

A Study on the Advancement Planning of the Design VE System

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Abstract

The economic efficiency review of design, etc. (hereinafter, Value Engineering (VE)) is the work designed to use the minimum life-cycle cost (LCC) and review the economy and field adjustment feasibility of design contents by function and alternative measure to secure the necessary functions of facilities. To systematically and comprehensively manage the results of the design VE done by ordering agencies and to use such results for performing similar design works, the Ministry of Land, Infrastructure, and Transport (MOLIT) has constructed and is implementing the design VE system based on the Guidelines for the Review of Economy of Design, etc. (hereinafter, VE guidelines).

The design VE system, however, is outdated because of the changes that were made in the input and management items when the VE guidelines were amended and because of the inappropriate function improvement since its construction. It currently requires the input of many unnecessary items, and the information is stored chiefly in the form of text, making it inappropriate to utilize the data for designing similar construction projects.

This study proposes measures for the update of the design VE system to reflect the amendment of the VE guidelines, to simplify the unnecessary input functions, to boost the search function, and to provide diverse forms of statistics. These proposed update measures are expected to assess the comprehensive analysis of the design VE performance results, to share the design VE information with the ordering agencies and design firms so as to come up with effective alternative measures, to reduce construction project costs, and to improve the quality of construction projects.

Keywords: *Construction Project Information System (CPIS), Construction Project Information Portal System (CPIPS), Design VE, Design VE System, Life Cycle Cost (LCC)*

1. Introduction

Value Engineering (hereinafter, VE) is the work designed to use the minimum LCC and review the economy and field adjustment feasibility of design contents by function and alternative measure to secure the necessary functions of facilities. Design VE aims to come up with creative measures to ensure the required construction work quality, functions, and cost-efficiency, to enhance the construction work value, and to prevent faulty and excessive design works, in order to reduce the construction costs and improve the construction quality. [1]

According to the current laws including the Construction Technology Promotion Act, construction projects with a total construction cost of over KRW 10 billion shall undergo a design VE review in the basic and execution design stages. The agencies and subordinate agencies of MOLIT, local governments, and ordering agencies, among other project-ordering agencies, perform design VE on their own or through outsourcing. To systematically and comprehensively manage the results of the design VE done by ordering agencies and to use such results for performing similar design works, MOLIT has constructed and is implementing the design VE system based on the VE guidelines.

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2. Main Subject

2.1. Analysis of the Overview of the Design VE System

According to the design VE law, the Construction Technology Promotion Act's Enforcement Ordinance - Article 75 (Review of Design Economy), construction projects with a total construction cost of over KRW 10 billion shall undergo a design VE review in the basic and execution design stages. Also, the design VE review shall be required in construction projects ordered more than three years after the execution design is completed, or when adjusting the design by over 10% of the total construction execution cost or of the construction costs by work type, or as the ordering agency deems necessary for construction projects with a total cost of less than KRW 10 billion.

In addition, one of the notices of MOLIT, the Guidelines for the Review of Design Economy, *etc*, specifies the targets of design VE review, the review execution time and frequency, the review organization, the review work procedure and contents, the adoption of proposals, the payment of VE prices, *etc* The design VE review shall basically be performed one or more times in the basic and execution design stages, respectively, under the responsibility of the ordering agency.

Finally, the Guidelines for the Operation of the Construction Project Information System (CPIS) provide that the results of the design VE, performed pursuant to the VE guidelines, must be inputted into the Construction Project Information Portal System (CPIPS) to ensure that no data are dropped. [2-3]

The survey on the design VE implementation status of the ordering agencies including the agencies and subordinate agencies of MOLIT revealed that, first, the regional national land management agencies and other relevant agencies have no dedicated design VE review department and manpower, and thus, outsource this work mainly under their design supervision, *etc* Next, the Korea Land & Housing Corporation (LH) performs more than 150 design VE projects yearly, the largest number of design VE projects undertaken by an agency. Especially, it implements VE through task manuals and separate operation guidelines and shares the results every year by publishing a book. LH and K-Water conduct over 10 cases of design VE projects each every year. The Korea Rail Network Authority (KR) performs approximately 50 design VE projects through its dedicated department.

