INFORMATION-ORIENTED DESIGN MANAGEMENT SYSTEM PROTOTYPE

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Abstract. The construction design project is a complex process that makes corporeal building from incorporeal information. As construction projects become bigger, more participants join together for a single project. Thus it makes the communication and information flow among the project participants become a key success factor of a project. For effective design management, a computerized design management system that controls the design information and its flow is needed. It is the roll of design management system to guarantee uniform quality of design outcome regardless of personal experiences. This research aims to propose a prototype of the design management system. In this research, actual design work process data have been analyzed and that the standard design work process has been proposed. For each standard design work process activities, input and output information have been defined and relationships between each activities are defined using the input and output of the activities Entity Relationship Diagrams(ERD) for each system function are designed to reflect the information-centered design work process. Based on the ERD, User Interfaces(UI) for the system prototype are designed to give convenience to system users. If the system prototype suggested in this research is developed to web-based design management system, the competitiveness will be advanced.

Keyword : Information-centered, Design Management, System Prototype

1 INTRODUCTION

Architecture design is a process of planning a tangible building on a tangible land through intangible work. Due to this characteristic of design work, conventional design management was conducted around the drawings as the final outcome with concrete forms, and the actual individual steps of design were excluded. As a result, design work completely depended on the individual abilities and experiences of each architect, and even aspects such as the organization of information required for design, or the utilization of existing design data, were
considered to belong to the domain of individual ability.

While it is possible to gradually improve the quality of one architect who works on different design outputs through education and training, the role of systematic management should be to guarantee similar levels of quality from different architects with similar abilities in similar projects. Therefore, efficient design operation and management, outside the domain of individual design abilities, can be made possible simply by providing the appropriate tools for systematic management.

This study was conducted to develop a prototype for an information-oriented design management system, which allowed architects to easily access information to be provided in each design stage, and for design offices to improve the performance level of their company through the systematic storage of performance information after the completion of a project. To this end, we designed entity relationship diagrams (ERD) and user interface (UI) for an information-oriented design management system.

2. LITERATURE REVIEW

These days, interest in the assessment and standardization of design processes is increasing among the large design offices, and there have been attempts to build this standard process into a system. In academic circles as well, there have been studies regarding the idea of approaching design management from the perspective of information management. Before presenting our research, we will review some important prior studies related to information-oriented design management systems, which is the theme of this study.

Bae et al (2006) in their study, "A Suggestion for Design Process Improvement to Develop a Design Management Model," analyzed the design processes of domestic companies, and summed up the three factors for improvement of design abilities as detailed and clear work definition, information flow-oriented work definition, and strengthening of tasks related to design management.

Shin et al (2006) in their study, "Introducing Information-oriented Work Process Modeling Method for Effective Design Management in Design Collaboration," identified the types and flows of information exchange that occur during collaboration between design participants, and proposed a process modeling technique for constructing a computerized real-time design management system by modifying IDEF0.

Bae et al (2007) in their study, "Development of Architectural Design Process Model for Information Flow," divided the entire design process into the five steps: preliminary design, schematic design, plan design, basic design, and implementation design, and defined subcategories from these five steps. They proposed a basic model for design management through templates to identify the outputs from each subcategory level and understand their correlations.

Even though these past studies surveyed the status of domestic design management and systematically approached design management techniques from theoretical viewpoint, they fell somewhat short in understanding the domestic design process, and in any consideration of a system for design management that could be applied to actual work in the future. Moreover, even though some studies defined important checkpoints in the progress of design work and
the flow of knowledge and information, studies on actual design performance procedures and the generation and delivery of the information related to this were somewhat insufficient.

This study analyzed design work processes at the working level through actual results data. We examined the work definitions by subcategories of actual design operations, along with the input and output information for each process, so as to propose an information-oriented standard design process for the construction of a design management system, and developed an information-oriented design management system prototype for utilization and storage of information that is generated and communicated from design work.

3. DEVELOPMENT OF SYSTEM PROTOTYPE

The first page must contain the Title, Author(s), Affiliation(s), and the Abstract. The Introduction must begin immediately after the Abstract, following the format of this template.

In order to implement an actual design management system from the derived information-oriented standard design process, we need to design a system that can manage information flow during the design process.

Figure 1 is a conceptual diagram of the design management system prototype developed from this study.

![Conceptual Diagram of System Process](image)

Figure 1: Conceptual Diagram of System Process

Basically, a process begins when the previous process generates output information, which is then provided to the next process as input information. If there is one person in charge of a process, the person in charge generates output information and saves the final version in the system, and it is automatically delivered to the following process as input information. If there are multiple persons in charge of a process, and there are multiple pieces of output information to be generated, each person in charge performs their role using the input
information. If one piece of output information is generated by one person in charge, he or she may directly save the final version of the output he or she prepared in the system. However, if two or more persons in charge must prepare one piece of output information, there must be a feature to allow them to share continuous feedback, and establish whether or not the information under work is in progress or completed, so that the progress of the information can be checked through the file database in the system.

3.1 Entity Relationship Diagram (ERD)

The title should be written centered, in 14pt, boldface Roman, all capital letters. It should be single spaced if the title is more than one line long.

ERD is a graphical representation of the relationships among entity types derived from each analysis of operations. This is the most important notation and output describing the correlations between data flow and process in actual projects (Lee, 2005).

What we wanted to implement most on the system in this study was the connections between and configuration of design process, project, and users based on information. To this end, we defined the list of all design information as the common denominator of all projects, rather than as a specific project and the required information and results for each micro design process.

Further, we linked each micro design process to the person in charge, so that the confirmation and storage of information required by the architect will be conducted systematically.

