

A Study on Target Types of Work, Applicable Technologies, etc. for Works Using ICT

(Study period: FY2016-)

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1. Introduction

In order to accomplish the measures for "Full utilization of ICT" in i-Construction, the Ministry of Land, Infrastructure, Transport and Tourism ("MLIT") is conducting construction works using ICT in the projects under its direct control in accordance with the "Implementation policy for promoting full utilization of ICT."

In order to promote further dissemination of construction works using ICT, NILIM is studying for expansion of target types of works and applicable technologies and improvement of applicability to on-site work. Meanwhile, in order to reflect promptly technologies for construction, measurement, etc. held by private enterprises etc. in work progress control, etc., NILIM is also studying technical confirmation, verification, etc. required for procedures / standardization as the State in the "Private Sector Standards Proposal System," which the MLIT started in fiscal 2019.

This paper introduces the outline of the measures mentioned above.

2. Outline of study

(1) Expansion of target types of works and applicable technologies in works using ICT

Triggered by construction works using ICT, etc. which started in earthworks from fiscal 2016, dissemination and development of construction machines have been progressing in recent years, which are provided with the technology (machine guidance) of supporting operation of the construction machines by calculating differences from design values (3D design data) based on the position / construction information of the construction machine and providing the result data to the operator, or with the technology (machine control) of automatically controlling the machine on real time according to design values (3D design data).

Meanwhile, in accordance with the improvement in performance of the equipment used for measurement of work progress etc., it is also possible to apply ICT to various types of works including dredging and slope

works, of which measurement conditions, accuracy requirements, etc. are different. In addition, for the software for formatting results of work progress measurement as well, a system that enables timely response according to the expansion of types of works using ICT, etc. is being established.

NILIM determines targets for the expansion of application range of works using ICT by collecting such information as stated above from private organizations etc. and considering the factors of productivity improvement, shortening of the construction period, applicability of existing technologies, etc., in cooperation with the MLIT, and is studying, as examination for expansion, on-site measurement (comparison with conventional management), grasp of the effect of productivity improvement through hearings, etc. NILIM is going to continue further expansion of application range with similar process (see Fig. 1)

Standard application year				
FY2016	FY2017	FY2018	FY2019	FY2020
ICT earthwork				
	ICT road paving work (FY2017: asphalt paving, FY2018: concrete paving)			
	ICT dredging work (harbor)			
		ICT dredging work (river)		
			ICT soil improvement work (shallow and middle layers mixed treatment)	
			ICT slope work (spraying work)	
			ICT incidental structure installation work	
				ICT soil improvement work (deep layer)
				ICT slope work (spraying slope-crib work)
				ICT paving work (repair work)

Fig. 1 Road map for expanding the types of works using ICT

(2) Follow-up after expansion of types / application of works using ICT

NILIM collects and analyzes measurement data for both the "new work progress control method" and "work progress control method by the conventional method" (work progress control in control sections) with respect to the types of works for which the

standards for work progress control in works using ICT were organized or revised in the past years, and conducts a hearing from the owners and contractors in each construction site to collect information about productivity improvement, etc.

Based on the results of the study above, we organize them as to whether "the new work progress control method" is superior or inferior to "the conventional method" in productivity improvement, utilization for maintenance, performance of completed construction, etc. and, based on the results, organize the issues of the work progress control in each type of work and consider the draft of measures to address the issues. NILIM continually implements the measures referred to above and reflects results in the revision, etc. of standards, if necessary.

(3) Support of planning standards for work progress control, etc. based on proposals from private sectors, etc.

Since fiscal 2019, NILIM has been soliciting proposals for standards from private sectors, etc. as a "measure for preparing standards in cooperation of industry, academia and government." Proposals for standards are received according to the following three categories, and solicitation started in September 2019. (Refer to Fig. 2)

- (1) Proposal for utilization of new ICT (new technology)
 - Standards that enable the use of new ICT in an existing type of work using ICT
 - Standards that enable the use of new ICT in a new type of work
- (2) Proposal for expanding the existing target of ICT utilization (application expansion)
 - Standards that enable the use of existing ICT technology in a new type of work
- (3) Proposal for improvement (kaizen) of existing standards (improvement).
 - Standards for improving existing standards for efficient use of ICT

For this solicitation, a total of 22 proposals were presented from the industrial organizations (Some of them are outlined in Table 1). Based on these proposals, we are going to conduct a hearing from individual proposers and verify the effectiveness and validity of a proposals, if necessary, in cooperation of the MLIT and NILIM.