It was found that the agencies have no dedicated design VE department and manpower, though, and perform the design VE through design supervision or outsource the work. On the other hand, the subordinate agencies have a dedicated design VE department that performs the work on its own.

The design VE job plan is classified largely into the pre-study phase, the VE study phase, and the post-study phase. The operation techniques used to achieve the goals of

each phase are applied after reviewing the characteristics and suitability of the corresponding VE.

The pre-study phase includes the collaboration building stage for ensuring efficient VE work, the common goal establishment stage, the orientation meeting stage for securing information, the VE review organization establishment stage, the selection of VE review targets stage, the measurement of user requirements stage, and related data-gathering stage.

The VE study phase, a key stage of VE activities, is designed to use various techniques and propose various alternatives regarding the determined VE themes. Key works include the analysis of functions, deriving of ideas and rough evaluation, embodiment and detailed evaluation, and proposal. The post-study phase is designed to finalize each VE alternative proposed in the VE study phase, aims to formulate systematic action strategies and plans for the derived proposals, and includes the review and approval of proposals, and follow-up action [4].

2.2. Analysis of the Design VE Systems of Subordinate Agencies

LH combined the separate functions for complexes and housings into the Construction Technology Information System (COTIS) in 2013. The system controls information link from the planning of a construction project through the maintenance stage. It manages the design VE information through the design outsourcing management function of the system.

The following table shows the design VE systems overview of subordinate agencies.

Table 1. Design VE Systems Overview of Subordinate Agencies

Agency	K-Water	KEC	LH	KR
Category				
Information system (Remark)	CMS (linked with electronic approval)	hi-value portal system (Reconstructed in 2013)	COTIS (Reconstructed in 2014)	e-PMS system
Design VE system retention	○	○	○	○
Statistical information retention	○	○	○	○
Network	Intranet	Intranet	Intranet	Intranet
Design VE execution	Internal+ external	Internal	Internal	Internal

The existing design VE system of the Korea Expressway Corporation (KEC) simply inputs the review results information, but it was reconstructed in 2013 and adopted a Web-based work processing system. Thus, it now manages the design VE information within the high-value portal system. Major information includes basic information, VE management, pre-study phase, VE study phase, and post-study phase. The system is not linked with the electronic approval system.

K-Water has the design VE system within the construction management system (CMS) and the system is in conjunction with the electronic approval system. Finally, the Korea Rail Network Authority (KR) has the design VE system within the e-PMS design management system in its own ERP system that is operating in its intranet.

The design VE systems of subordinate agencies have been constructed, reconstructed, and upgraded by individual agencies, and is thus being positively used at the working level.

2.3. Analysis of the Design VE System of MOLIT

The design VE system of MOLIT, after being constructed, operates in the CPIPS, one of MOLIT's work systems. The CPIPS, the total portal of CPIS, is designed to integrate and manage the information and operation environments created by individual CPIS, to serve as the single access channel for user services and to allow the sharing of diverse construction information. The CPIPS consists of the agency portal system used by the MOLIT HQ, five local national management agencies, and their subordinate agencies, and the user portal system used by MOLIT's own and subordinate agencies, local governments and public ordering agencies, builders, and the general public. A conceptual diagram of the CPIPS is shown below.

