

# Managing Communication-Based Collaborative Design Process

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**Abstract:** Advanced information and communication technology (ICT) dramatically changes the design process in terms of communication, use of information, and accumulation of knowledge. This kind of design process deals with huge information and involves much more complicated interpersonal communication. Divergence among design team members usually departs from initial design vision and mission. This paper addresses a framework of managing communication-based collaborative design processes focused on close coordination. Through the interactive communication mechanism, designers perform creative thinking depended on a variety of abilities and disciplines. A software interface design project is used as a case study to describe the proposed framework. In this case study, the design studio communicates design needs and concepts with the customer via face to face communication (FTF) and computer mediated communication (CMC). The management of information flow and creativity generation flow are integrated and design knowledge is accumulated during the design project. A communication-based collaborative design process is successfully executed as the result shown in the case study.

**Key words:** *design communication, collaborative design, design project, CMC*

## 1. Introduction

Advanced information and communication technology (ICT) dramatically changes the design process in terms of communication, use of information, and accumulation of knowledge. Rapid information flow removes the limitation of time and location due to the development of internet. The accuracy of information communication becomes a more important topic. Design communication means disposing and interpreting huge information in

the design development process. Cognition difference among design team members will cause the divergence between the final outcome and initial design vision and mission. Design is the action of creativity which implements concepts involving unprecedented styles and useful articles [1]. This creative action combines disciplines of engineering, human factors, environment, culture and aesthetics, and includes a series of development processes rather than just imagination. During the creative process, designers moves towards “perfection” through consecutive internal and external communication to transcend personal capability and other limitations. In a collaborative design project, team members with multidiscipline work together to coordinate their efforts. Therefore design communication is very important under the environment of collaborative design development via mutual interaction that integrates different skills, thinking's and values to inspire more creative solutions. Nevertheless the failure report of communication among multidiscipline can be found in many historical design projects. This paper discusses the operation cycle of design communication for a design team in the collaborative product development environment and proposes a framework of managing communication-based design processes. Members of the collaborative design team are closely connected to share experience and integrate mutual cognition for the project success. Therefore members of the design team gain experience via the design knowledge base during the creative process, and more effective design performance can be anticipated.

## 2. Literature Review

Collaboration means all members establish goal together and solve problems in a cooperative manner to reach common objective [2]. Collaboration usually divides into two types: data-based collaboration and reciprocation-based collaboration. The former, such as product data transmission and product design technique exchange, narrates mainly the sharing of data and knowledge through the integration of artificial intelligence and database technology. While the latter discusses the situation of real-time and synchronous operations between the participants in a collaborative process, such as real-time virtual 3D drawing and design [3]. Collaboration utilizes computer supported cooperative work (CSCW) and computer-based groupware to assist the communication, cooperation and coordination between groups or users together in order to finish the work [4,5]. Applications of collaboration can be found in access control, information notice, users management, group interface, information distribution, data storage, general survey of data, working meeting, information cognition and users transmission [6]. The collaborative product design assembles many relative personnel who simultaneously participate in the product development process, including designer, manufacturer, supplier and marketer. Members from different locations can communicate and discuss together to concurrently carry out the product design and modification via the network that makes design results are more in accordance with the consumer's requirements [7].

Various collaboration models are normally defined by time and location of collaboration and operation of collaboration such as close coupled and loosely coupled [2]; face to face collaboration, synchronous distributed collaboration, asynchronous collaboration, asynchronous distributed collaboration [8]; mutual collaboration, exclusive collaboration, dictator collaboration [9]. The strength of face to face collaboration, synchronous distributed collaboration, close coupled collaboration and mutual collaboration is to provide on-line compiling and real-time operating functions for participants to reduce process duration. And its weakness is the difficulty of

reviewing and auditing personal performance in an effective way. On the other hand, the strength of loosely coupled collaboration, asynchronous collaboration, asynchronous distributed collaboration and exclusive collaboration is no need to gather all participants to accomplish the work with a specific location at one time. The weakness of this kind of collaboration is the work breakdown structure may cause potential impacts on task completion due to individual delay [2,8,9].

The five elements of communication are source, transmitter, channel, receiver and destination [10]. The source of information is encoded by the transmitter, transmitted through specific channel, decoded by the receiver after this piece of information arrives at designated destination. There are two types of communication applications: face to face communication (FTF) and computer-mediated communication (CMC) [11,12]. Design communication differs from general commercial communication in the process of communication which focuses more on “looking over” drawing than “seeing” the meeting participant [11]. Design communication paid more attention to the communication of image, communication of abstract concept, clarity of communication, details description and tempo of understanding communication. The design innovation rather establish a bridge from question space to answer space via the affirmation of the key concept than merely jump to creation [13]. Design communication is a necessary route for the accomplishment of design goal. It is therefore essential to frequently keep communication channel clear and smooth during the design process to ensure design project success [14].

