

Information-centered Design Management for Effective Design Cooperation

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Abstract

As construction projects become bigger and more complex, the communication and information flow among the project participants becomes a key factor in the success of a project. The concept of design management and cooperation, however, has not yet spread widely in the architectural-design field, and the design cooperation processes have not yet been clearly defined. For effective design management, a computerized design management system is needed, and work process modeling is needed to establish the system. This research aims to propose a standard process model that will set the foundation for the improvement of the design management system.

The five elements that are needed to establish an information-centered design process are defined in this research, and two templates that can be used to identify these elements in the field are suggested. Finally, based on the definition and templates presented, information-centered work process modeling is introduced to represent the design process.

This study has made the following contributions:

1. Although the design process model proposed herein cannot be applied to all kinds of projects, the fact that this study was able to visualize and actualize the intangible scope of the design process is nevertheless an important contribution.
2. The templates for identifying design work elements proposed herein can be used to reveal the information relationships of design works.
3. The information-centered design process model can lay the foundation for the development of a computerized design management system.

Keywords

Design Management, Design Work Process, Process Modeling, Design Information Flow

1. Introduction

The architectural-design products that have recently emerged are more complex than the older ones, and have a larger scale (Colin and Will 2001). After many years and considerable efforts at perfecting and promoting it, the computerized management system is now commonly used in the building construction field. Unlike construction works, though, architectural-design works have a creative and repetitive character (Chu et al. 2004) and, as such, their computerized management, and even the more basic concept of their management, has not yet settled. This makes the design work vague and the process less systematic. 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 systematic design management, and to develop the system. The design process, particularly the actual design field, must also be improved.

The purpose of this research, therefore, is to suggest methods of developing the information-centered design work process and design management process model, and to lay the foundations for a design management system.

2. Research Scope

As part of the process of developing a design management system, the terms related to information-centered design management were defined in this study, and templates that can be used to identify the defined terms in the field were proposed. The five elements and the templates proposed in this study were derived from reference studies and from interviews with experts in the design field. Based on these elements and templates, an information-centered design process model was constructed and proposed herein. This design process model is similar to a prototype of the design process, and it needs to be updated by gathering actual project data. The research flow of this paper is shown in Fig. 1.

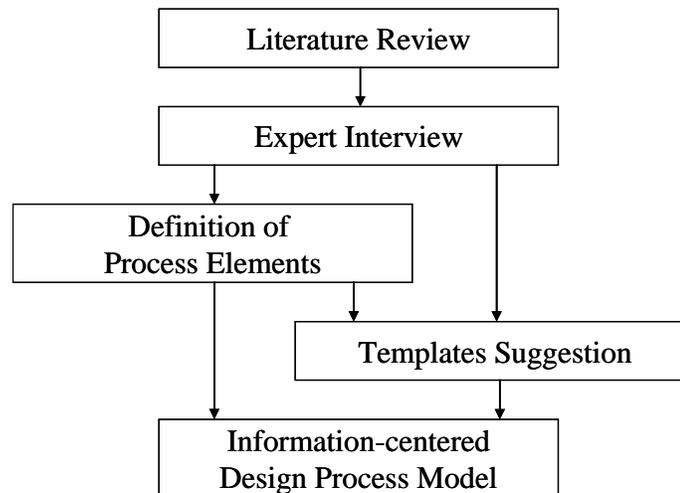


Figure 1: Research Flow.

3. Information-centered Design Work Process Elements

When dealing with a complex problem, the whole must be broken down into parts (Colin and Will 2001). In like manner, to apply a process model to an actual design work, a standard design work process has to be developed. The standard design work process consists of five elements, and the fundamental rules for the development of each element are as follows:

3.1 Input and Output Information

There are four types of information that are needed to identify a unit design work. These are input, output, supporting, and guiding information. Input and output information may overlap—that is, an input information in one work can be an output information in another work. A supporting information is an information that affects a certain work but is not essentially needed for the work. Finally, guiding information such as laws and guidelines are not generated by design works.

3.2 Unit Design Work

The design work processes used in the field now, focus on the final drawings for government offices. For a design work to be identified through the related information, though, the focus must be on the design work and the information it generates or receives throughout its duration. Therefore, the scope of unit design works should be limited to works that generate work-related information. The types of information (input/output/supporting/guiding), and their data type, generated by each unit design work should be identified. The composition of a unit design work is shown in Table 1.

