

Research on Systems for Promoting New Technology Introduction in Singapore

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1. Introduction

The Ministry of Land, Infrastructure, Transport and Tourism ("MLIT") is promoting i-Construction to improve labor productivity in work on construction sites using new technologies and advance quality control, etc. In order to introduce such new technologies to construction sites, it is required to take actions according to technologies in terms of systems, such as revision of technical standards, and support to enterprises.

There are some overseas examples where the country is already addressing productivity improvement by introducing new technologies etc. or promoting labor saving on construction sites. Of such countries, Singapore is particularly addressing productivity improvement in construction sites by introducing actively BIM (Building Information Modeling) and new technologies under the government's initiative. Then, we conducted a hearing, in addition to bibliographic survey, about the construction industry of Singapore from the BCA (Building and Construction Authority), which is responsible for construction administration of Singapore, and from Japanese enterprises receiving building and construction orders in Singapore. Then, we organized the results in terms of measures taken in the phases of (1) Employment of skilled workers (who engage in direct operation of construction), (2) Introduction of new technologies, and (3) Receipt of orders for construction work.

2. Measures in the construction industry of Singapore

(1) Employment of skilled workers and technical improvement

Construction sites in Singapore are characteristic in that skilled workers are mostly foreigners. Their working force had supported the high-growth era of Singapore, but the Singapore government is now advancing the measures to reduce foreign workers since the country has already entered the age of economic maturity.

In February 2010, the Economic Strategy Council, which is an inter-departmental organization across the Singapore government's ministries and agencies, proposed that excessive dependence on foreign workers should be avoided because it will inhibit

enterprises from making investments for productivity improvement. Following this proposal, measures to maintain and improve the productivity of construction sites have been implemented by actively promoting the introduction of new technologies. Accordingly, management of the number of skilled workers would be closely related to measures for productivity improvement in Singapore.

According to the hearing from enterprises and BCA's employees, there is no limitation in employing domestic workers for construction sites in Singapore, but domestic workers rarely work on construction sites. As a result, foreign skilled workers will be employed and they need to obtain a work visa for employment. Work visas are distributed to the contractor of construction work in the number determined according to the size of construction site. Since the number of work visas to be issued is decreasing year by year, construction contractors are increasingly required to introduce new technologies, etc. in order to perform construction work with such a limited number of workers.

As a base for calculating the number of work visas to be issued, there is a daily construction report to be submitted to the MOM (Ministry of Manpower), a government organization. In public works, use of biometric authentication is required in order to control access to construction sites (Fig.), and "the number of

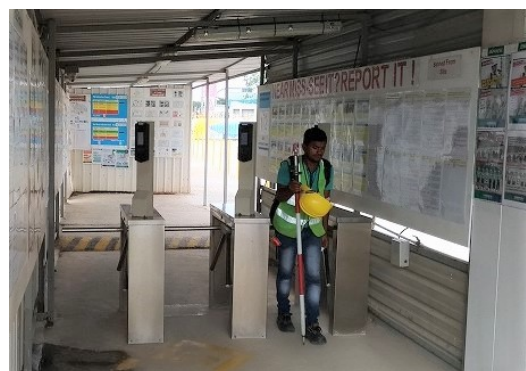


Fig.: Construction site access control by biometric authentication

workers employed in the work for construction of one square meter area on the site" is calculated based on the monthly number of skilled workers who accessed the site, which is recorded in the daily report, and the

area actually constructed. Based on such data of past works, the number of work visas to be issued for subsequent works is determined.

In addition, measures for obtaining a high quality workforce have been implemented in Singapore. BCA has opened a technical center in the surrounding countries for skilled workers there who aim to be employed in Singapore in order to support them in acquiring qualifications and skills. BCA also encourages foreign workers in Singapore to acquire further qualifications and skills by conducting training etc. at its facility called "BCA Academy."

Further, BCA recommends employment of multi-skilled workers to enterprises by reducing the tax to be imposed on employment of skilled workers with multiple qualifications ("multi-skilled workers") rather than skilled workers with a single qualification ("single skilled worker").

According to the hearing from enterprises, employment of multi-skilled workers is also advantageous to them because it is expected to shorten the construction period by reducing the waiting time of skilled workers on construction sites.

(2) Measures for promoting new technology introduction

1) Sand box

As a method of considering introduction of new technologies, there is a technique called "sand box." This method allows a technology that is not yet standardized to be used in the proposed site on a trial basis and has been more actively used in Singapore than in Japan. Results of trial use, including success or failure, are accumulated in the government and fed back to subsequent construction works.

Implementation of this method in an early cycle is considered to be promoting the introduction of new technologies in Singapore.

2) Design / construction evaluation by Score System

Singapore has a system of Buildable Design Score (B-Score), which digitizes and evaluates the ease of construction, etc. in designing buildings, and a system of Constructability Score (C-Score), which digitizes and evaluates the constructability in construction work. To these Scores, points are added according to adoption of technologies designated by BCA, such as measures for improving constructability and considerations for technologies, equipment, and safety. As this Score becomes higher, building design is evaluated safer and easier and constructability of the site is evaluated higher.

In addition, required minimum points have been determined according to the size of construction site and types of buildings (school, commercial facility, etc.) and required points need to be satisfied under the responsibility of designer for B-Score and builder for C-Score.

Further, since each Score is used as evaluation items in bidding for construction work to be described below,

the contractors are supposed to actively adopt new technologies etc.

Table: Distribution of evaluation by PQM system

	Building	Civil engineering
Price	30~50 %	40~60 %
Productivity	10 %	10 %
Quality	60~40 %	50~30 %

3) From PCa to PPVC

In Singapore, PCa (precast concrete) technology is normally used. In recent years, BCA has been actively recommending the use of the building method called "PPVC (Prefabricated Prefinished Volumetric Construction)," which builds up prefabricated units completed up to interior at a certain level. With adoption of this method, the technology is expected to greatly reduce the construction period and improve safety due mainly to decrease in work at dangerous spots.

(3) Evaluation system in construction bidding

In Singapore, contractors are decided based on the results of total evaluation in bidding for construction work, and it is characteristic that the evaluation items include "Productivity" in addition to "Price" and "Quality" (see Table). In this item of productivity, results of past construction works indicated with the index calculated based on the aforementioned Scores, introduction of technologies such as BIM by the enterprise, and measures for workforce development (education) are evaluated.

3. Conclusion

With the findings obtained from this research, we are going to contribute to promotion of i-Construction in Japan by organizing and studying information in other countries.