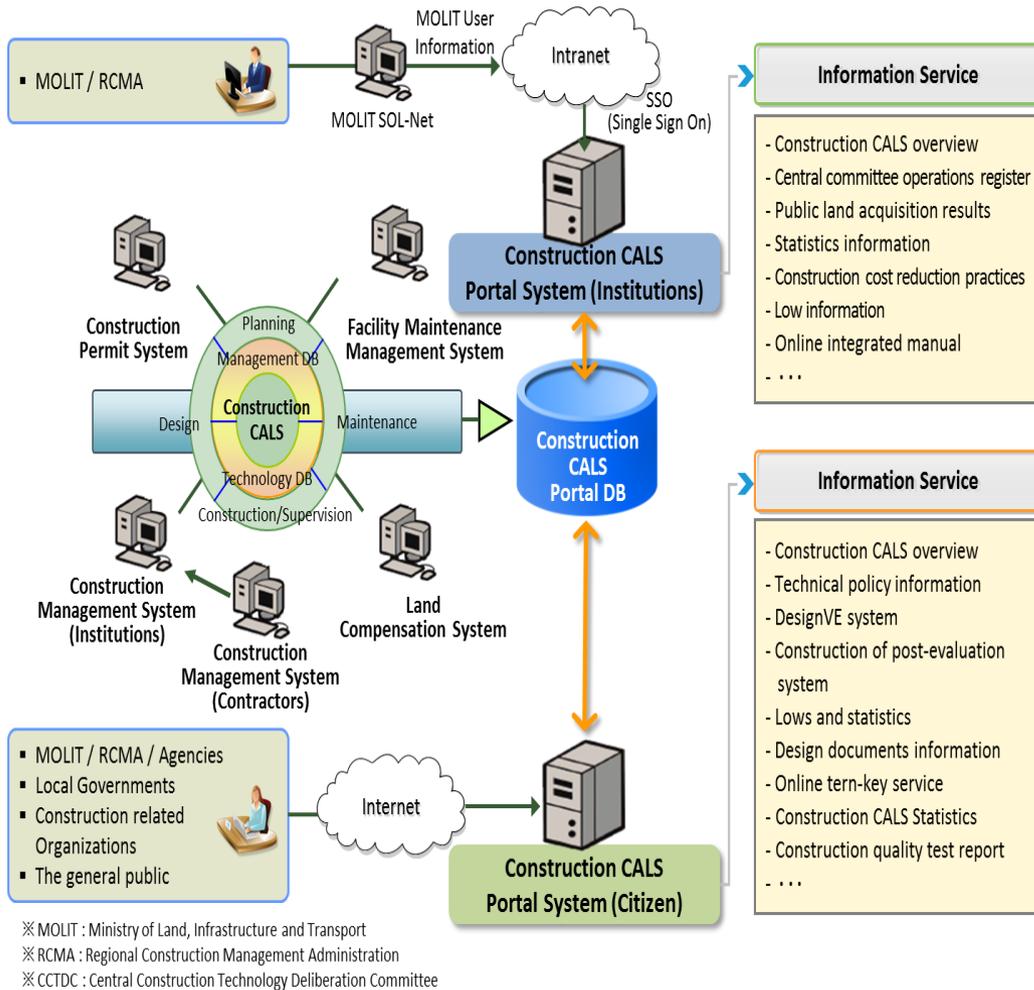


Figure 1. Conceptual Diagram of the CPIPS

Under the CPIPS, the agency portal system has 10 major functions, which include drafting the Central Technology Review Committee's operation books and construction project cost-saving examples, and the user portal system has 10 major functions, which include construction project post-evaluation and drafting of the design VE page, the online turnkey page, and the design document information page [5].

The design VE system is used by MOLIT's own and subordinate agencies, local governments and public ordering agencies. The system is located in the user portal

system of the user network (general internet network), not in agency network (intranet). A conceptual diagram of the design VE system is shown below.