Table 1: Composition of a Unit Design Work

Class	Composition	Description
Producer	Function	A design work that generates work-related information
Information	Input	Information that is required for the accomplishment of the unit design work
	Output	Information regarding the output of the unit design work based on other information
	Supporting Guiding	Information that affects a unit design work Reference information such as laws and guidelines
Transfer	Data type	Format of an information

3.3 Design Work Package

Unit design works should be defined in greater detail and should be made clearer than the design process used in the field now so that the information they generate, and their relationship with one another, would be revealed. If their subdivision and clarification is too precise, however, they will not be manageable and realistic. Therefore, design work packages, which are groups of unit design works, are needed for better management. Design work packages are not a permanent concept but a variable idea that changes along with the changes that may occur in the project's circumstances.

3.4 Design Review

As both design and engineering companies go through each design process, a design review process is needed. This design review is not just a cross-checking of the final drawings but a confirmation of all the information that affect the decision making throughout the design process. The feedback and iteration of design works can be accomplished in this design review.

For unit design works and design work packages that involve iterative decision making, the last task should be a design review so that it could be decided whether to stop the iteration or not to. A design manager should be made responsible for the design review.

3.5 Design Cooperation

The cooperation in a design work can be classified into three types. The first is active cooperation, which is done through official meetings or consultation. The second is inactive cooperation, which is done within the design workers' minds. In this case, a design worker comes up with ideas regarding the parts of a design work based on his personal experience and intelligence, and proceeds by himself. The third is one-way cooperation, where a design company comes up with a design, and other engineering companies make use of it and address any problem it may have. All these types of cooperation have advantages and disadvantages, as shown in Table 2.

Table 2: Types of Cooperation and Their Characteristics

	Active Cooperation	Inactive Cooperation	One-Way Cooperation
Description	<ul style="list-style-type: none"> ▪ The project participants consult one another and meet throughout the design process. 	<ul style="list-style-type: none"> ▪ Individual design workers cooperate by coming up with ideas and pursuing these. 	<ul style="list-style-type: none"> ▪ The leading project participant comes up with a design, and the other project participants follow through.
Advantage	<ul style="list-style-type: none"> ▪ Communication is obvious and easy, thus facilitating complex design decision making. 	<ul style="list-style-type: none"> ▪ Easy and fast decision making 	<ul style="list-style-type: none"> ▪ Easy and fast process
Disadvantage	<ul style="list-style-type: none"> ▪ Loss of time and money 	<ul style="list-style-type: none"> ▪ Its outcome depends on the abilities of the individual workers. 	<ul style="list-style-type: none"> ▪ If the leading company fails to manage the project well, the whole project will crumble.

4. Templates for Identifying Design Work Elements

Since the ideas mentioned earlier about the design work elements are new or cannot yet be clearly identified in the field, efforts must be exerted to facilitate their identification. In this study, the following two templates are proposed for the identification of the design work elements:

4.1 Identifying Design Work and Information

There are seven categories that are used to identify the relationships among design works and information, and these are shown in Table 3.

Table 3: Categories of Templates for Identifying Design Works and Information

Task No.	The order of unit design works
Design Work Package	A work package derived from unit design works
Unit Design Work	A design work that generates information out of other information
Guiding Information	Existing information such as laws, guidelines, etc.
Output Information	All information regarding the output of a unit design work
Relation to Information	Relation between the target unit design work and the information
Required Information	Required information among the output information

An example of a template for identifying design work and information is shown in Fig. 2.

Template for Identifying Design Work and Information

Task No.	Design Work Package	Unit Design Work	Guiding Information	Relation to Information		Required Information	
			i				
1	A	a	I				
2		b	II, III				
3		c	IV	2	IV		
4	B	d	V	1	V		
5		e	VI, VII, VIII	2	VI	VIII	
6		f	IX, X				
7		g	XI				
8	C	h	XII, XIII				
9		i	XIV, XV				
10		j	XVI				
11	D	k	XVII				

Figure 2: Template for Identifying Design Works and Information.

The following are the steps in using this template:

1. Align all the unit design works according to their time frame, and group them into a design work package.
2. Provide all the guiding information needed.
3. For each unit design work, enumerate all the output information.
4. Make a copy for each unit design work (in this example, 11 copies).
5. Mark each copy as one unit design work (in this example, unit design work f).
6. For each unit design work, identify the relation between the unit design work itself and all the other information (designate essential information as “2,” and reference information as “1”).
7. Repeat the process 5-6 times until each unit design work copy has been marked accordingly.

In this example, for unit design work f, V, VI, and VII are input information, and V is a supporting information. At the end of this process, the relationships of all the unit design works and information can be identified, and the design work process can be finalized.

4.2 Identifying Design Review and Cooperation

There are six categories that are used to identify the cooperation type in each unit design work and design review, and these are shown in Table 4.

