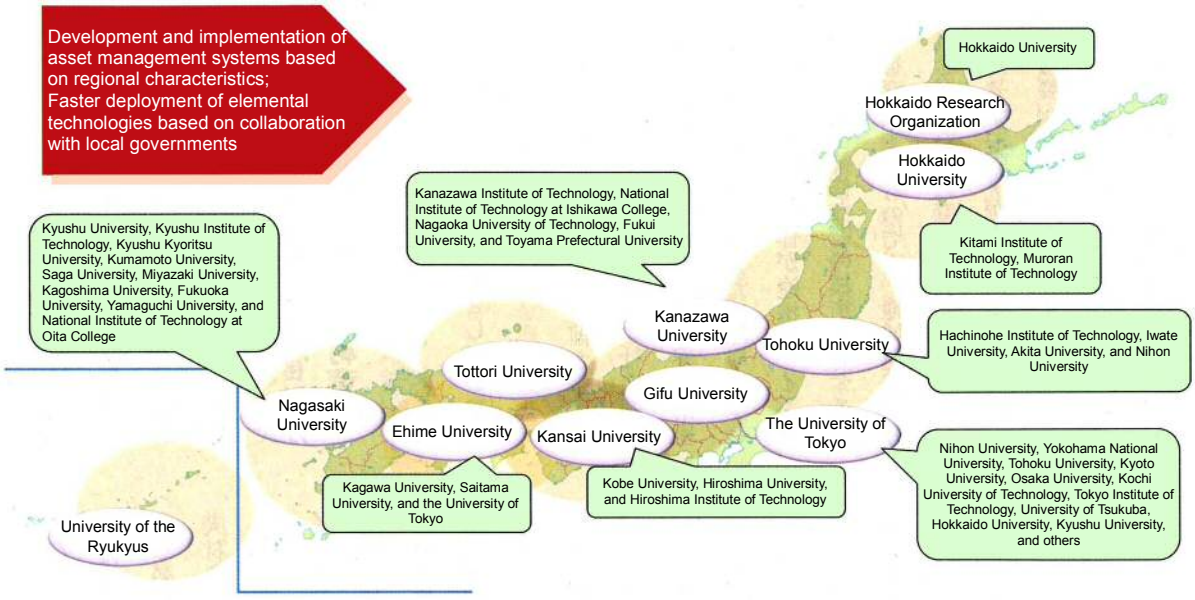

Fig. 1. Regional Implementation Support Teams in the SIP Infrastructure Program

Cooperative human resource development by industry, government, and academia, with universities playing the central role

Moderator:

First, what sorts of activities are the teams doing with regard to human resource development?

Rokugo:

In the case of Gifu, collaboration among industry, government, and academia began 15 years ago, and a training program for infrastructure maintenance experts (ME) was established 10 years ago. Its purpose is to train human resources having the necessary skills for infrastructure inspection and repairs through collaboration among Gifu University, the prefectural government, and organizations related to the construction industry. Human resource development needs to be a key theme when considering the future of regional collaboration, and I believe that universities need to play a central role in these activities.

The ME program provides a venue for engineers with high aspirations to gather together from industry, government, and academia and exchange useful information. I believe that the existence of this framework has contributed to the relatively high level of success in the regional implementation activities of SIP.

Matsuda:

Nagasaki University established the Infrastructure Lifetime Extending Maintenance Research Center in 2007, even before the needs for infrastructure inspection, diagnosis, and preservation had become so pressing. This center prepares human resources to work in the area of road maintenance in a program known as "Michimori." A decade has passed since the center was launched, and graduates of the road maintenance training program had begun to advocate for creating some mechanism to find practical applications for the results of technical development and research, in addition to inspection and diagnosis. So when we heard about support for implementation under SIP, we realized that this would be just right for us and we applied to participate.

The road maintenance training program provides three levels of training: "Michimori," who have the ability for overall road maintenance; "Specified Michimori," who have the ability to diagnose the level of soundness of steel bridges and concrete bridges; and "Assistant Michimori," who have the ability to conduct inspections. In addition, there is a program called "Michimori Auxiliary" which gives the general public an opportunity to help out. Residents can join the "Michimori Auxiliary" by completing about three hours of training, and then if they see some problem with a road, they can send a photo from their smartphone. When this message is received, the university notifies the appropriate road administrator. This is also useful as an awareness-raising activity because it encourages people to watch over and take care of the public civil engineering structures that were built with their tax money.