### **3. Managing Communication-Based Collaborative Design Process**

The framework of managing communication-based collaborative design process emphasize on a mutual and inseparable coordination manner. The design team performs work group coordination, relationship connection, knowledge sharing and cognition integration to create new product under the foundation of design communication in the collaborative environment throughout product design development. During the creative process, the design team gains experience through the storage, classification and combination of the design knowledge base which support the design team to carry on product design development. As shown in Figure. 1. its mechanism is described as below:

1. Work Group Coordination: It is necessary to coordinate every team member to harmonize and stimulate with each other. Degree of participation should be adjusted based on project requirement to reach maximum project benefit.
2. Relation Connection: Members of the collaborative design team create inter-relationship via direct, indirect, formal and informal approach to enhance understanding of current status.
3. Knowledge Sharing: Members of the collaborative design team share their own professional knowledge and transfer tacit knowledge of design to explicit knowledge.
4. Cognition Integration: The whole team recognizes the importance of partnership with the identical vision and establish the value network.

Each round of design communication goes through the following four steps: interpret design, comprehend design, temper mind and generate consensus. Detail listed as follows:

1. Interpret design: The transmitter interprets the design value and transmit to the receiver. This stage may exist interpretative gap which shows the different value between anticipation of the receiver and interpretation of the transmitter.

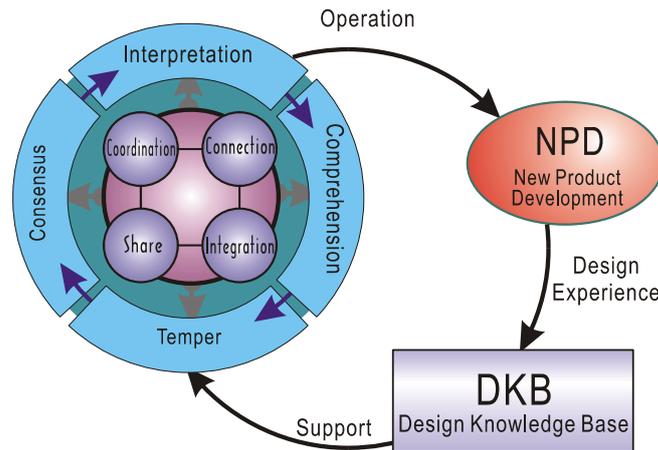


Figure. 1 The Framework of Managing Communication-Based Collaborative Design Process

2. Comprehend design: The receiver understands the design value transmitted from the transmitter. A comprehensible gap derived from the difference between the transmitter's recognition of the anticipation value collected from the receiver via design method and original anticipation value.
3. Temper mind: When above interpretation and comprehension have proceeded mutually, the cognitive gap is unavoidable. Both sides of communication should temper their mind together as said in "Iron makes iron sharp; so a man makes sharp his friend". In this stage, various kinds of communication skills can be utilized, such as spoken and written language, graphic language and body language.
4. Generate consensus: Coordination between the transmitter and the receiver is required continuing the design activity.

The design team reaches the design goal together and shares knowledge in collaborative manner during each design cycle. It forms a spiral type of design communication process and advances to next cycle. The participants are composed of designers, engineers, suppliers, customers, design development consultants and marketers. Individual values based on versatile discipline, opinion, market experience, product experience, know-how and culture are connected and interacted to turn into common value throughout the cycle of design communication.

#### 4. Case Study

In this paper, a case study regarding a collaborative design development project carried out by two teams with different disciplines is investigated. One of them is the client from public sector with meteorological specialty. They aim to promote modernized meteorological observation, to develop refined meteorological forecast, and to provide diversified channels of information dissemination, by which to improve the quality of its meteorological services and to achieve the goals of disaster prevention and mitigation and promotion of economic development [15]. The other team, the contractor who is a design studio skilled in multimedia design and information visualization, then proposes to build up a new typhoon warning briefing system as the target project. The objective of this design development project is to change existing presentation type of typhoon warning briefing. It begins with real-time touch control handled by the weather forecaster to explain the typhoon warning briefing. The second feature is to provide the weather forecaster with flexible operation through an interface design in the typhoon warning briefing system by integrating typhoon information. A professional image and service quality

are expected to be the achievement through the public release of typhoon warning briefing from the proposed system. The design development process of the typhoon warning briefing system (TWBS) project is shown in Figure. 2. The design communication process is divided into the following two stages:

1. Design specification and design proposal stage

This stage is initial contact for reaching mutual understanding and common trust. There are intensive meteorological data, information and knowledge transfer and many presentation meeting held to communicate the design philosophy with each other and recognize the design value in common. Face to face communication is performed mainly in this stage.

