INFORMATION SYSTEM FOR MANAGING COST REIMBURSABLE CONSTRUCTION PROJECT

NAMHEE KANG, HYUNJUNG KIM, HAEKYUNG IM and JAEHYUN CHOI

Dept of the Architectural Engineering, University of Technology and Education, Choen-an, Korea

The project management information system (PMIS) has recently been developed by using the IT technology in order to implement advanced information management technology to construction industry in Korea. The PMIS has been applied not only to domestic construction projects, but also to some overseas projects executed by Korean construction companies. This study was performed to develop the PMIS that is tailored to the US construction IT market. The US construction IT market has been monopolized by the US-based IT companies, but other companies are recently emerging with competitive technology and market strategy. As a preceding study, existing systems commercially available were analyzed, and the required features of the PMIS were identified by analyzing the core elements of contract, process and cost management for construction projects in the US. The PMIS then was developed based on the aforementioned analysis results. The system includes the document management module with an internal electronic approval system, the cost-plus-based automatic labor cost calculation module, and the progress management module to support the integrated project cost management. In addition, the functionality of the developed system was verified by construction project management experts in the US via questionnaire survey. The PMIS, which was developed in this study, is expected to be applied not only to the US construction IT market as a system specialized for the US construction industry, but also to other overseas markets in the future.

Keywords: Information technology, Construction project management.

1   INTRODUCTION

The construction Project Management Information System (PMIS), which combines the project management technology with advanced IT to maximize construction project management efficiency, has recently been introduced as the representative project management system in Korea (Yoo *et al.* 2004). The US construction industry significantly differs from that of Korea in that cost-plus-fee contracts are used more often in the U.S. than lump-sum contracts, which are mainly used in Korea. Because the document and cost-handling methods for construction projects vary according to the contract type, the PMIS designed for construction projects in Korea cannot ensure efficient project management in construction sites in the U.S. In this study, the construction industry and the related commercialized systems in the U.S. were examined to develop a PMIS for cost-plus-fee payment and to prepare the Korean construction IT industry to enter the US construction market.

The scope of this study was limited to the development of the ASP-based PMIS, which can be applied to construction sites in the U.S. Technical situations were analyzed using relevant preceding studies and literature worldwide to derive problems, and the characteristics and management methods of construction work in the U.S. were examined to identify the required features of the PMIS. Then the PMIS was developed by applying the required features, and a questionnaire survey was conducted with local professional managers to verify its validity.

2 TECHNICAL STATUS AND CONSTRUCTION INDUSTRY IN THE U.S

2.1 Technical Status in and out of Korea

In Korea, construction PMISs have been developed by some large companies for internal knowledge management, and by specialized system development companies. Construction PMISs are integrated systems that include separate tasks for each construction phase, such as the design and construction phases, as well as project management items, to manage overall construction procedures (Yoon 2002). Information management systems have been commercialized and Web-based systems have been developed earlier in overseas countries than in Korea. Thereafter, not only the overall project management systems but also individual management systems for major project management areas, including contracts, costs, and document management, have been developed.

2.2 Analysis of the Construction Industry in the U.S.

In the U.S., cost-plus-fee contracts are more common than lump-sum contracts. According to the data announced by the White House, the country's cost-plus-fee and T&M contracts significantly increased from the year 2000 to 2010 to 162 billion and 28 billion dollars, respectively (Washington: Executive office of the president 2011). The contracts in the cost-plus-fee methods accounted for about 35%, and are constantly increasing (Figure 1).