Based on results of verification, we are going to prepare procedures in fiscal 2019 for the proposals that passed verification etc.

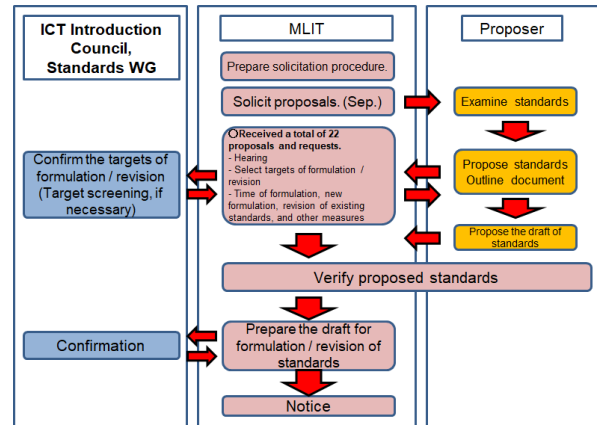


Fig. 2 System of standards preparation based on proposals from private sectors, etc.

Table 1 Outline of proposals from private sectors, etc. (relating to standards)

	Applicable ICT	Type of work etc.	Category	Outline of proposal
Commitment survey / Work progress / completed work measurement	Aerial photogrammetry using UAV	Earthwork	Improvement	- Mitigate installation at orienting point (utilization of RTK-loaded UAV and GNSS-loaded orienting point) - Reduction by using GNSS-loaded orienting point in UAV photo measurement. - Evaluate the performance of camera lens to mitigate the lap rate of vertical / horizontal crossing.
		Paving work	Application expansion	- UAV photogrammetry technology is available for paving work
	Ground-installed laser scanner	Tunnel	Application expansion	- Measurement density, etc. according to measurement targets in application of the laser scanner to tunnel work
	Land mobile laser scanner	Earthwork	Improvement	- The work progress control procedure for earthwork that enables application of the laser measurement system loaded into heavy equipment.
		Pavement repair	Application expansion	- Availability of TLS, non-prism TS (Total Station), and MMS considered in paving work (repair work).
	Land mobile stereo photogrammetry	Earthwork	Improvement	- Response to the technology of completed civil engineering work management by creating point groups from the video data of smart phones, etc.
	Optical distance measurement such as TS	Structure (tunnel)	Application expansion	- Expand the application of three-dimensional coordinates measured with TS etc. to measurement of all structures.
	History of the construction equipment positions for construction machines (completed work / work progress measurement)	Earthwork (earth cut)	Improvement	- Use the "construction history data" of the working device (edge of blade) of ICT construction machines as work progress control data.
		Earthwork (banking)		- Use the operation track data (operation history data) of the vibrating roller used for shape adjustment as the final work progress data of road body / bed.
	History of the construction equipment positions for construction machines (three-dimensional measurement)	Earthwork	Application expansion	- Measure some points using the three-dimensional coordinates of the working device (edge of blade) and expand application to work progress control, etc.
Quality control	Image analysis	Grade of aggregate	New technology	- Quality control by image grain size monitoring. - When quality variation is detected, check the grain size by conducting a grain size test. - Quality control according to quality variation
Field management / standard values	- Aerial photographic surveying using UAV, etc. - Ground-installed laser scanner, etc.	Earthwork (cobble / boulder)	Application expansion	- Newly define standard values for the ground mixed with cobbles / boulders in the work progress control standards of earthwork excavation (field control).
		Earthwork (underwater)	Improvement	- Select no lower design limit in the work progress control standards for excavation works under water.

3. Study schedule

Based on the findings obtained up to this fiscal year, in the following years, we are going to further expand the applicable types of works and continue the measures by conducting follow-up so that standards further contribute to productivity improvement, etc.