Chun:

Ehime University started an ME training program in FY 2014, in addition to Gifu University and Nagasaki University. As Dr. Rokugo also mentioned, this program has

gathered people who have very high aspirations, and this naturally has resulted in an environment that facilitates conversations that transcend the barriers of industry, government, and academia. This has been the basis for an emerging trend of interest in establishing venues for discussion between Ehime University and the municipalities of Ehime Prefecture, and meetings for exchange of opinions among universities in the four prefectures of Shikoku, the prefectural governments, and the Shikoku Regional Development Bureau. These kinds of opportunities for discussion have helped to develop a shared awareness among industry, government, and academia of infrastructure for the sake of residents. I find it extremely significant that mechanisms have been put in place for the seamless sharing of views from a wide range of standpoints.

I feel that one of the major achievements of SIP at Ehime University has been the sharing of information that only locals could know, such as "this section is constantly traveled by vehicles loaded right up to the limit," or "this bridge was built as a test of technologies that were new at the time and these problems have arisen," with opportunities to talk with each other about ways to resolve the problems. Sometimes the stated views are quite demanding for SIP members who handle technical development, but these are expressions of the heartfelt desires and hopes of municipalities for new technologies to meet their needs.

Shimozato:

Okinawa is a region of subtropical islands with high temperatures and high humidity, and it experiences a great deal of salt damage. Two bridges have collapsed because of the deterioration caused by said damage.

These bridges did not show obvious damage on the outside, but internally, they were heavily corroded. Nothing was done to stop these bridges from deteriorating so badly that they actually collapsed, because the municipalities did not have any civil engineers to take appropriate measures. SIP is responding to this situation with teams mainly from University of the Ryukyus in two programs: training core human resources, and developing manuals for dealing with recurrent deterioration and repeated repairs.

In the program to train core human resources, a bridge preservation master team has been formed in which administrator engineers and university personnel together observe the structures and perform actual diagnoses. For advanced technologies developed by SIP to be deployed in the field, I believe it is important to incorporate the needs that emerge through this kind of implementation by core human resources, along with statements offered by diagnostic engineers in the field, such as the kinds of data they want to obtain for use in checking proof strength.

Addressing regional issues such as earthquakes, salt damage, and depopulation

Hisada:

In the Tohoku region, the 2011 earthquake struck a severe blow to infrastructure, and there is a sense of crisis as to what future steps should be taken to maintain infrastructure with consideration for its residual damage. In response, the Infrastructure Management Research Center was established in 2014, based on a cooperative agreement for infrastructure maintenance and disaster prevention by Tohoku University and the Tohoku Regional Development Bureau in December 2013. The scope of cooperation has been further expanded since then, and we have signed agreements with 14 organizations, including the prefectural governments of Miyagi and Yamagata.

Since joining SIP in 2016, we have been working to determine the technical needs and requests of local governments and connect them with developed technologies. Unfortunately, maintenance tends to be postponed in the Tohoku region because reconstruction is still the priority there. However, it is possible to introduce new technologies when building new infrastructure, such as the extension of Sanriku Expressway. Still, even within the six prefectures of the Tohoku region, in Akita and Yamagata on the Sea of Japan coast, the fact is that high hurdles still exist for introduction of new technologies.

Shimozato:

We are also working on preparation of an inspection manual that will target salt damage and recurrent deterioration in a way that is close to actual practice. A technical committee of the Okinawa branch of JSCE-West Japan transported some removed bridge members to the University of the Ryukyus and used technologies developed by SIP to investigate the depth of internal damage, and the results will be compiled and related to the residual proof strength. Initially, this will be handled under JSCE, and as more cases of actual bridges are studied, we will develop a manual for this era in which it has become necessary to deal with recurrent deterioration and repeated repairs. Eventually, I would like to see this expanded to include not only the main island of Okinawa, but also remote islands and other countries in Southeast Asia.

Because our region experiences many typhoons, we are also working on using SIP technologies to introduce constant wind stability monitoring for long bridges and fatigue evaluation for road and bridge structures such as light poles.

Ushijima:

Unlike the other teams, our Hokkaido team is specializing in water infrastructure, especially water supply for small rural communities. Homes in Hokkaido have tended to be widely scattered ever since the land was settled, and the population decline in recent years has increased the level of isolation, so the infrastructure is extremely inefficient.

