THE DESIGN GUIDANCE OF CSCW

Learning from Collaborative Design Studios

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Abstract. Computer supported collaborative work (CSCW) becomes important for the architectural practice and design education in recent years. Design guidance on design operations facilitates design studios to achieve their educational and research purposes. This study depicts the experience of computer-supported collaborative design learned from three collaborative design studios. Design guidance can advise participants to understand the purpose of communication in CSCW, anticipate design collaboration, and formulate design operations by the process model. Based on the observations of CDS, the discussion focuses on how to develop guidance on design operations according to the following factors: (1) structured framework, (2) the kind of technology, (3) the level of communication, and (4) the process model of CSCW.

1. Introduction

Computer supported collaborative work (CSCW) becomes important for the architectural practice and design education in recent years. Design collaboration is not a separate activity, and CSCW should allow people to cooperate by overcoming barriers of space and time that imposed on people. Furthermore, CSCW motivates the development of systems and tools to encourage organization collaboration (Maher, et. al., 1997).

Virtual Design Studios are proliferating (Wojtowicz, 1995). The fundamental issue of design teaching is what is the primary goal of VDS? Kvan (1997a) indicates why many institutions are still willing to run a VDS, even the technology is not cheap to acquire and difficult to support. The justifications lie in both the educational and professional reasons. However, there are issues in CSCW besides the technology. To better understand the phenomena of design collaboration, VDS brings both the educational and research agendas into design studios. Indeed, VDS facilitates our understanding and learning CSCW, and also

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provides the test ground for modeling the activities.
In the design context, the research issues include: (1) how to establish a working design environment, including hardware and software, (2) how to develop guidance on design operations, (3) how to systematically record, monitor, and analyze the design processes and the emerging design tools, (4) how to use the results of these studies as a starting point for modifying and evolving existing techniques and tools, and (5) how to construct a design collaboration model for describing the current design process or predicting future process (Mitchell 1996). These issues are correlated, and design guidance is the key to bridge the questions and answers.
Previous research focuses on how the technologies can facilitate the process of creating design through the provision of convenient communication interfaces, but is lack of provision of guidance on design operations, and subsequently documentation and analysis of the design operations. Without the design guidance, the educational and research goals can not be examined. Therefore, this paper depicts the experience of computer-supported collaborative design learned from three collaborative design studios (CDS) undertaken from 1995 to 1997. CDS have the similar platform as VDS, but more focus on the methodology of design collaboration. Based on the observations of CDS, the following discussion focuses on how to develop guidance on design operations.
To explain the experience, I will first define the role of design guidance on design operations, and develop design guidance according to the following factors: (1) structured framework, (2) the kind of technology, (3) the level of communication, and (4) the process model of CSCW. At the end of this paper, I raise issues for future design studio teaching and research.

2. Design Guidance on Design Operations

2.1. THE ROLE OF DESIGN GUIDANCE

Do we need design guidance in VDS? For those one tries to understand and contribute his/her works to an experimental project, the most important thing is knowing better about the essence of design operations, and available resources and supports. Therefore, participants can utilize available resource and position his /her role in the process in better manners. Particularly, the VDS carries not only the educational goals but also research goals.
Unfortunately, it is still vague in general for the first time tutor, students, and even jurors to participate the VDS because there is only few descriptions. In most cases, there may exist only the intentions or vision of design studios. Furthermore, the general perception of VDS is assuming that technologies will be used, exchange of ideas or comments will be required, and the design will be a teamwork project. Therefore, collaborative design is but just a collective design

done by individually and separately through the network.

To correct the perception, design studios need design guidance for ensuring education and research goals can be reached, data can be collected, and behavior can be analyzed. In short, the role of design guidelines is to provide the approach and the game rules for participants in design collaboration.

2.2. DESIGN PROCESS AND DESIGN OPERATIONS

We have to first examine the relationship between the design process and design operations. Basically, the process of VDS as shown in Figure 1 makes no difference from the process in traditional design studios. The design process is generally considered as a problem-based learning process, and also an exploration process. From the education point of view, designers are concerned about the change of design states from the concept to final presentation, and evaluation is based on design performance. From the research point of view, designers are concerned about the causes and outcomes of design thinking, and design analysis is based on the observations of design interactions.