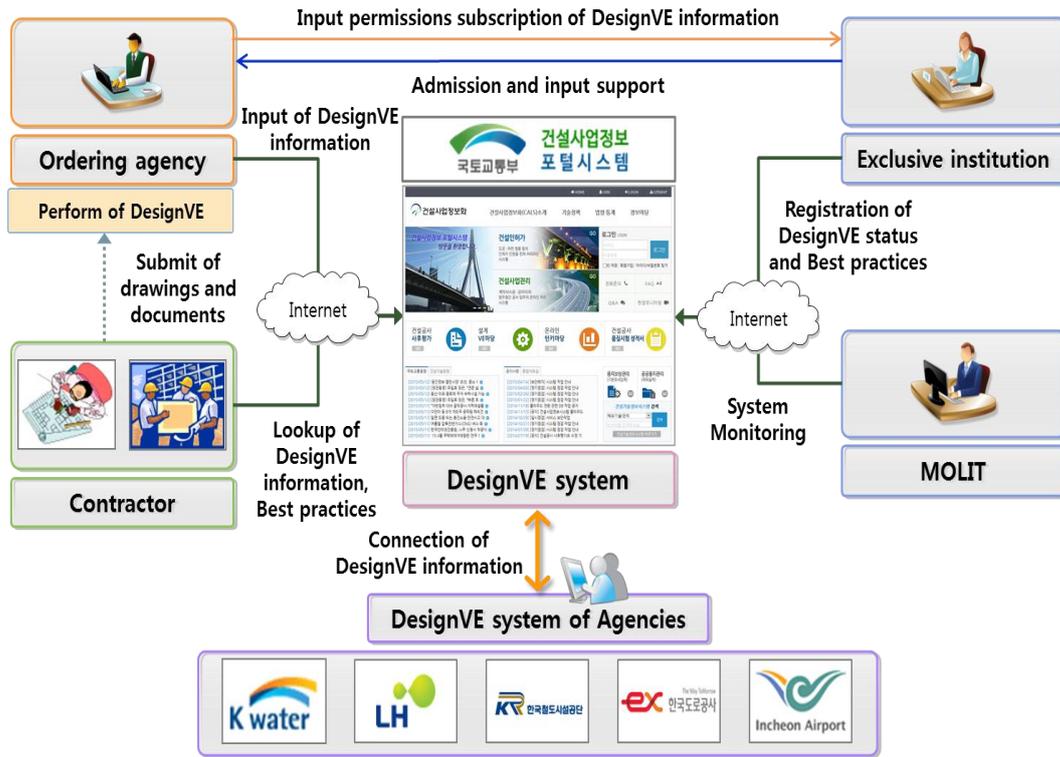


Figure 2. Concept Diagram of the Design VE System

The operation overview of the design VE system shows that 94 ordering agencies were registered from 2008 to 2014, the total number of the projects was 1,530, and the total number of the suggestions was 28,852.

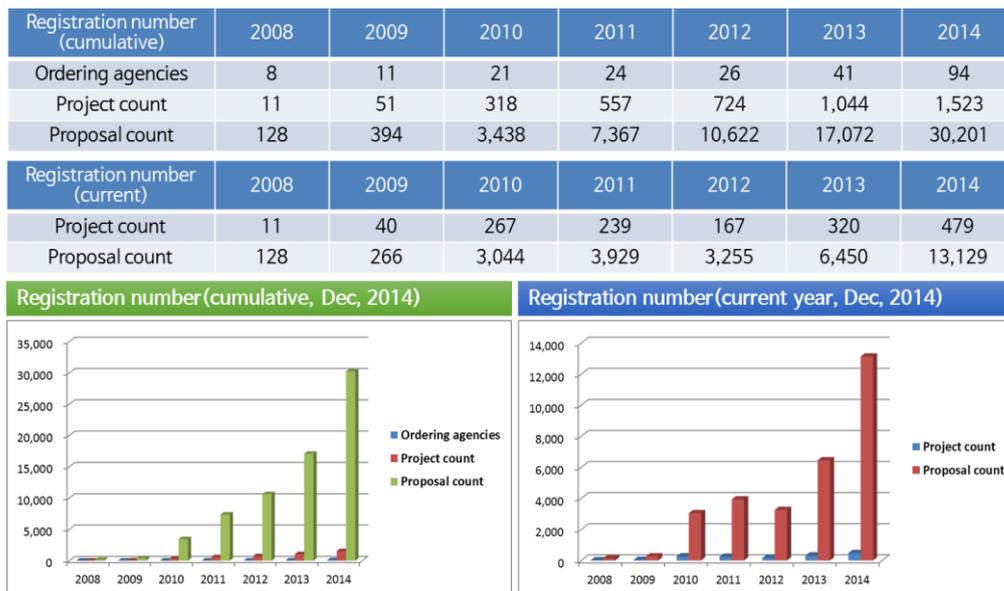


Figure 3. Operation Status of the Design VE System

2.4. Measures for the Advancement of the Design VE System

This study aims to upgrade the design VE system. Towards that end, it presents measures designed to improve the system's functions in line with the amendment of the VE guidelines, and to improve the existing statistical function for the design VE input data. The design VE system was initially constructed using the latest information technology, including the relevant framework, but it created many problems surrounding the system maintenance and user convenience. To improve and upgrade the system, this study applied the e-government's standard framework, removed the unnecessary Active-X, and adopted the Web standards for boosting the Web access and compatibility.