We are collaborating with organizations such as municipalities, NPOs, and individual water cooperatives to implement projects, rather than the Regional Development Bureau. We've just heard about a situation where there were no civil engineers to perform inspections, and the situation is similar with water supply, as some municipalities have only one person in charge. It would be difficult for us to comply with efficiency rules prescribed by the national government with cities in mind.

During the past year, the SIP team has investigated several water cooperatives. Almost all of these have handled management independently, taking care of everything themselves from initially laying the water pipes to repairs. Meanwhile, they have some deficiencies with regard to asset management; for example, they tend to have almost no funds set aside for repairs. In many cases, these water facilities are used in agriculture as well as residential use, but there are differences in the situation of agricultural water for business use versus water for residential use, and problems arise in relation to the allocation of repair costs. Our goal is to provide good support for those needs and make use of local resources in developing a mechanism for maintenance, and we will consider technical development on that basis in relation to SIP technologies.

Promoting interest in civil engineering to increase the future supply of maintenance personnel

Moderator:

You have mentioned several programs for human resource development, including ME training. There is a declining number of young people who will enter civil engineering and supply the human resources that will be needed in the future.

Rokugo:

It is important to create an environment where civil engineering graduates can use their specialization to engage in productive work. Incorporating new technologies, such as those that are being developed by SIP, is one way to make it more interesting.

Chun:

To encourage the introduction of new technologies, I think that it would be good to have incentives in areas such as infrastructure maintenance inspections, so that builders would receive additional points in the evaluation of completed projects ordered by the national government or prefectures. If an environment is created where it is easy for industry, government, and academia to adopt new technologies, and there are mechanisms for that to continue on an ongoing basis, I think the educational systems would also be developed as a result. That, in turn, would also help to increase openness in the civil engineering industry overall.

Matsuda:

In Nagasaki, we began a human resource development association for the construction industry three years ago with collaboration among industry, government, and academia, and we have been working on improving the working environment to attract more young people and providing scholarships to high school students from remote islands who want to attend university for civil engineering.

We are also offering internships to civil engineering students at industrial high schools. The instructors have Michimori qualifications, and the training given to the interns is between the level of Assistant Michimori and Michimori Auxiliary. A good environment has developed there.

Hisada:

In Yamagata Prefecture this year, a new civil engineering department was established at the prefectural industrial technology junior college. This program will provide training in infrastructure maintenance, and advantages are provided for employment within the prefecture. Yamagata previously had no college or university with a civil engineering department, and the program was established in response to urging by the governor, who expressed a sense of crisis regarding infrastructure maintenance. Through collaboration with the civil engineering department, students will be able to learn the latest technologies, including SIP technologies, in their classes; and when they are employed in the field, these technologies are likely to be adopted more widely in the region.

Rokugo:

In prefectures where there is no college or university with a civil engineering department, we need to raise our voices in calling for the establishment of civil engineering departments for the sake of the future of civil engineering.

Hisada:

The Council on Competitiveness-Nippon (COCN) has recommended curriculum changes and restructuring of the curriculum in civil engineering education at universities in order to cover new areas, such as "i-Construction" and productivity improvement technologies, in addition to conventional areas of the curriculum, such as structural dynamics and materials. They recommended similar changes at high schools, and another idea is for departments to develop a curriculum that focuses on developing human resources with an interest in information and communications technology (ICT), as well as conventional civil engineering departments.

Shimozato:

From the standpoint of human resource development, another problem is that the price of maintenance diagnostic services is too low. Consultants who are asked to provide diagnostic services do not make a profit unless repair work is ordered. This situation does not make sense, considering that there are economic advantages if repairs are not needed and the economic losses of construction costs and traffic restrictions can be avoided. The compensation of engineers with technical capabilities needs to be improved. It's fine to let the general public get involved and cooperate with inspections as volunteers, but who is responsible when there are defects? Because it has to be the administrator who makes the final determination, it is still ideal to conduct in-house education of engineers, as they do at Shuto Expressway and JR.

Expanding opportunities for practical application through coordination with the national conference

Moderator:

New technologies and regional cooperation are the themes of Japanese Congress for Infrastructure Management. What are the views of the Ministry of Land, Infrastructure, Transport and Tourism in this regard?

Yasuhara:

Japanese Congress for Infrastructure Management was established for two purposes. One was the practical purpose of developing ways for administrators to reliably maintain infrastructure in the midst of deteriorating systems. The other was to develop a new social paradigm in which the citizens of Japan will see infrastructure maintenance as something that concerns each of them personally and seek solutions for issues that affect all of us. It is called a "national conference" as a way of reflecting this sense of creating a movement in its name.