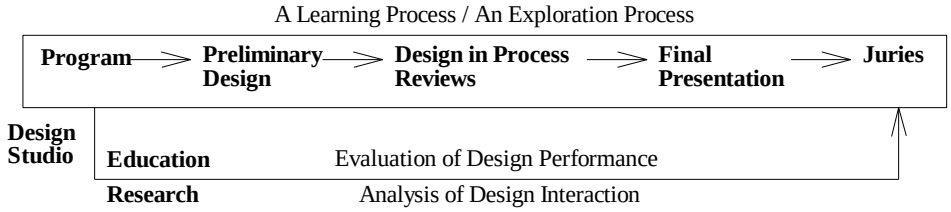


Figure 1. The design process in design studios

However, design collaboration in definition requires multiple participants who work collectively in different manners for the same project. VDS is different from the traditional design studios in terms of the format of organization and communication. In the process, design collaboration involves the organization, communication, and decision-making. In order to develop design guidance, four assumptions of design collaboration are made:

1. Organizations exist for communication.
2. Communications are undertaken for design decision-making.
3. Decision-making is applied for exploring design possibilities or solving design problems.
4. Technology can facilitate the effectiveness of communication and decision-making.

Apparently, design operations or activities are the central concerns of collaborative design. The collaborative process is characterized by "action-reflection-critique" (Ostwald 1995). We have to move the focus from representations to the causes of actions. The process shown in Figure 2 takes into account the design interactions caused by organization and technologies. The

design program and its contents provide the impetus for design collaboration. The design operations then can be documented and analyzed. Technologies are primarily used for communication.

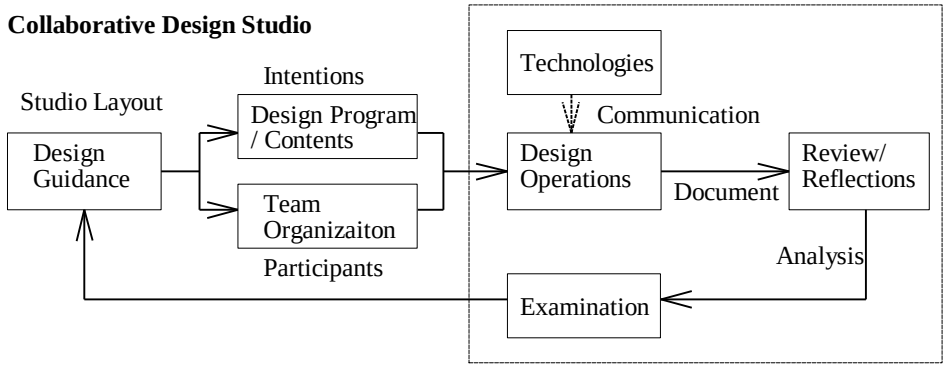


Figure 2. Studio settings

3. Development of Design Guidance

During the last three years, collaborative design studios (CDS) were held at Department of Architecture, National Cheng Kung University, in join with several institutions. The process and result of CDS'95 were reported in CAAD Future'95 (Chiu 1995). CDS'96 was also reported in CAADRIA'96 (Chiu 1996). While each studio has its own intention and research agenda, it is critical to achieve the follow goals:

1. Stimulates effective actions
2. Continues to build the knowledge base about design collaboration
3. Enhance the performance of collaboration
4. Develop solutions to problems raised

Apparently, we need better technology and process to stimulates effective actions, better experience to continues to build the knowledge base, better organization structure to enhance the performance of collaboration, and better tools and models to develop solutions to problems raised. The following sections will explain how the design guidance is developed.

3.1. THE CONTENTS OF DESIGN GUIDANCE

The contents of design guidance provide the snapshots of design operations. While the details of design operations can be trivial, the details of design guidance should be elaborated according to the needs of evaluation or analysis. A sample design guidance may consists of the following sections:

1. Mission statement / intentions
2. Program

a. The Scope of Works
b. Requirements - Function, Space
c. Schedule

3. Design theory or methods
4. Players
   a. Students / Teams
   b. Studio master or tutors
   c. Juries or virtual juries
   d. Technicians / Coordinators
   e. Others - Clients
5. Task
   a. Documentation
   b. Presentation - texts, images, animation, etc.
   c. Resource usage
   d. Peer learning
   e. Reviews / Juries - juries / virtual juries
6. Knowledge Resources
   a. Design information / regulations / references / cases
   b. Expertise
7. Technical Supports
   a. Setting up the network and the web site
   b. Tutorial lessons - such as homepage editing, image processing, computer modeling and rendering
   c. Networking, file transfer, e-mail, chat
   d. Teleconferencing
8. Grading Policy
9. Miscellaneous

For example, documentation is the fundamental task for evaluation and analysis. We tend to primarily document visual information to reveal the communication cycle in the design process, and particularly the themes related to design decision-making activities (Chiu 1997). The hypothesis of CSCW is that the frequency of communication is related to design decision-making, and changes of themes will be occurred during the divergence and convergence of design problem space. Documentation includes data collection, data organization, representation, analysis, and statistics during the process from the program to juries. If communication activities can be systematically recorded, monitored, and analyzed, then we can assess the usefulness of current design tools. Furthermore, we can use the results of these studies as a starting point for modifying and evolving existing techniques and tools.

