

Initiatives of the Research Center for Infrastructure Management Aimed at Promoting DX in the Infrastructure Sector

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1. Introduction

The Research Center for Infrastructure Management has been conducting research for some time into i-Construction (productivity improvements on construction sites). The application of penalized maximum restrictions on overtime work in construction businesses is approaching in FY2024 and working style reforms for the construction industry cannot wait any longer. In addition, the Fifth Priority Plan for Infrastructure Development (cabinet decision, May 2021) added two new targets to previous plans' four priority targets based on recent changes in social circumstances: digital transformation (DX) in the infrastructure sector, and decarbonization of the infrastructure sector and quality-of-life improvements through multifaceted use of infrastructural spaces.

As we work towards promoting DX in the infrastructure sector, the Ministry for Land, Infrastructure, Transport and Tourism (MLIT) established the Infrastructure Sector DX Promotion Headquarters in July 2020, against the background of an increased need for responses to increasingly frequent and severe disasters and control measures for infrastructure deterioration, a

serious lack of personnel in the construction industry, and the rise of COVID-19, among other factors. The promotion headquarters will promote interministerial initiatives¹⁾ intended to handle these radical changes in socioeconomic conditions, to utilize data and digital technology in the infrastructure sector to reform infrastructure and public services based on the needs of the citizenry, as well as reforming operations themselves, organizations, processes, and the culture, climate, and working style in the construction industry and MLIT, and to encourage public understanding of infrastructure, in addition to realizing safe, secure, and rich lifestyles (Fig. 1), and it is scheduled to formulate its action plan by the end of FY2021.

NILIM also launched its Digital Transformation of Infrastructure Systems Research Committee in March 2021 and is promoting research and development into infrastructure sector DX. This article presents the center's main DX-related initiatives.

2. Initiatives aimed at expanding ICT construction

In moving forward with DX, it is important to have the perspective of changing how we work, rather than introducing new technologies and tools into existing workflows and merely digitizing them. To date, ICT construction has introduced aerial photographic surveying (unmanned aircraft), ground laser scanning, non-prism total stations, and other measuring technology to work sites and shifted the thinking about work process control using three-dimensional data from cross-section control (sample inspection) to plane control (total inspection). This assumes that these methods allow confirmation that they can assure similar quality to conventional inspection methods, but changing the inspection methods and items according to new technology being introduced, reducing construction management and supervisory inspection labor, and contributing to simplifying documents is expected to promote on-site productivity improvements and reform of working styles for both the

Concrete action		
Reform administrative procedures and services in everyday life	Use robots, AI, etc., to support people and improve site safety and efficiency	Use digital data to reform work processes and working styles
Faster administrative procedures, etc. <ul style="list-style-type: none"> Faster procedures for special vehicle traffic, etc. Move procedures for river use, etc. online Build coordinated base for port-related data 	Realize safe, comfortable working environments <ul style="list-style-type: none"> Improve safety and productivity by unmanned/autonomous construction Reduce strenuous work with power-assisted suits, etc. ICT use in regional construction industry Introduce automated railway operations 	Reform investigation operations <ul style="list-style-type: none"> Upgrade information collection for rapid disaster response Check disaster conditions using satellites, etc. Remote-controlled/automated underwater construction, etc. Building and multifaceted use of data platforms in the roads sector
Improve services in everyday life <ul style="list-style-type: none"> Encourage use of technology to prevent falls from platforms using IT and sensing technology, etc. Popularize touchless payment using ETC 	More efficient work through use of AI, etc. <ul style="list-style-type: none"> Support inspector determinations with AI, etc. Automatic detection of traffic impediments using CCTV camera imagery, etc. 	Reform supervisory inspection operations <ul style="list-style-type: none"> Reduce labor and eliminate contact for supervisory inspections Realize remote supervision and construction management in public telecoms dead zones Work progress confirmation using image analysis
Services to increase safety in everyday life <ul style="list-style-type: none"> Increase time covered by water level forecasts Remote technical support during disasters 	Efficiently learn skills by digitizing mastered skills <ul style="list-style-type: none"> Use motion sensors, etc. in personnel training Coordination between CCUS and Mynportal 	More efficient inspection and management operations <ul style="list-style-type: none"> More efficient/automated inspections More efficient daily management Network dams for water use and enrich flooding risk information Risk management-style lock management

Fig. 1. Outline of DX policy in the infrastructure sector

orderer and the contractor.