Table 4: Categories of Templates for Identifying the Type of Design Review and Cooperation

Task No.	The order of unit design works
Design Work Package	A work package derived from unit design works
Unit Design Work	A design work that generates information out of other information
Related Information	All information regarding the output of a unit design work
Type of Cooperation	Cooperation type in each unit design work
Active Cooperation	The project participants consult one another and meet
Inactive Cooperation	Individual design workers come up with ideas and pursue these
One-Way Cooperation	The leading project participant comes up with a design, and the other participants follow through
Necessary Review	Type of design review of each unit design work

An example of a template that can be used to identify the type of design review and cooperation is shown in Fig. 3.

○ General Review
/ Review when Required

Task No.	Design Work Package	Unit Design Work	Related Information	Type of Cooperation			Necessary Review		
				A	I	○	Person in charge	Manager	Client
1	A	a	I			√		○	
2		b	II, III			√		○	
3		c	IV	√				○	/
End of Package								○	
4	B	d	V		√			○	
5		e	VI, VII, VIII		√			○	
6		f	IX, X	√				○	
7		g	XI	√				○	○
End of Package								○	
8	C	h	XII, XIII		√				
9		i	XIV, XV		√			○	
10		j	XVI	√				○	
End of Package								○	
11	D	k	XVII	√				○	
End of Package								○	○

Active Cooperation: All kinds of meeting or consultation of project participants
 Inactive Cooperation: Cooperation made by design worker's brain
 Oneway Cooperation: Leading participant designs forward and other participants follow up

Figure 3: Template for Identifying Design Review and Cooperation.

As can be seen in Fig. 3, between the design work packages, the phrase “End of Package” is added. This task is for design review only. General review is the common type of design review, and review when required is the kind of review that is conducted when the situation calls for it.

After defining all the unit design works of every participating company, the relationships among the participants in each unit design work can be identified, and the design review process can be systemized.

5. Information-centered Design Management Model

The information-centered design management model in Fig. 4, which is based on the results of the aforementioned templates, is hereby proposed. For actual design management, this model should be used together with the templates.

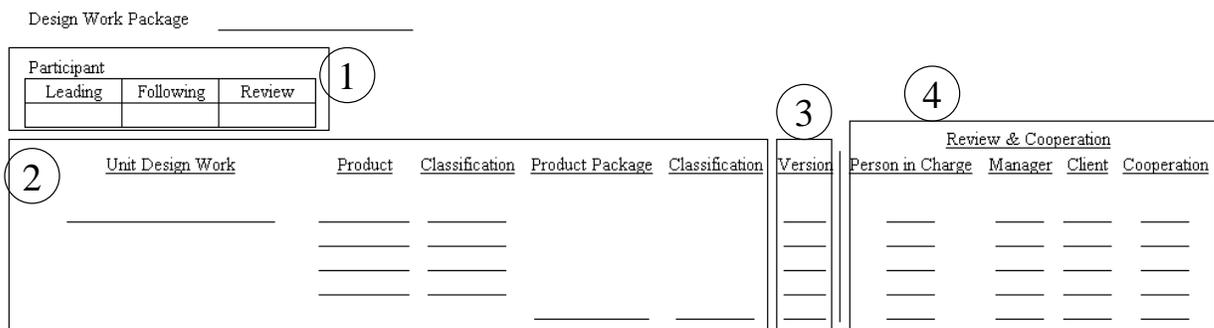


Figure 4: Information-centered Design Management Model.

The following are the descriptions of each part of the model:

Participants: The leading participant, the following participant, and the review participant are identified so that their respective responsibilities can be properly delineated.

Design Work and Product Details: These are organized with the unit design work and its products. Each product has a product ID, and the decision flow of one product can be tracked by the information flow between unit design works.

Track of Version: By keeping track of a product's version, the flow of the design process can be checked, and the confusion in terms of cooperation can be lessened.

Design Review and Cooperation: The design review of each product and the assignment of review points necessitate that every product has a person in charge of the review.

6. Conclusion

The outcomes of this study are as follows:

Fundamental rules for developing an information-centered design process were proposed.

Two templates that can be used to identify five design work elements in the field were proposed.

An information-centered design management model was proposed.

This study has made the following contributions:

Although the design process model proposed herein cannot be applied to all kinds of projects, the fact that the study was able to visualize and actualize the intangible scope of the design process is nevertheless an important contribution.

The templates for identifying design work elements proposed herein can be used to reveal the information relationships of design works.

The information-centered design process model proposed herein can lay the foundation for the development of a computerized design management system.

This research provides information that are important for design management. Further research involving case studies and verification can pave the way for the development of an information-centered design management system.

7. References

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