The initial screen of the improved CPIPS is shown below. The design VE system is located in the middle of the screen.



Figure 4. Initial Screen of CPIPS (Reformation)

The improved design VE system function again has six major functions, which include the registration of the design VE results, the registration of the review results, the management of the design VE results and statistics, the summarization of the design VE, and the best cases of design VE. Also, the system users were reclassified into three categories, which include general users (non-members), general users (members/login), and design VE staff. They were allowed to share among them all the design VE information.

The user registration and the functions for each user of the design VE system are shown below.

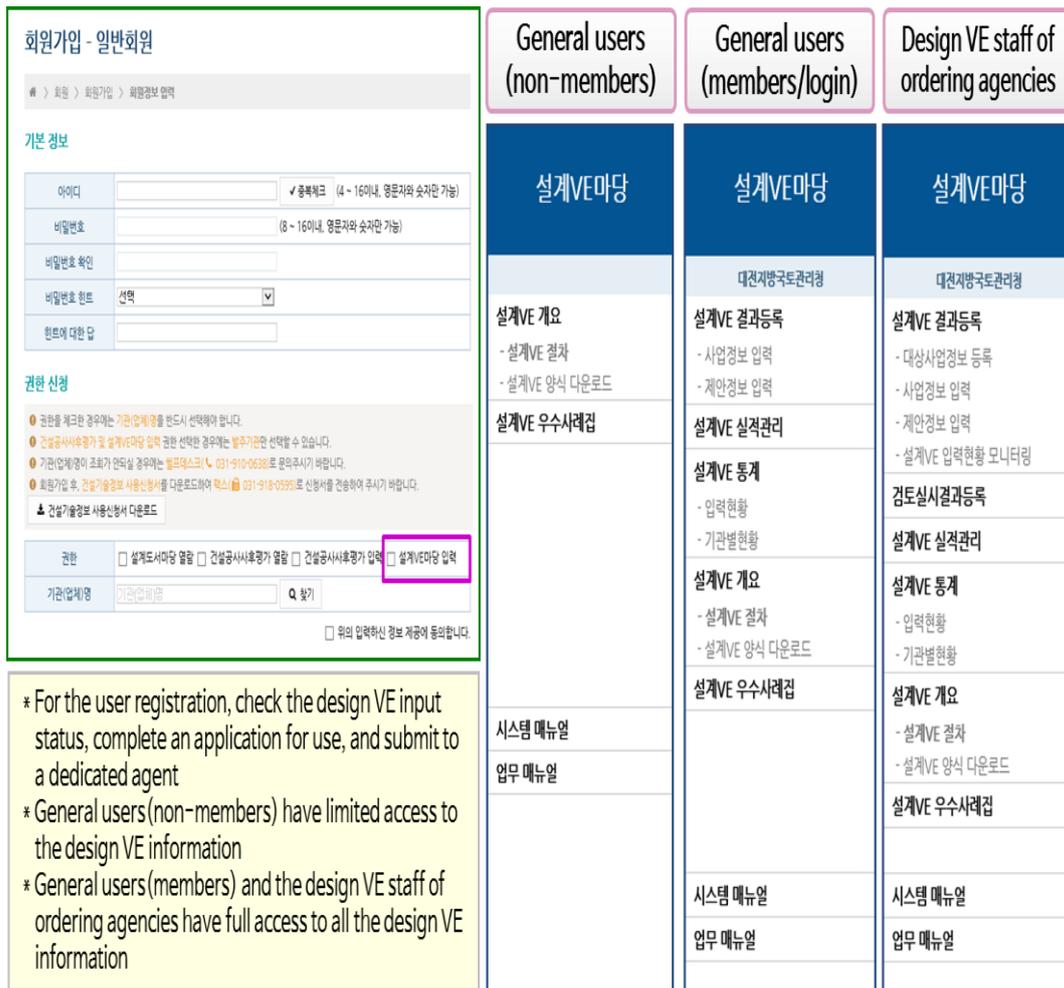


Figure 5. Functions for Each User of the Design VE System

The existing design VE system changed its input and management items in line with the amendment of the VE guidelines, and created the many input items problem. Also, the existing analysis and statistical function involved mainly text information, which made it difficult to analyze and use the design VE input data.

