

## **Information-Oriented Integrated Design Management System**

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### **Abstract**

A construction design project follows a complex process of designing corporeal buildings from incorporeal information. With construction projects becoming bigger, there are now more participants in a single project. This makes the communication and information flow among the project participants a key success factor of the project. Moreover, unsystematic and qualitative design management has made it difficult to accurately manage design work. This reality has been detrimental to the development of the design industry. For effective design management, a computerized design management system that controls design information and its flow is needed. This design management system must guarantee a uniform quality of design outcomes, regardless of personal experiences.

This research is based on the concept that if an integrated design management system can reduce the management efforts of designers, design quality can be improved. An information-oriented integrated design management system is hereby proposed. The following three design management system applications are presented: design documents management, design personnel management, and design progress management. A design documents management application was developed based on the design work process, and a methodology that can be applied to design progress management was developed using design work and design products. Also, using the information accumulated during the design process, the resources that must be inputted into design work were analyzed. All these three design management tools are not separate from each other but are connected to each other so that one input datum can be used for two different aspects and will result in different managerial outcomes.

### **Keywords**

Integrated design management system, Information-oriented design management

### **1. Introduction**

The architectural design products that have recently emerged are more complex than the older ones, and have a larger scale (Gray and Hughes, 2001). After many years and considerable efforts at perfecting and promoting a computerized management system for the building construction field, such system is now commonly used. Unlike construction work, though, architectural design work has a creative and repetitive character (Choo *et al.*, 2004); and, as such, its computerized management, and even the more basic concept of its management, has not yet been perfected. This makes design work vague and its process less systematic, but it is difficult to change architectural designers' minds. Many studies have been conducted to improve architectural design performance, but most of these studies are conceptual and do not suggest

a specific approach. It is important to develop a design management system for quantitative design management.

Thus, this research seeks to develop a quantitative design management system that needs the least degree of additional efforts from architectural designers.

## **2. Scope and Procedure for Study**

An architectural design management system can manage many factors. Such factors can be the design quality, the schedule, collaboration enhancement, and so on. This research focuses on three management factors: design documents management, design personnel management, and design progress management. These three factors are the three primary management factors (time, cost, and quality) in all kinds of projects. Three corresponding design management system applications were developed, and possible connections among the three applications were suggested.

## **3. Design Management Applications**

The following three design management applications were developed as web-based system applications. All the user interfaces (UIs) are realized on the Internet.

### **3.1 Design Documents Management Application**

Design documents management is the most important factor in an architectural design project. Because all the design information is contained in the documents, such documents are the project's ultimate deliverables. Successful design management can be achieved not only by controlling the final documents, but also by managing all the design documents produced in the entire design process.

Process setting and assignment of a person in charge for each process has the purpose of setting the processes that must be carried out in each project when a new project is set up in the system. This process contains the information on the design outcomes for each design activity.

Once the standard processes proposed in this study have been implemented in the system, the project setup begins by loading the standard processes. After checking and reorganizing all the standard processes, system users who belong to the project can be assigned to each microprocess from a new window. Assigning a person in charge for each microprocess allows architects to clearly understand the process that they must work on, and to easily find out the required information and the output linked to the process.