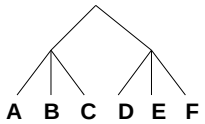
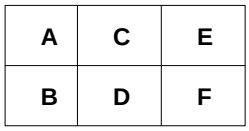
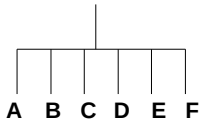
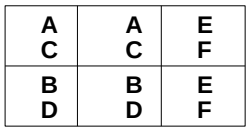
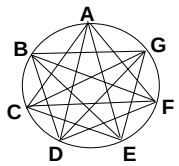
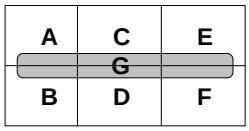
In order to allow the design process and interactions such as communication be monitored and documented, influencing factors of design collaboration should be considered. Learning the past experience of CDS, design guidance is gradually shaped by (1) the structured framework, (2) the kind of technology, (3) the level

of communication, and (4) the process model of CSCW. The follows will address the development of design guidance.

3.2. STRUCTURED FRAMEWORK OF COLLABORATIVE DESIGN STUDIOS

The design program should consider the arrangement of team organization and the site, while the design guidance should advise participants to focus the relation between the information flow and the impacts on design, and therefore constrain or simplify the documentation of the activities. As shown in Table 1, Studio CDS'95, CDS'96, and CDS'97 have different organization modes, team structure, and site assignment. This study examines three modes of collaboration and team organization, i.e., the team-oriented mode, the task-oriented mode, and the theme-oriented mode. These three modes are carried out in three studios respectively.

TABLE 1. Comparison of three CDS

Studio	Organization Mode	Team Structure	Site Assignment
CDS'95 Housing Project	Team-oriented mode	 Hierarchical	 Individual Site
CDS'96 Dormitory Project	Task-oriented mode	 Parallel team	 Overlapped Site
CDS'97 Future Community Project	Theme-oriented mode	 Parallel team	 Overlapped Site

In CDS'95, teams are organized by common interests, and each team is assigned to an individual site governed by the master plan. One team is responded for developing the master plan and facilitating design communication to solving interface problems. In CDS'96, teams are organized by the task requirements, and each site is assigned to two teams to study different approaches at the same site. Apparently, the operations in CDS'96 are more complex than CDS'95.

In CDS'97, color codes are used to represent seven key issues in the future

community project, and these issues are considered as seven design themes: red (energy resources), orange (building technology), yellow (social activities), green (ecological issues), violet (computer and communication technology), cyan (transportation), and blue (water resources). Each team should take the lead of one central theme but encourage all other participants to involve. Each team then becomes the expertise in one aspect of collaborative design. The team efforts will be helpful by negotiation or consultation to integrate all themes. The theme-oriented mode is proved to be more effective than the other two modes in helping each team for sharing information and decision-making.

3.3. TECHNOLOGIES EMPLOYED IN CDS

This study also examines in which manner communication technologies are used in the collaborative design process. Typically, the technologies employed in CDS include teleconferencing, whiteboard, IPhone, and CUSeeme which are used in synchronous mode; and e-mail, FTP, Web, HTML, JAVA, and VRML which are used in asynchronous mode. While the asynchronous mode is economical to manage, the synchronous mode is essential to critical decision-making. Both can be complimentary to each. Meanwhile, CSCW are moving forward to teamwork-based software, because traditional CAD software is used individually, and file transfers cause more difficulties in communication.

Figure 5 demonstrates that technologies are increasingly used in the process. However, we found that the use of technologies in presentation is more than in communication. The phenomena are related to the learning curve of technologies as well as the basic design training. The choice of technologies should be balanced between the process and the design performance. If we want to focus the interactions in the process, then the use of technologies in communication will be essential. Design guidance should provide the design orientation and motives for communication, and decide the suitable technologies to be implemented.