This study addressed these problems and streamlined the input function, pursuant to the guidelines for the amendment of design VE. To simplify the design VE information input and to improve the search and statistics functions, the Design VE project information table, the design VE final results table, and the results review table were added. The design VE project information table had the additional project type information column in DB.

A DB data model of the design VE system is shown below.

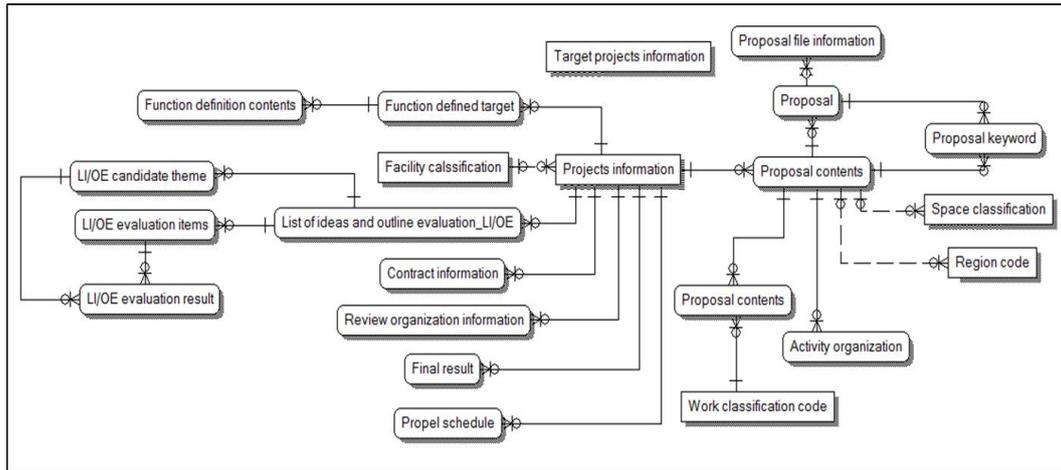


Figure 6. DB Data Model of the Design VE System

To simplify the input, the system was improved in this study to establish, as the selective input items and not as the mandatory items as with the existing system, the evaluation statistics, project schedule, quality model, and other information in connection with the input of the proposed information, and to comprehensively register "the list of ideas and the evaluation outline table" that especially had a huge input quantity in the form of Excel files. Also for the input of project information, "turn-key base/alternative tender project", "technology offer tender project", and "public private partnership and design competition project" can be selected for registration. The system was updated to be able to retrieve this information by project type.

The collective upload function of the design VE excel file is shown below.

Target Name	Function Definition Nouns	Function Definition verbs	Function Classification	Notes
인천국제공항 제2여객터미널	위험공정 경쟁력	확보한다	최상위기능	
인천국제공항 제2여객터미널	국내외 항공수요 증가에	대비한다	주기능	
인천국제공항 제2여객터미널	인천국제공항	건설한다	주기능	
인천국제공항 제2여객터미널	최종단계 사업	완성한다	주기능	
인천국제공항 제2여객터미널	3단계 사업	완성한다	주기능	
인천국제공항 제2여객터미널	제2여객터미널	운영한다	주기능	
인천국제공항 제2여객터미널	T2 전면시설	건설한다	부기능	
인천국제공항 제2여객터미널	승객용 T2로	수송한다	부기능	
인천국제공항 제2여객터미널	T2의 연결통로	제공한다	부기능	
인천국제공항 제2여객터미널	에너지 파이프	건설한다	부기능	
인천국제공항 제2여객터미널	공명시설	건설한다	부기능	
인천국제공항 제2여객터미널	Landscape	건설한다	부기능	
인천국제공항 제2여객터미널	Airside	건설한다	부기능	

Figure 7. Collective Upload Function of the Design VE Excel File

The system was recomposed to boost the analysis and statistical function. Towards that end, the design VE input status and the status data by project size, by review stage, and by review type, among other status data by ordering agency, were expressed in the form of chart-type visualized information. Thus, the design VE performance results by ordering agency can be comprehensively analyzed by project size, by review stage, and by review type. This analyzed information is expected to be used as the basic data for comparatively evaluating the project performance results. [6]

The design VE input status and statistical data by project size are shown below.