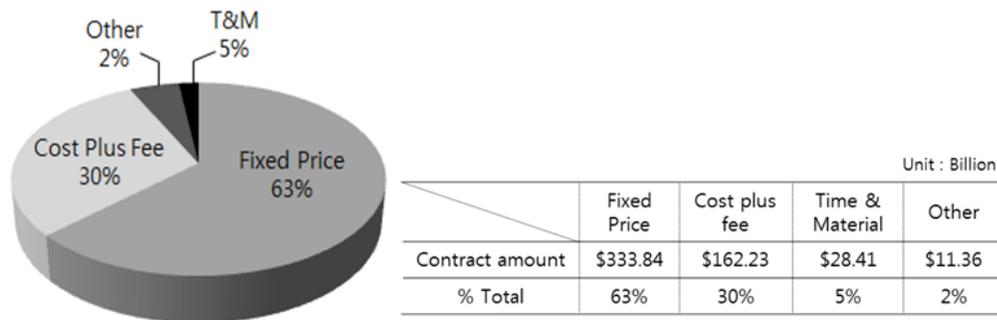|	Fixed Price	Cost plus fee	Time & Material	Other
Contract amount	$333.84	$162.23	$28.41	$11.36
% Total	63%	30%	5%	2%

Unit : Billion

Figure 1. Contract amount by contract type in 2010.

In public construction projects in the U.S., there are diverse specified rates for labor cost payment from the orderer to the contractor, or from the contractor to the subcontractor. In the unified facilities criteria (UFC), which are the DOD integrated

facilities management criteria, the labor cost consists of the base cost per time, overtime payment, general expenses, fringe benefits, and other expenses (Unified Facilities Criteria 2010). Major institutions, including the U.S. government, specify diverse rates and calculation methods according to the labor cost items, number of working days, and jobs.

3 DEVELOPMENT OF THE CONSTRUCTION PROJECT MANAGEMENT INFORMATION SYSTEM FOR CONSTRUCTION SITES IN THE U.S

3.1 Development Environment

The basic technical development framework was based on the Microsoft .Net framework 4.0. iBatis.Net was used for the data tier, and JQuery PlugIn control, CSS3.0, and BootStrap were used for the UI. With such advanced Web technologies, the user convenience was improved, and the system was organized to allow the expected mobile support.

3.2 Document Management and Automatic Labor Cost Calculation Module

The PMIS in this study was established in online and offline document management systems. The online document management system was developed in general documents such as change order requests, design change, non-conformance reports (NCR), punch lists, and transmittals, and in special documents whose forms and headers could be freely created. The offline document management system is for those who do not use the PMIS, and in such system, the document title, number, sender, recipient, and reply date can be registered.

The labor attendant management system provides the labor attendant records collected from the RFID card tagging by period, company, and construction work, and manages safety trainings and safety violations. The labor-attendant information is used to manage labor cost calculation data and overtime work, and to determine the number of hours worked by each laborer according to the automated labor cost calculation procedure. The paid completed amount is automatically transferred to the payment status of the cost management, which can be checked and managed in real time. Figure 2 shows the work flow of the document management and labor management system.
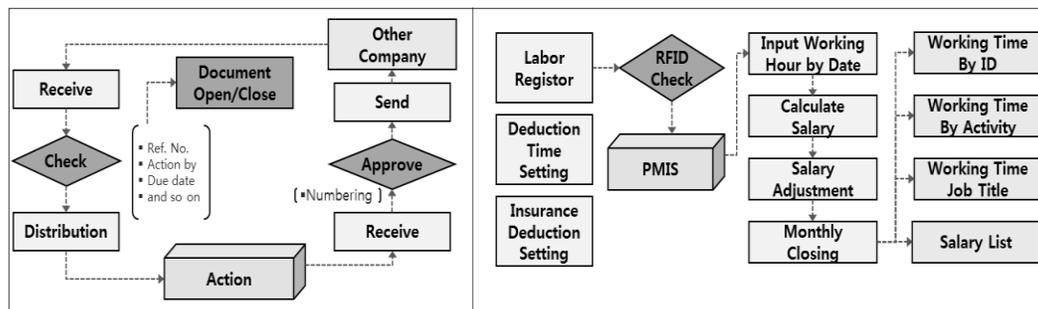