To expand and promote these uses of ICT construction as efforts throughout the country, we believe that it is important to give this broad-ranging industry sector a real sense of the effects of the various ICT construction tools and to have members become familiar with using the tools and put working style reforms into practice company by company.

The center began operations in June 2021 as a location for research and development on technology to support the promotion of infrastructure DX, making progress in establishing construction DX experiment fields²⁾ to develop and test autonomous construction technology with construction equipment using 5G communications and work progress measurement and inspection technology for structures using three-dimensional data. We have also opened it to the private sector and others as a testing and demonstration field for work progress management and new measuring technologies used in it, as well as verifying ICT construction standards, and we hope that it will lead to further technical development aimed at improved accuracy and to the spread of technology that can easily be implemented in small-scale work sites and is cheap, versatile, and effective in introduction. (Fig. 2)

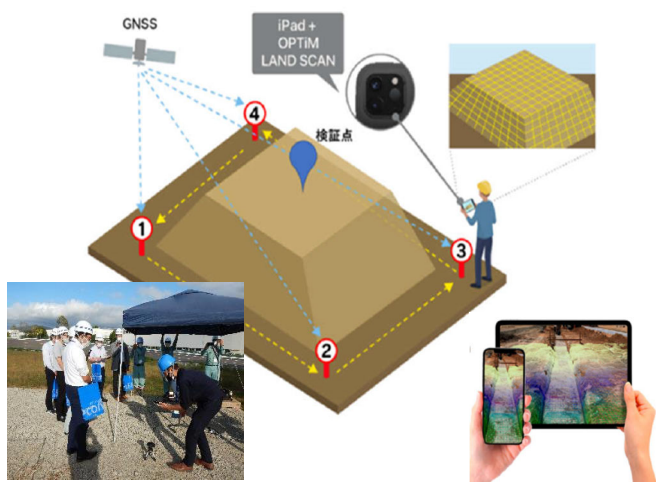


Fig. 2. Testing experiment with small-scale ICT construction technology
(Using smartphone-mounted LiDAR in work progress surveying)

3. Initiatives aimed at application of BIM/CIM principles

To promote DX in construction production processes, it is important to create an environment that is capable of using digital data across several processes, not just in specific settings, in addition to making use of digital data in various settings, and besides the further deepening of existing technology, such as BIM/CIM, the challenge is to build an environment that centrally

stores digital data from many sectors, such as rivers and roads, over the several stages from investigation and design to management and allows the required data to be used at the required time. The target of applying BIM/CIM as a general rule (except in small-scale works) from FY2023 has been set, and the center has developed various standards and the like, such as the *Guidelines for creating three-dimensional modeling products (draft)*.³⁾

Furthermore, to ensure smooth consultation through the centralized management of three-dimensional data, including BIM/CIM models and point group data, and sharing it between the orderer and the contractor, we are developing a DX data center as the foundation for such use and we aim to have it in operation from FY2022.

4. Conclusion

Works using ICT construction are increasing year on year, but we are not yet at the point of widespread adoption. The current reality among regional small and medium-sized enterprises in particular may be that adoption is proceeding slowly due to reasons like the initial investment cost and the difficulty in learning to use the technology. We believe it is important to ensure the spread of technology that is easily accessible to local government employees and small and medium-sized enterprises, not just MLIT employees.

Moreover, we hope that standardization will pick up pace, that productivity will further improve, and that working styles will be reformed in both orderers and contractors through on-site demonstrations using the PRISM (Public/Private R&D Investment Strategic Expansion Program) system,⁴⁾ including new technologies developed by various companies, with a view to making on-site construction management and quality control more efficient and advanced.

While social conditions grow more severe with the declining population and other factors, the progress of digital technology is remarkable and the potential for use of a variety of element technologies is spreading. MLIT has declared 2022 to be a “year to challenge ourselves,” when it will resolutely work on innovations through DX, and in addition to conducting research and development with a view to reforming working styles and realizing work-life balance across the entire construction industry through the effective use of a wide range of digital technologies, we hope to continue efforts in broadcasting information that leads to the spreading of outcomes of our efforts.

☞ See here for detailed information

1) List of digital transformation (DX) policies in the infrastructure sector

<https://www.mlit.go.jp/common/001385990.pdf>

2) *Development and Operation of Experimental Fields for Construction DX*, p. 154 herein

3) *Formulating Guidelines for Creating Three-dimensional Modeling Products for Detailed Design*, p. 105 herein

4) *Establishing Inspection Methods for Rebar Layout Using Image Measurement*, p. 103 herein