Abstract. The research proposed a mechanism to manage design communication information in an internet aided design system based on an issued-based and process-oriented approach. A system prototype with enhanced searching mechanism, named as DECADE, is presented to deal with the ill-structured problem of design communication data. The system performance is evaluated and shows effective results by empirical studies.

1. Introduction

Turing to 21st century, the trend of globalization has leading the needs to develop a design project across multiple domains through internet. There are many researchers having been focused on issues regarding with computer supported cooperative work (CSCW) based on information technologies (Mills, 1999; Kvan, 2000; Morozumi et al., 2001; Jabi, 2003). An internet aided design system to assist collaborators in developing a design project has become an important issue.

In this paper, in order to enhance the effectiveness of design communication in an internet environment, an issued-based and process-oriented approach to manage design communication data is proposed within an internet aided design system.

2. The Problems of Design Communication

Today, most internet aided design systems provide either email function or electronic whiteboard for design communication. However, with the limited functions of email or whiteboard systems, communication data are usually stored as sequential records in according with timing of information posted. Searching in these data, sometimes with files attached, it is not easy to find complete data addressing specific design issue and associate related information since the ill-structured nature of design communication data.

On another hand, from design practice point of view, it is important to develop a design project with efficiency based on time and budget limitations. A project leader should be responsible to lead the team members to conduct the entire project in accordance with time limitation. By using
email or whiteboard tools, design collaborators could communicate with each other “quickly”. However, a quick way to communicate doesn’t promise to develop a design project efficiently. Indeed, based on empirical studies, many designers are still doubtful about the “real” design efficiency through internet communication. The miss-understandings or miss-interpretations of design communication data are occasionally happened, especially while the team members have less of tacit knowledge (Lan and Chiu, 2005). Moreover, by using these “quick” communication tools, it is getting difficult to search data addressing specific design issue since the information overload problem is turning into obvious during the overall design processes.

3. An Issue-based and Process-oriented Approach

To deal with the problems of communication tools mentioned above, the research presents an issued-based and process-oriented approach to develop an enhanced mechanism for managing design communication data in an internet aided design system. The system prototype, named as DECADE, is initially developed based on our previous study (Chiu and Lan, 2005). In this research, DECADE is further developed with enhanced mechanisms for managing design communication data to reach the research intension.

Based on an issue-based and processed-oriented approach, the research intends to manage design communication data with a hierarchical structure according to specific design issue at specific design stage. To achieve the research intension, in DECADE, a design team is formed analogously to a real world situation. There is always a project manager who leads the design team to develop a specific design project. A project manager is responsible to coordinate the overall design tasks. He/She needs to set a consensual design process for the design group to follow. This consensual design process serves as a process-oriented mechanism to manage design communication data generated by the team members. The project manager is authorized to make an extensible, but avoid inconsistent, modification of the consensual design process, if necessary.

With the process-oriented mechanism, each team member is guided to raise design issue at specific design stage. Besides, a design issue raised might also raise other related issues for group discussion (Wolverton, 1999). However, based on issue-oriented viewpoint, these design issues can be classified and associated in a hierarchical structure with the process-oriented mechanism. The project manager is responsible to make the final decision for each design issue at specific design stage to move the project forward.

4. Design Information Management in DECADE

4.1. OVERVIEW

In this paper, the Design Information Management of DECADE is presented to illustrate the issue-based and process-oriented approach to manage design communication information. The functions of Design Information
Management include: 1) adding and setting new design projects; 2) modifying information related with specific design project; and 3) querying information regarding with specific design project. A few images showing the interface of Design Information Management is shown in Figure 1. The followings illustrate the general application of Design Information Management from user-oriented viewpoint.

![Image of Design Information Management interface]

**Figure 1. The Interface of Design Information Management in DECADE**

Once a new design project is assigned to a project manager by an architect, as Figure 1 shows, the project manager starts to create the basic data regarding with this new design project. These data include site address, land area, building cover ratio, floor area ratio, owner information, design requirements, and so on. Besides, a consensual design process mentioned previously is set by the project manager for specific design group to follow at this stage.