Figure 2. Process of document management and workforce management

3.3 Progress Management Module

The progress management module was developed so that the WBS and CBS data created from Primavera, Oracle's process management software, could be interconnected using the entry functions of the PMIS. The interconnected schedule data are expressed in the form of a Gantt chart in the system, and the complete inputted schedule is shown on one screen (Figure 3). The details of the work that the user specifies are presented in the same format as that of the process management program, and the material cost and expenses, in addition to the labor cost, are included in the integrated project cost.
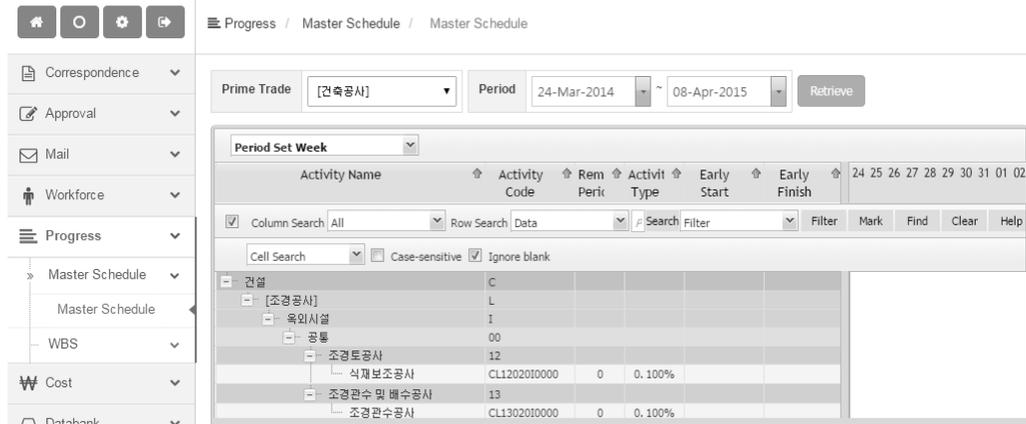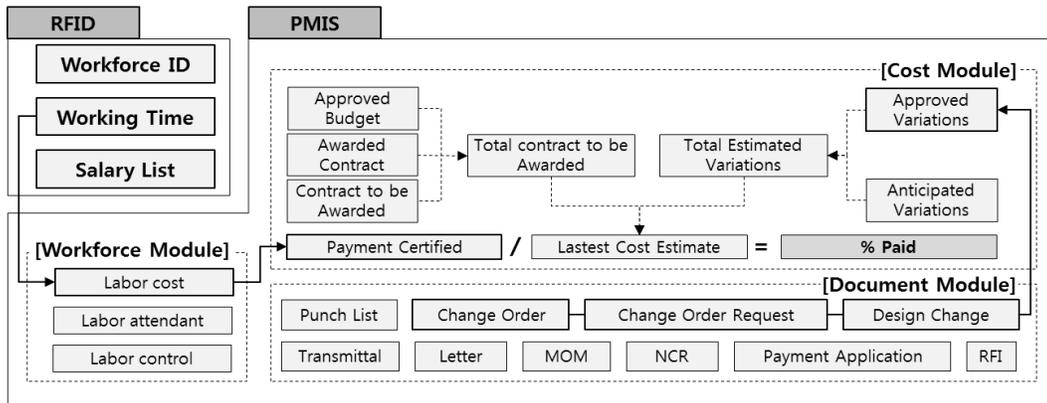

Figure 3. Screen of progress control in PMIS.

Figure 4. Process diagram of project cost management.

3.4 Integrated Project Management Module

The project cost management items include the budget, contracted amount, requested amount, completed amount, and paid amount. The cost is calculated using the cost-plus-fee method. During the project period, the integrated project cost management, which is automatically connected to the document management function, is available to

ensure the efficient management of the data for project cost changes and their causes. The automatic interconnection feature improves the systematic project cost data and the access to relevant data, and allows the management of contracts by company according to the budget, contract amount, and project cost change. In addition, the entire cost flow is understood and integrated project cost management is possible because individual contract amounts are summed up. Figure 4 shows the integrated project cost management procedure of the established system.