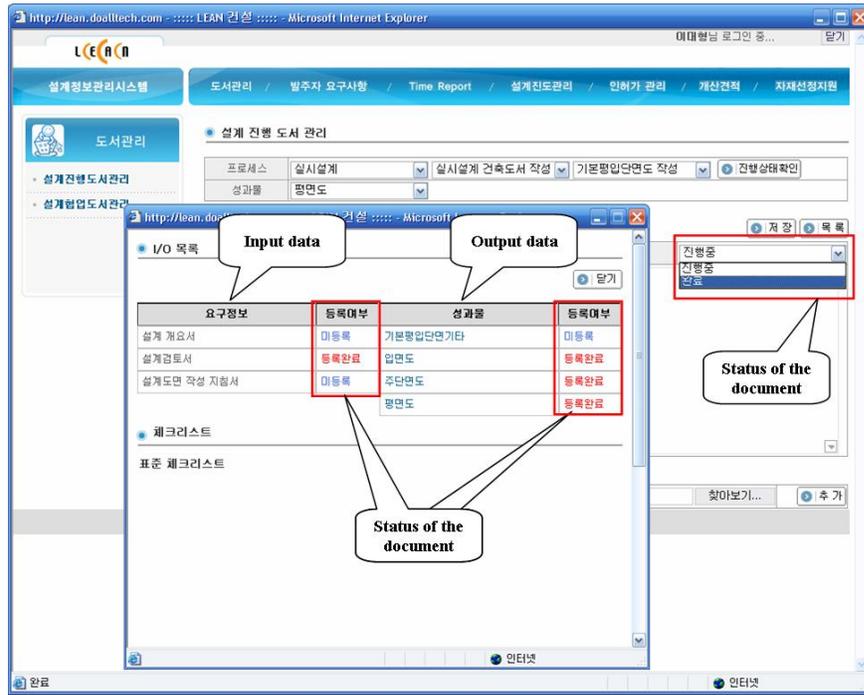
Every piece of information is registered in the design information list, which is set up as a message board, and work information is registered by posting a message on the board. When registering a drawing, a subject that can be intuitively understood must be chosen. The drawing numbers are automatically inputted based on the organization and process of the user, as well as the drawing type and progress status setting at the bottom of the UI. The drawing numbers were adopted from those of the Korean Ministry of Land, Transport, and Maritime Affairs.

The system was designed in such a manner that users must select a drawing type from the output list defined in the standard process, to enable clear understanding and delivery of information in the process. Moreover, the progress status of tasks must be registered as either "in progress" or "completed," so that the users of the following process can easily refer to this. Additional notes can be directly inputted, and users must personally find and register the drawings they have worked on. For the names of the attached

drawings, instead of the drawing name set by the author, automatically generated drawing numbers are saved in the system for easy searching of drawings.

The system was developed by designing the UIs for each function in the system at the same level as the UI for the process registration and assignment of the person in charge, and the UI for the registration and modification of drawing information.

Figure 1 shows the UI of the design documents management application.



**Figure 1: UI of the Design Documents Management Application**

The status of each design document is shown in red characters when it is registered in the system, and in blue when it is not.

### 3.2 Design Progress Management Application

Up until now, the management of design project implementation in design firms has been limited to final drawings such as drawings for a permit application. In the design progress management methodology proposed in this study, the objects to be utilized in design progress management are divided into design work and design progress products. As mentioned before, the information required for design work used to be centered on design and design product information, and such information was closely investigated for each tertiary classification process. It is difficult, however, to quantify such information in the conceptual and schematic design stages, and depending on the project conditions, such information is also frequently omitted, combined, or corrected. It is more effective to determine the design progress by focusing on whether the works have been completed in the tertiary classification process units, than to impracticably manage the design progress on the basis of design progress information in the early design stages.

On the other hand, in the development and construction design stages, which are the later design phases, the design progress may be managed by prioritizing the design works in the tertiary classification process units, as mentioned above. When the design works have been proceeding for a substantial amount of time,

the actual work flow can be determined with the flow of the design products because of the characteristics of the design stages. Also, the design progress may be managed with the design progress products because the progress has a direct impact on the final design products in each primary classification stage unit.

Thus, there are two design progress management methods: one method that prioritizes the design works, and another method that prioritizes the design progress products. The first method calculates the number of completed works or design products from the total number of design works or design progress products to determine the design progress. The second method considers the different time weight values of each design work or each design progress product when the work or product is completed. In the conceptual and schematic design stages, in which management of design work units is desirable, a simple management method based on design works and a weight value allocation method are available. In the development and construction design stages, in which management based on design work units or design progress product units is possible, there is a simple management method and a weight value allocation method that are both based on design works. Furthermore, there is a simple management method and a weight value allocation method that are both based on the design progress products. Thus, a total of four methods are available. Such design progress management methodologies can be arranged as shown in Table 1.

**Table 1: Design Progress Management Methodologies**

Methodology	Applicable Primary Process				Treatment
	PD	SD	DD	CD	
	Design progress management based on processes – Normal	√	√	√	
Design progress management based on processes - Advanced	√	√	√	√	Identifying the design progress by counting the number of tertiary processes completed and multiplying it by their weighted value
Design progress management based on products – Normal			√	√	Identifying the design progress by counting the number of products completed out of the total number of outputs
Design progress management based on products – Advanced			√	√	Identifying the design progress by counting the number of products completed and multiplying it by their weighted value

Designers and design managers can choose the proper options for their project from these design progress management methodologies at the early stage of a project and can change them at any time during the project. The UI of this design progress management application is shown in Figure 2.