After the basic data of a new design project are created, the team members are authorized to develop the design project. They start to communicate with each other by the communication tools provided by Design Information Management. The functions of communication for each design group include: 1) uploading/downloading drawings; 2) a whiteboard for group discussion; 3) an on-line meeting tool; and 4) a message board. To explain the notion of managing design communication data based on issue-based and process-oriented approach, the whiteboard function is further introduced below.

### 4.2. THE WHITEBOARD FUNCTION FOR DESIGN COMMUNICATION

The whiteboard function of Design Information Management provides the capabilities to do collaborative design communication for each design group. Based on the process-oriented approach, each team member can only raise
design issue at specific design stage for group discussion within the whiteboard function. This is because there is a consensual design process for each design project, which was set by specific project manager. The purpose is to provide a good way to organize design communication data into an issue-based and process-oriented structure. These design communication data then can be queried and managed in a more meaningful framework. Besides, for each design issue raised, the team member could also attach related files with meaningful labels for group references. The developed whiteboard function provides the underlying mechanisms to index and associate the generated design communication data for further inquiry. A few images showing the interface of the whiteboard function mentioned above is shown as Figure 2.

![Figure 2. The Whiteboard Function for Design Communication](image)

5. Empirical Studies

To evaluate the capabilities of managing design information based on the issue-based and process-oriented approach in this research, two empirical studies to test system performances are illustrated below.

5.1. QUERYING INFORMATION FROM PROCESS-ORIENTED APPROACH

To search information of specific design project from a process-oriented approach, the system prototype provides a list of design processes for inquiry. This list is collected from the consensual design processes of various design projects in DECADE. Once a user queries information of specific design process, the queried result is shown in a visualization interface with a network-like structure from a process-oriented viewpoint. The design information structure based on process-oriented approach and sample queried results are shown in Figure 3. The followings examine the queried results to evaluate the system capabilities.
In Figure 3, the user queried information regarding with the design process named as “Site Analysis”. By using the developed visualization tool, the user can traverse backward to search information of “Site Analysis” in different design projects. This function provides the chance for users to share design experiences of various design projects in DECADE. On the other hand, the user can also traverse forward to search information of various design issues raised during the “Site Analysis” design process. This function provides the user to aware information of related design issues to avoid possible mistakes during the design process. The information visualization tool, which is developed by JAVA technologies, can assist users in getting more comprehensive information for supporting design decision making based on our previous study (Lan and Chiu, 2005).

5.2. QUERYING INFORMATION FROM ISSUE-ORIENTED APPROACH

To search information of specific design project from an issue-oriented approach, the system prototype provides a list of design issues for inquiry. These design issues are collected and organized into a hierarchical structure according to specific design process of specific design project. When a user queries information regarding with specific design issue, the queried result is shown in a visualization interface with a network-like structure from an issue-oriented viewpoint. The design information structure based on issue-oriented approach and sample queried results are shown in Figure 4.

Again, by examining the queried results in Figure 4, the user initially queried information regarding with the design issue named as “Noise Problem”. By using the information visualization tool, the user can traverse backward to search information of the design process named as “Site
Analysis”. Once the user makes a further inquiry to “Site Analysis”, he/she can also query the “Noise Problem” of different design projects for reference. Of course, the user can also traverse forward to search communication data regarding with “Noise Problem”, which were created by specific team member. Moreover, the user can make a further inquiry to search information related with specific design team member.

Comparing with DECADE, most internet aided design systems provide a loose structure to manage design communication data. Based on two empirical studies illustrated above, the issue-based and process-oriented approach in this research provides an effective way, not only efficient, to manage design communication data in an internet aided design system.

6. Conclusion

In this paper, an internet aided design system, named as DECADE, is presented to demonstrate the capabilities of managing design communication data from an issue-based and process-oriented approach. By conducting empirical studies, the developed searching mechanism in DECADE provides great potentials to manage design communication data during the overall design processes. The developed information visualization tool also provides a good system performance to assist user in finding comprehensive design communication data for reference.

For further studies, the research will continue to conduct more empirical studies and collect user feedbacks to evaluate the system performance. Besides, the information visualization tool will be studied further to explore issues about the information overload problems.

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References

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