Obstacles and measures when adopting new technologies for maintenance of infrastructure: Based on a hearing survey

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Surveys on obstacles and measures when adopting new technologies

The Gifu University SIP implementation team conducted questionnaire and hearing surveys of the following engineers in order to clarify what are the obstacles to the application of new technologies to infrastructure managed by local governments and what measures are effective in overcoming such obstacles[1]:

- Ordering parties: 16 civil engineers of local governments on the ordering side,
- Developers: 8 engineers developing new technologies in the maintenance field,
- Contractors: 7 civil engineers of construction companies and construction consulting companies on the contractor side.

Results of the questionnaire survey

The questionnaire consists of description-type questions No. 1, 2 and 6 and selection-type questions No. 3-5 as shown in Table 1. In the selection-type questions, options were prepared beforehand, and the respondents made a plurality of selections and the most fitting one. This questionnaire on the application of new technologies covers not only maintenance but also all processes including survey, design, construction, and maintenance of civil engineering projects. "Conventional technologies" are defined as those described in the current technical standards and manuals in addition to data for the cost calculation. Technologies other than these are defined as "new technologies".

(1) Obstacles

Figure 1 shows the results of question No. 3 regarding the obstacles to the promotion of new technologies for each position. The numbers in those graphs represent the number of respondents. "Fairness is not guaranteed" and "Burden over the explanation for account audit" were the main obstacles for the engineers from the ordering parties. The obstacles for the engineers from the developers and contractors were "Insufficient ascertainment of needs" and "Performance and precision are not assured," respectively. About 40% of the engineers from the developers and contractors chose "Standards or manuals are not satisfied", but only 20% of the engineers from the ordering parties made that choice. Therefore, we can say that the new technologies that do not satisfy the standards or manuals can

Table 1 Contents of questionnaires.

No.	Questions	Contents
1	Image of new technologies	- How do you feel about utilizing new technologies for your work? - When you hear "new technologies", what comes to mind?
2	Experience in utilizing new technologies	- Have you ever adopted new technologies in your past work? - What kind of new technologies did you adopt? - Was the adoption a success or failure? - What do you think was the reason for the success or failure?
3	Obstacles to the utilization of new technologies	- What are the reasons why you cannot or are averse to using new technologies? (Selection-type question)
4	Measures to promote utilization of new technologies	- What are effective the measures to make it easier to utilize new technologies? (Selection-type question)
5	Key points in utilizing new technologies	- What are the key points when utilizing new technologies? (Selection-type question)
6	Others	- Free description.

be accepted by the ordering parties, provided the main obstacles, “Fairness is not guaranteed” and “Burden over explanation for account audit,” are removed. Japan’s account audit system that rigorously checks appropriate use of tax revenue at local governments may form the background of these answers

(2) Measures

Figure 2 shows the results of question No.4 regarding measures for the promotion of new technologies. Many engineers of all positions chose “Encourage adoption of new technologies in manuals.” Engineers from the developers and contractors chose “Provide application examples of new technology” and “Create neutral evaluation systems for new technologies.”

(3) Key points

Figure 3 illustrates the results of question No.5 regarding key points to be considered when utilizing new technologies. Many engineers from the ordering parties and developers chose “Respect participation of local companies.” Many engineers from the ordering