To enable the user to directly select and use the methodology proposed in this study, a design progress management setting function is incorporated into the system. The user can select one of two management options from a general management option, and one or two options from a high-level management option based on the conceptual and schematic design processes. For development design and construction design, a general management option and a high-level option based on products can be selected, in addition to the above two options. Thus, a total of four options may be selected. For each option selected, the lists of processes and products and their relative time weight values can be checked.

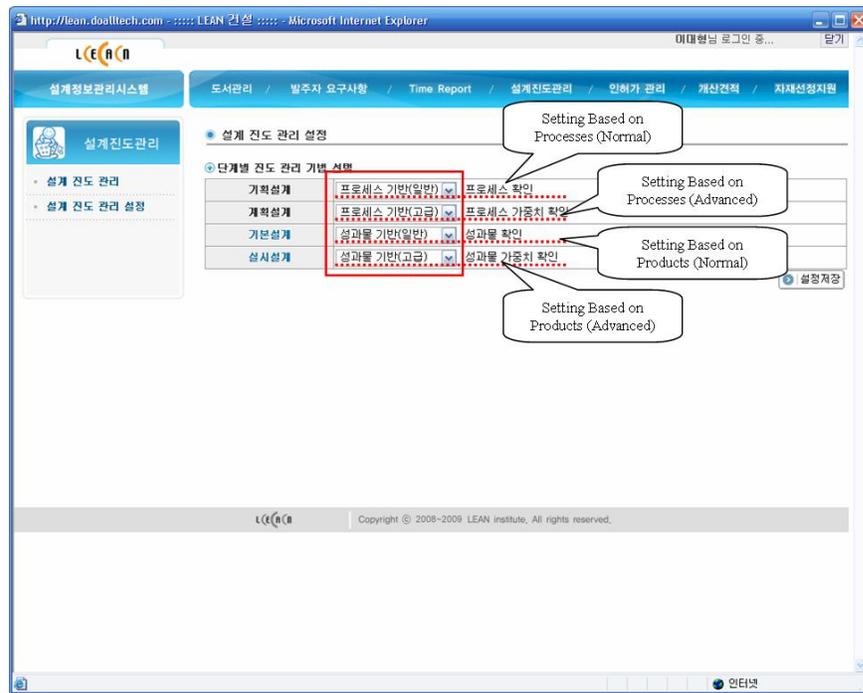


Figure 2: UI of the Design Progress Management Application

### 3.3 Design Personnel Management Application

In design companies, manpower is the main resource. Usually, many design projects are simultaneously running in one design company, and one designer is normally obligated to several different projects. For this reason, it is not always easy to level the manpower. In this research, a design personnel management application is suggested to help design managers easily track their manpower status and spread it if needed. To utilize this application, designers should register their working hours for their activities in the application. Their assigned activities in the design process are given, so all they need to do is register their working hours and confirm whether the activities have been “completed” or are still “in-progress”. Figure 3 shows the UI of the design personnel management application.

If this application is continuously and constantly used, a design company can obtain reasonable data on the average manpower required for specific activities, and these data can be used to demand a proper price for change orders and re-works.