Figure 2 is a partial illustration of the ERD of the basic system configuration among the ERDs that comprise the total system.

The groups of entities that comprise the system can be broadly categorized as process
group, project group, and user group. The process group was designed on the basis of the information-oriented standard design process mentioned above, and flexibility was obtained by allowing the user to add or delete items from the process list. In other words, each micro process defines input and output information, which allows every piece of information that needs to be managed in the entire process to be linked to the list of input/output information. One output is set as the input of another process, and parallel linking of information is allowed rather than serial linking so that no discontinuity will happen in the process. Therefore, one process can have multiple pieces of input information, but only one piece of output information, and thus the design process and information can be flexibly integrated.

With regard to the project group, one process can be set for each project and linked to project information, so that when similar project data is queried later, the information generated from the project design process can be systematically retrieved and utilized. Furthermore, each micro process can be assigned a person in charge, of any of the system users, so that individual architects can easily understand the tasks that they must carry out, as well as the input information required for the task at hand and the output information that they must generate.

With regard to user groups, many vendors can be registered in the system by vendor type, and when a new project is set up, a user can select vendors from among the registered vendors by type, and create an organizational chart. The personal and corporate information of system users can be linked, so that the system can actively respond to projects designed by one vendor, as well as to joint design projects involving multiple architects from various vendors.

Figure 3 illustrates an ERD for the implementation of a function to store design drawings among the ERDs for implementation of detailed functions.

![Figure 3: Progress Information Storage ERD - Drawing Storage](image)

The ERDs among the design progress information related to the storage of drawings include the same entities (e.g. project entity, process entity, user entity, I/O list) as the system.
default ERD. Another entity that needs to be noted among the drawing storage ERDs is the drawing information group. The drawing information group consists of drawing information entity, drawing file entity, drawing quality management information entity, and data transfer information entity.

Every piece of design process information including drawings is set in the total I/O list from the step of standard design process setting. Therefore, every piece of information is assigned to each micro process operation of the corresponding project, along with the corresponding code information. As there is a person in charge set for each process, each drawing contains information about the person in charge as well.

Data transfer codes were set to prepare for cases when data must be sent to other vendors during the process of design collaboration. In particular, drawing quality management codes were also set because drawings are the target of quality management. Even though the standardization of drawing information number settings were not set up in detail because they were not included in the scope of this study, we also included code assignment for drawing files and automatic naming of drawings in the drawing storage ERD to prepare for additional studies, or the possibility of government guidelines regarding drawing standardization in the future.

3.2 User Interface (UI)

After the system prototype design was completed, we designed the user interface for actual system development. We can say that while ERDs define the relationships among elements of the system, UIs propose methods by which users can easily use the system functions based on the relationships between entities.

Figure 4 shows a UI for project process setting and assignment of person in charge among all the UIs of the system by function.

Figure 4: UI for Project Process Setting and Assignment of Person in Charge
This function of process setting and assignment of a person in charge was mentioned in relation to project group in Figure 2 above. Process setting and assignment of a person in charge for each project 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.

Once the standard processes proposed in this study have been implemented in the system, the project setup begins by loading the standard processes. When the standard processes are loaded, you can view them by using the drop down menu for each macro, main, or micro unit. After checking all the standard processes, you can delete unnecessary processes or add new processes according to the characteristics of the project, and assign persons in charge of each micro process to set up the design process of the project. This operation can be directly accessed by right-clicking on the process you want to modify from the total process list.

An operation that is possible in the macro process unit is deletion of process. If a macro process is deleted, the main and micro processes belonging to the macro process are automatically deleted as well. Operations that are possible in main process unit are deletion of process and addition of micro process. If a main process is deleted, the micro processes belonging to the main process are automatically deleted as well. When a micro process is added, it can be added as a subordinate step of a main process. In the micro process unit, deletion of process and assignment of process user are possible. If a main process is deleted, the corresponding micro processes are deleted. For assignment of process user, you can assign system users who belong to a project to each micro process from a new window. Assigning a person in charge for each micro process allows architects to clearly understand the process that they must work on, and easily find out the required information and output linked to the process.

Figure 5 is the UI for registration and modification of drawings among the design progress information.

Figure 5: Drawing specification registration and modification
This is the system UI for the drawing storage ERD defined in Figure 3. The function to send data to other vendors was separated from it, and the UI for registration and modification of drawing information was designed.

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, you must choose a subject that can be intuitively understood. The drawing numbers are automatically input 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. Drawing numbers are outside the scope of this study. These arbitrary drawing number input rules can be modified at a later date.

The system was designed in such a manner that users must select a drawing type from the I/O list defined in the standard process, so as 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 input, and users must personally find and register the drawings they have worked on. For the names of attached drawings, instead of the drawing name set by the author, automatically generated drawing numbers are saved in the system for easy search of drawings.

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

4 CONCLUSION

Because there are no clear standards for design process in design offices, design operations depended on the past experiences of the persons in charge, and design management mainly depended on the management of drawings. Recently, interest in a standardized design process is rising among the larger design offices, but they are pursuing their own standards, which is an activity that is far removed from the establishment of one standard covering the entire domestic design industry.

This study was not to propose a standard design process, but suggested variable design process concept. If a system is constructed on the basis of this information-oriented standard design process, a process can be defined by interconnections between required information and the output of each task, instead of interconnections between operations, giving flexibility to the actual use of the standard design process.

In the future, we may be able to develop a design management system based on the design management system prototype designed in this study, and improve the international design competitiveness of domestic design offices through the systematic storage of design information, flexible application that is adapted to the characteristics of the project, and the maintenance of consistent design quality. The methodology of this study can be applied identically to all participants in a design project, from engineering companies to design offices.
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