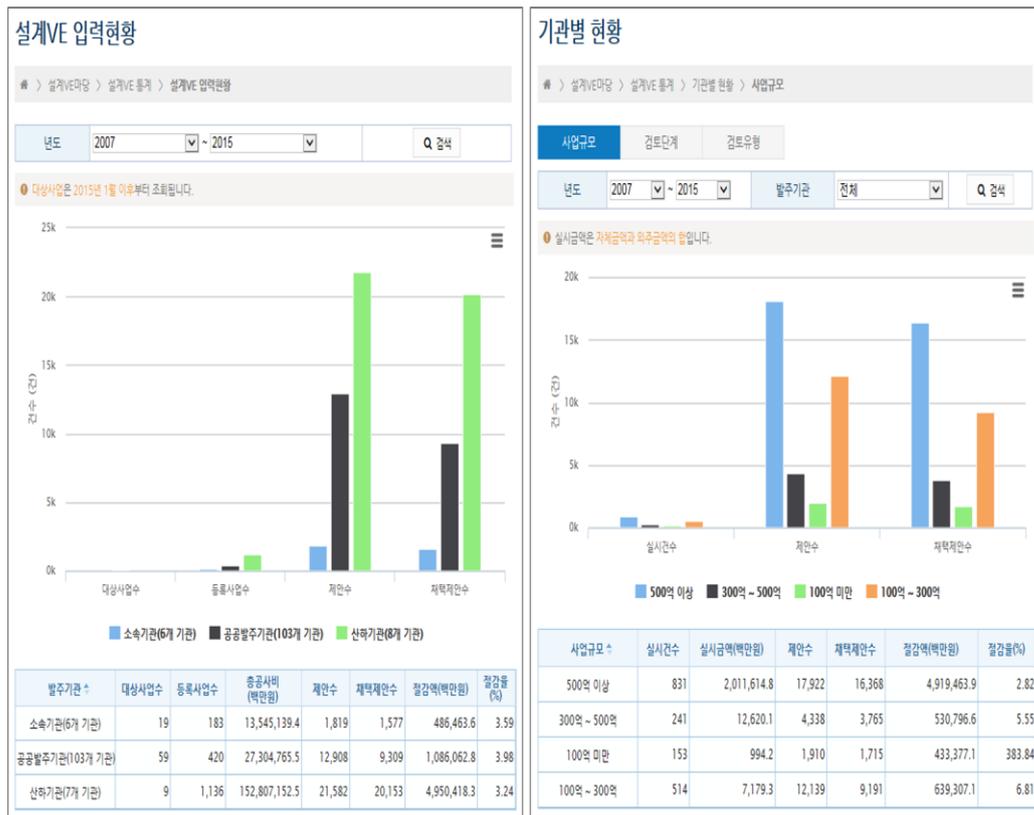


Figure 8. Statistical Data of the Design VE System

The design VE system of MOLIT is expanding to MOLIT's own and subordinate agencies, other departments, local governments, and public ordering agencies through the combined management of the design VE information and consistent operation.

The reliability of the accumulated data needs to be improved through consistent operational support for the design VE information to be utilized for similar construction projects in the future. Also the link to the design VE system of subordinate agencies is required to prevent double input of the design VE information.

3. Conclusion

The design VE is performed to obtain the best value at the minimum LCC. It analyzes the project's functions to come up with alternative measures. As such, it is a systematic

process that involves cooperative work across various professional areas; and the function analysis, ideas, and proposal information should be used as reference data for similar construction projects.

To ensure efficient implementation of public construction projects, MOLIT, together with the design VE program, systematically integrates and manages the post-evaluation results information by ordering agency, and operates the design VE system intended to use such information and data.

The existing design VE system, however, focused simply on the accumulation of data and the provision of statistical information.

This study reflected the requirements and boosted the visualized statistical function under the amended design VE performance guidelines, to present measures for upgrading the system so that it would refer to and use the design VE results information in the performance of similar public construction projects.

These proposed improvement measures are expected to assess the comprehensive analysis of the design VE performance results, to share the design VE information with the ordering agencies and design firms so as to come up with effective alternative measures, to reduce construction project costs, and to improve the quality of construction projects.

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