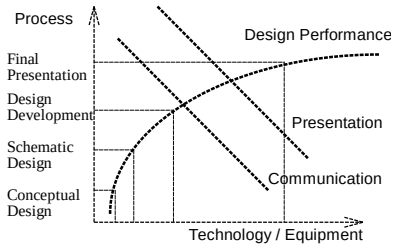


Figure 5. Technologies employed in the process

3.4. THE LEVEL OF COMMUNICATION

The contents of design program will define the necessity of communication. Site subdivision and assignment is a strategy to control the level of communication

(Chiu 1995). Meanwhile, group decision-making is different from individual decision-making. Particularly, the effectiveness of group decision-making needs critical design information. Therefore, this study examines the contents of design and the needs for information. The level of communication can be classified by the frequency of question-and-feedback or data transmission. However, we have to distinguish communicating and designing because communication does not necessary lead to the result of design. In most cases, communications address the technical issues or learning problems. More importantly, the key issue is whether the themes discussed are directly related to the design decision. Therefore, design guidance should advise participants to understand the purpose of communication.

3.5. THE PROCESS MODEL OF COLLABORATIVE DESIGN

We need a process model of collaborative design to describe certain phenomena in which the design tasks are undertaken to possibly reach the final design (Cicognani and Maher 1997). The model is important for all participants to understand his/her position in CSCW, and for researchers to analyze design activities.

Figure 6 illustrates that a general process of collaborative design driven by decision-making. The design information is delivered from initial state to the final state until the decision-making process is completed. The cyclic process involved in consultation, negotiation, decision-making, and reflection. Kvan (1997b) indicate that negotiation is observed as the major task in decision-making in the collaborative design. Consultation is an action to verify which decisions have to be made. Reflection is to confirm the decisions and initiate another cycle of information processing. In the process, stimuli and participants' attitude are also critical to decision-making.

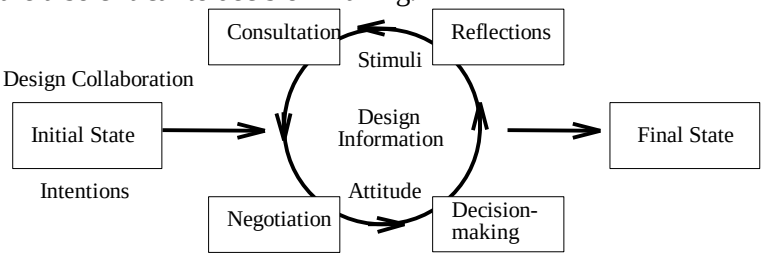


Figure 6. A process model of design collaboration

Design guidance can provide the basic understanding of design operations by the process model. The above factors gradually shape our design guidance. After examining the results of three CDS mentioned, some issues are raised for future studio teaching and research.

4. Issues Raised

4.1. THE LEARNING CURVE OF TECHNOLOGY

The effective technological support is one of the factors to achieve the success of a CDS. Process is as such a contributing factor to success as is technology. Thus a CDS must assist the students in learning about process a successful design exchange over communication networks (Kvan 1997a).
The learning curve of technology clearly demonstrates the impact on the performance of design collaboration. Shelden et.al. (1996) also suggest that orientation sessions should be conducted prior to the design review to familiarize with the strengths and limitations of the communications. Technical sessions prior or parallel to the studio teaching are critical to the performance. The critical question of CDS is whether we have sufficient time be spent on trials with all participants and sites? If not, then the observation from design activity will be unable to sufficiently support the research conclusions.

4.2. CHANGES OF DESIGN ORIENTATION

Because the emerging role of technologies in the design process, should the design orientation and program be changed because of the new technologies or platform? The collaborative design studio brings up the issues of where, when, and how design can take place, while the conventional design studio is more concerned about what is design, and who is doing design. The shift from a conventional design studio to a collaborative design studio is different in the manner of location, time, tools, communication, and reflections. The design studio should emphasis on the design process as well as the design product (Chiu 1995). Then design evaluation should balance between the design performance and the participation in collaborative design.

4.3. CHANGES OF THE WAY AND SETTING FOR DESIGN TEACHING

If we have VDS or CDS, then what the function of traditional design studios will be. To develop the future design environment, we need to redefine the design curriculum. The emergent idea of "the design studio of the future" indicated by Mitchell (1997) at MIT or "the next-generation architectural design environment" proposed by Yamaguchi (1997) at Kyoto Institute of Technology clearly demonstrate some changes needed for the future design environment. Furthermore, we also need faculty supports, design knowledge base, and a networked design culture.

5. Conclusion

In conclusion, this paper provides a better understanding the operations of CSCW through design guidance, and the implications for future design practice. The performance of CSCW is associated with the learning curve of new technology. However, it contributes mostly to the effectiveness of decision-making, including consultation, negotiation, evaluation, and confirmation. The quality of design is not driven by the technology, but design communication to reach effective decision-making can be facilitated by the technology in the design process. While the technologies are continuously developed, there are needs for better defining guidance for design operations in collaboration design.

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