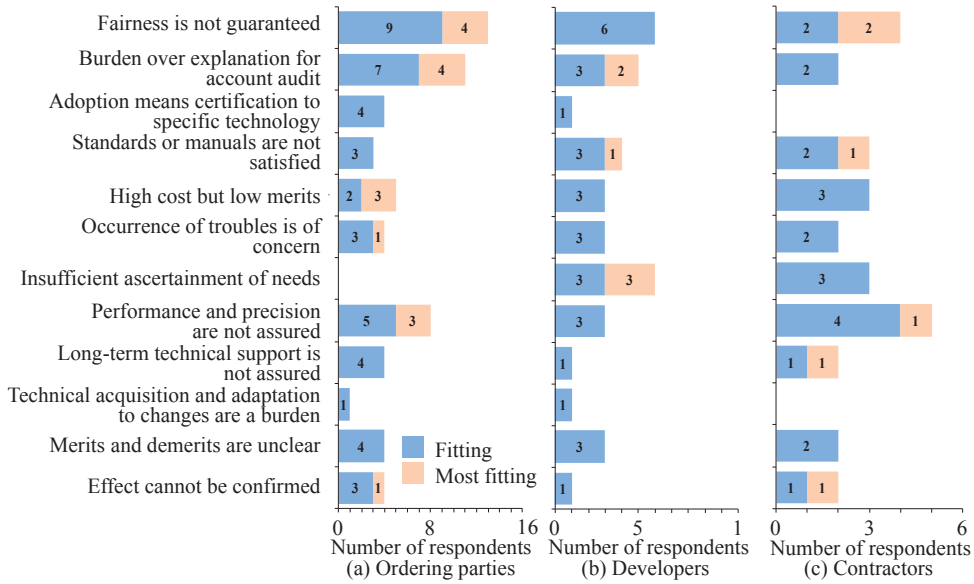

Fig. 1 Results of questionnaire survey regarding obstacles.

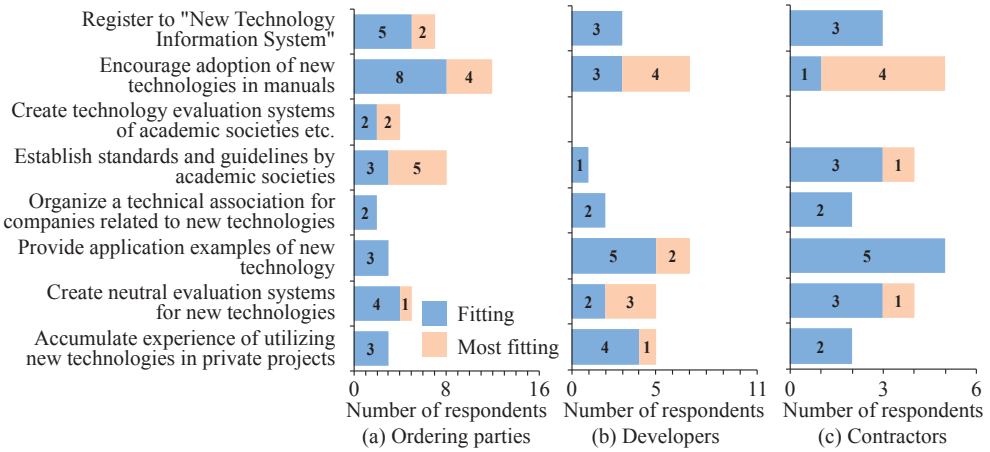

Fig. 2 Results of questionnaire survey regarding measures.

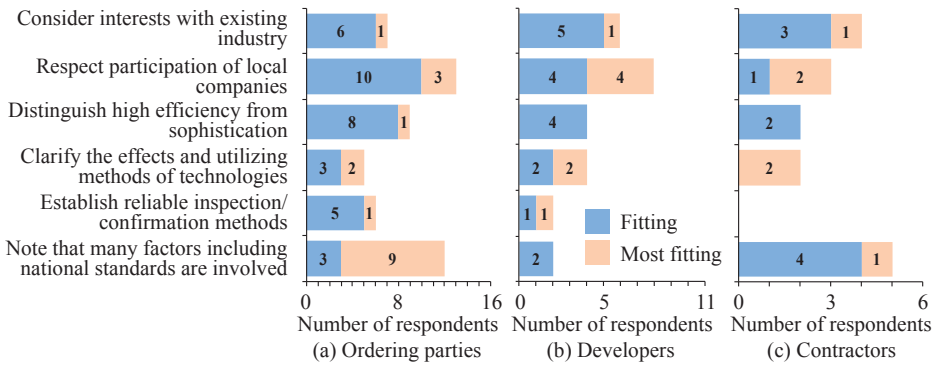

Fig. 3 Results of questionnaire survey regarding key points.