It has been pointed out that until now, there was no venue for administrators and residents to exchange information and hold discussions aimed at resolving issues. At the national conference, forums are held with the primary goal of creating such a venue and providing a platform. At the forum on the topic of technical development, representatives of local governments speak about maintenance issues and their needs; presentations are given in response by engineers and companies that have solutions; and thereafter the participants engage in further discussion. After last year's forum, this was taken to the point of local governments implementing matched technologies in the field on a trial basis. This is not a grassroots activity, but there was a good response from the participating local governments and companies which found it useful for their own planning, and it seems to have been effective.

At present, there is a high level of interest from private companies that see expansion of the maintenance market as a business opportunity. In the future, we hope to encourage greater use of this venue by local governments as well. Therefore, we plan to expand the congress activities to rural areas.

In this expansion into rural areas, we want to promote more active use of technologies developed by SIP. Therefore, we hope to increase collaboration with the researchers who are involved in SIP, including Regional Implementation Support Teams.

Rokugo:

We are aware of the role that universities should play in collaboration among local governments, industry, government, and academia. However, it is difficult for young researchers to achieve a track record of research, even if they are involved in SIP regional implementation. It would be appreciated if organizations such as JSCE could provide venues for presentations.

Hisada:

In the sense of being an open platform for matching between the needs of local governments and companies' technologies as solutions, our regional bases whose mission is to support implementation have basically the same purpose as the national conference. The opportunities for practical applications will be increased by introducing SIP technologies at regional forums.

Moderator:

At present, the SIP technologies are basically still under development. Would it be feasible to introduce them to the national conference at the so-called prototype level?

Yasuhara:

In the case of trial implementation that I mentioned earlier, the technology was at a relatively high level of completion, but it appears that the price would need to be reduced

for it to be implemented by local governments that are experiencing difficult financial circumstances. Because the business model still has these kinds of problems, it could be considered as a prototype that is still under development. In this sense, I hope that the congress will be able to grow alongside a wide range of technical development including developing technologies.

Hisada:

When companies engage in business development based on a prototype, that also gives rise to opportunities for local governments to attract businesses. A company may encounter resistance if it tries to suddenly establish a foothold in local industry, but if a proposal for business development using a particular technology comes from the local government, it can be accepted more easily by the community, and this contributes to the local economy.

Chun:

On the side of SIP technologies as well, I think that in the future, there may be a stage when we will want to obtain technical support from the Ministry of Land, Infrastructure, Transport and Tourism in establishing some conditions for the application of new technologies.

Shimozato:

The Japanese government has strict requirements for certification of new technologies. It goes without saying that a new technology does not yet have an established track record, but businesses in the prefecture will ask us to first consult with the Public Works Research Institute or the National Institute for Land and Infrastructure Management, and while we are trying to respond to their requests, the new technology loses its newness and becomes just another technology. In my opinion, Japan's mechanisms for the introduction of new technologies are not adequate.

Hisada:

In our questionnaire survey of local governments, many respondents stated that they feel more able to adopt a new technology if it is registered with the New Technology Information System (NETIS).

Moderator:

The Ministry of Land, Infrastructure, Transport and Tourism is currently making preparations for certification of technologies in the form of a new NETIS, including the SIP budget. I think it's good to provide information on the flow of certification and introduce new technologies at the national conference.

Shimozato:

I wonder about the possibility of creating a mechanism for certification by SIP, where a regional implementation team would report on the ways that a particular technology has been used.

Rokugo:

In fact, we are now making plans for evaluating the applicability of SIP technologies based on the results of field tests, with participation from government officials as well.

Shimozato:

We carefully analyze every piece of data and evaluate it in committee. Participants in our discussions include experts in institutional design. It would be an interesting development if that kind of opportunity arises. That would truly provide support for implementation.

Matsuda:

If a way to evaluate developed technologies is established, that could lead to increased utilization of SIP technologies not only within Japan but also in other countries. It is important to create a mechanism to sustainably carry on with the efforts of SIP, without being limited to human resource development.

Moderator:

Infrastructure maintenance and disaster prevention and mitigation technologies were identified by the Council for Science, Technology and Innovation of the Cabinet Office as one of the research and development areas that should be targeted for investment in FY 2017. It is my hope that we will produce solid results with the Regional Implementation Support Teams and achieve a good transition to the next SIP.

[Article by Mie Mikami]

[Photos by Ayumi Sano]

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