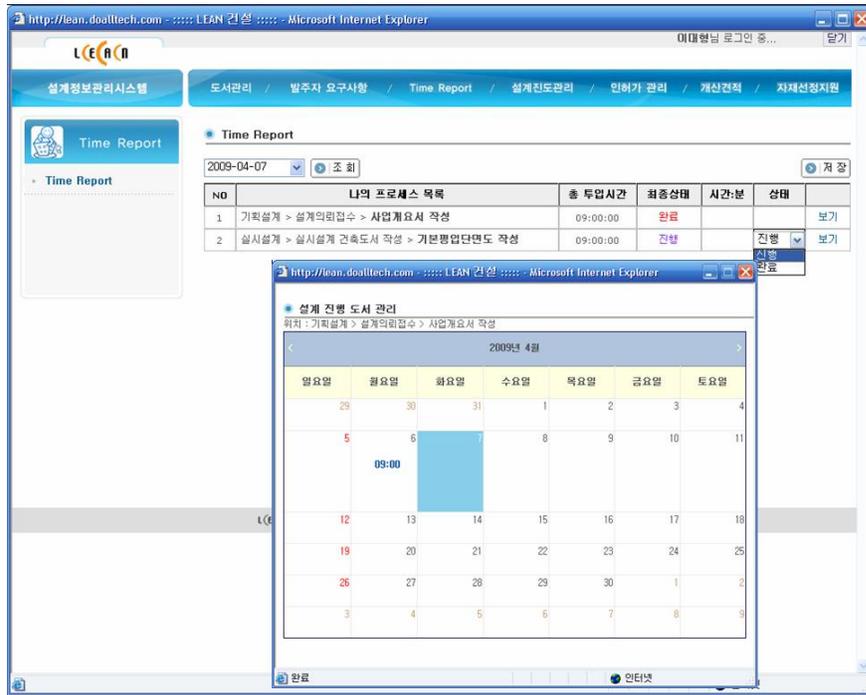


Figure 3: UI of the Design Personnel Management Application

#### 4. Integrated Design Management System

None of the three design management applications described above stand alone in the Integrated Design Management System. Figure 4 shows the concept of the integrated design management system.

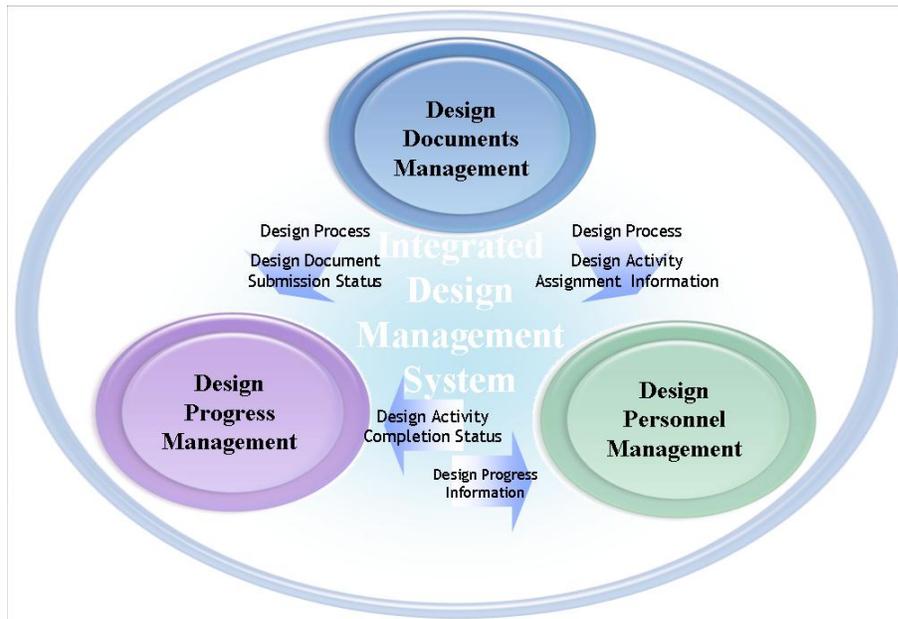


Figure 4: Integrated Design Management System

When a design work process is fixed for a design project, it is sent to the progress management application to calculate the relative time weight value of each design work activity and product, and it is also sent to the personnel management application to give room for the designers to register their working hours. When a completed design document (product) is uploaded to this system, the design progress management application adopts the signal and reflects it on the progress of the design phase for which the product-base option was chosen. Also, when an activity is checked as completed in the design personnel management application, the design progress management application adopts the signal and reflects it on the progress of the design phase for which the process-base option was chosen.

With the two additional operations other than the designing, uploading of the design, and registering of one's work hours to the system, the project team can use the management data to run the project effectively, and the design company can obtain valuable data for future projects.

## 5. Conclusion

Architectural designers are very proud of their work as works of art, and as such, do not consider the management concept suitable in the architectural design field. There is no doubt that architectural design work requires creativity, and this makes it difficult to manage such work. As construction projects are becoming bigger and more complex, however, the architectural design field cannot avoid adopting the systematic management concept. In fact, the integrated design management system that is proposed in this research can make designers concentrate on design work itself. The designer can focus on design work because this system reduces the time designers must spend away from their design work, by offering design management applications that require minimum resources and maximize management.

This research suggests an efficient design management system that can change the architectural design field. Broadening this design management concept, however, will require continuous user education and advertisements.

## 6. Acknowledgement

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