Table 2 Obstacles viewed from different positions.

Positions	Major obstacles		Major causes
Ordering parties	Lack of incentives	Attitudes of people in charge widely vary	- The organizational mission is unclear. - Enthusiasm gap between head and local offices. - Resistance to changes.
		Significant energy and effort are required for introduction	- Fairness should be ensured. - Basis for external explanation (account audit) is necessary. - Basis for internal explanation (organizational consensus) is necessary.
		Great risks in the events of trouble	- Who takes responsibility is unclear. - Certainty and continuity of support by developers are not assured.
Developers	Difficult to build a business model	Investment decision for development is difficult	- First-mover advantage from development is not assured. - Investment recovery in a short time is difficult. - It is difficult to grasp the market (scale, continuity).
		Required specifications are unclear	- Needs for new technologies (required performance/precision) are unclear. - Appropriate cost for ordering parties is unknown. - Content and period of technical support required are unknown.
		Government's situation is unknown	- Each organization or local government is in a different situation. - Methods of order placing and introduction conditions are difficult to understand. - Attention to industry officials is required.
Contractors	Lack of incentives	No direct benefit	- Technical proposals do not lead to increase in orders received.
		Great risks in the events of defects	- Who takes responsibility is unclear.
		Cost of technical proposal is high	- Needs should be grasped and seeds should be collected. - Documents supporting the validity of introduction should be formulated.

Table 3 Examples of measures taken to promote the use of new technologies.

Goal	Measures	Orientation of measures
Raise incentives for order-placing staff	Define the mission of introducing new technologies	- Mandate introduction by law - Agree on the introduction policy within the organization
	Raise the consciousness of individual staff members	- Exchange personnel with other organizations
	Reduce the labor of order-placing staff	- Increase the explainability of necessity for introduction - Increase the explainability of performance, accuracy, and effect - Increase the explainability of cost adequacy
	Reduce the risk in case of trouble	- Clarify the defect liability
Support developers to create a business model	Support investment decision	- Find areas where introduction in a short time is possible - Formulate a system to facilitate introduction of new technologies
	Match seeds with needs	- Clarify public needs (required specifications) - Clarify the seeds of developers - Make proposals that are easy for order-placing staff to explain
	Support ascertaining the administrative situation	- Cooperate with appropriate developing partners
Raise incentives for contractors	Clarify the advantages for contractors	- Create a system by which proposals lead to increases in orders - Show concern for local companies
	Deal with the risk of defects	- Clarify the defect liability
	Raise the awareness of the necessity for introduction	- Introduce new technologies suitable for the competence levels of contractors

parties and contractors chose "Note that many factors including national standards are involved".

Results of interview survey following the questionnaire survey

The interview survey was carried out in line with the questionnaire items filled in by the interviewees. The interviewers paid attention to extracting possible causes along with the apparent obstacles. After the interviews, keywords in the transcripts were extracted and analyzed. Table 2 gives the items recognized as major obstacles and their causes.

As seen from this table, engineers from the ordering parties and contractors feel a lack of incentives to use new technology for various reasons and perceive this as an obstacle. On the other hand, those from the developing parties feel it difficult to create a business model when developing a new technology, due to the special nature of the public works market, and perceive this as an obstacle.

Table 3 shows examples of promising measures taken by each position, which were ascertained through the interviews.

[Reference]
1) Rokugo, K., Kinoshita, K. and Hasuike, R. : Activities of Gifu University SIP Implementation Team for Utilizing New Maintenance Technologies, The 2nd Asian Concrete Federation (ACF) Symposium 2017, D015, 2017.