3.5 Other Modules

In addition to the aforementioned technical developments, the PMIS in this study provides the databank feature that allows the mail and Web hard disk functions, and the community feature that allows notices or discussions. The project cost management items include the budget, contracted amount, requested amount, completed

4 VALIDATION OF THE SYSTEM AND EXPECTED RESULTS

4.1 Validation of the System

To validate the feasibility of the developed PMIS before its application to construction sites in the U.S., the trial version of the system was provided to local experts and the questionnaire survey was conducted based on a five-point scale. The survey included 10 questions for five categories: general, document management, labor management, project management, and portability and convenience. The resulting score was 258 points out of 300 points (Figure 5).
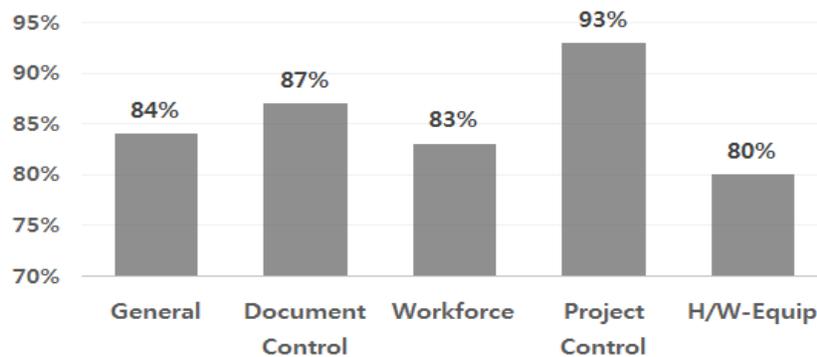

Figure 5. Survey result for measuring user satisfaction.

4.2 Expected Results

If the user training and system maintenance for the developed PMIS is continued, companies can ensure efficient project management and an advanced construction project management technique. The system is expected to automate work related to labor cost calculation and systematic integrated management for diverse documents,

which would facilitate knowledge management in the company. The accumulated construction information can be used for the follow-up construction projects to improve the project management efficiency.

5   CONCLUSTION

In the development of the PMIS system for the efficient management of the entire life cycle of a construction project, not only the characteristics of the project but also diverse environmental effects should be considered. In this study, the project management systems and procedures for construction projects in the U.S. were analyzed, and the systems developed in Korea were compared with the overseas commercial systems to develop a PMIS equipped with the features needed in construction sites in the U.S. The management modules in the developed PMIS include diverse document creation and electronic approval features within the system to facilitate real-time collaboration and systematic document management, and the process management software data were interconnected with the system to realize progress in real time. Finally, document management was interconnected with cost management to allow integrated project cost management. The results of the questionnaire survey on the developed system showed that the system was expected to enable more systematic and efficient project management than the existing overseas systems that provide standardized services. Further studies are required on the assessment of this system as applied to overseas sites and the improvements needed.

References

Unified Facilities Criteria. Retrieved from www.wbdg.org/ccb/DOD/UFC/ufc_3_740_05.pdf on November 8, 2010.

Washington: Executive office of the president. Retrieved from www.whitehouse.gov /sites/default/files/omb/assets/blog/Update_on_Contracting_Reforms.pdf on July, 2011.

Yoo, W. H., Lee, H. S., Kim, W. Y., and Yu, J. H., A Case Study on the Development Strategy of Project Management Information System, *Proceedings of Korea Institute of Construction Engineering and Management,* 127-134, 2004.

Yoon, J. H., and Moon, Y. I., The Study of Project Management Information System Establishment for Construction, *Korean Journal of Construction Engineering and Management,* 3(4), 132-138, Jun 2002.