2. Interface design and information visualization stage

In this stage, briefing meeting is initially used to discuss the design progress with the same face to face communication (FTF). The result of these meetings collect required data and information from the meteorological team for further design purpose. The procedure composes of providing data, making request, proceeding design, demanding revision and modifying design. Due to various demands retrieved from the meteorological team that causes frequent design modification, severe problems of redundant design and inconsistent version are identified. The confused situation is shown in Figure. 3.

After examining the design communication process, deviation caused by different professional perspectives and languages are labeled and discussed as follows.

1. Briefing Meeting:

The progress report is carried out by face to face communication (FTF). FTF has its advantage in the sense of close communication through spoken language, written language, graphic language and body language. However, it's very time-consuming for use in design discussion by preparing briefing materials.

2. Interactive discussion during design proceeding

This kind of discussion in the design communication is the most complicated especially in the step of “temper mind”. The meteorological team brings up design demand and offer four kinds of data: original drawing, sketch, content description and fuzzy concept. Original drawing includes blueprint, meteorological map, all kinds of statistical graphs and data. Sketch is the hand drawing of depicting idea and partial manuscript. Content description explains the demand either in oral or written; and fuzzy concept is just a very vague concept, such as feeling of non-artistic. Among them, original drawing and sketch have the highest degree of accurate communication, and the other two kinds provide respectively low accuracy. Unfortunately, content description and fuzzy concept are very often used in this design project and result in inconsistency between design outcome and demand.

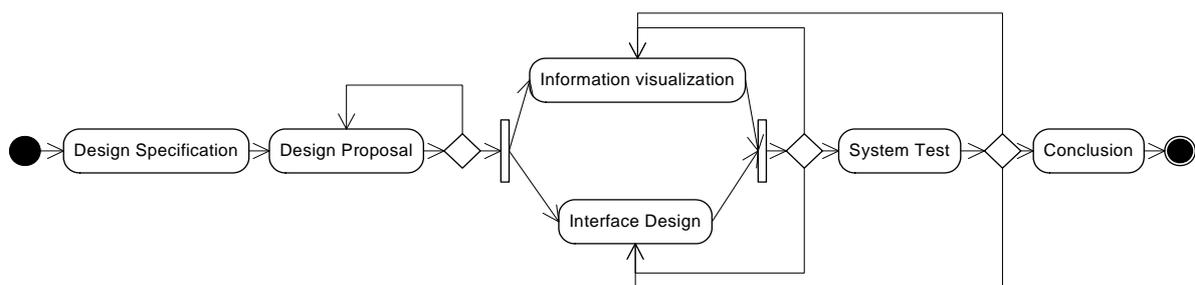


Figure. 2 TWBS Design Project Process

### 3. Contact window:

As shown in Figure 3., every meteorological team member's request forces direct design changes. The redundant contact windows has brought the information out of control. The design team is unable to judge the exactness of information due to misunderstanding or information omitting. The design project eventually shows severe schedule delay caused by poor design communication. For this reason, the design team decides to introduce computer-mediated communication system (CMCs) to assist the design communication for speeding remaining project execution. As a result, time for the interactive discussion during design proceeding and disorganization of file transfer are substantially reduced. This CMCs tool used in this design project is River Design Communication System (RDCS) and divided into SVN and Q&A Database System Online as shown in Figure. 4., and discussed as follows:

#### 1. SVN (Subversion)

Apply SVN program to integrate version management and avoid communication error because of version inconsistency. SVN can reveal the revised content among versions and can be conveniently and immediately upgraded. The efficiency of design communication and accuracy of design changes are greatly improved.

#### 2. Q&A Database System Online (QADSO)

Telephone is the most easily used communication tool but lacks of recording function during design project proceeding. Email is hard to integrate communication content due to repetitive sending. In real case, papers and electronic files are frequently used for recording function in briefing meeting. In order to completely record the historical data of the design project, the CMCs tool also uses a mode of instant online communication -Q&A Database System Online (QADSO). Both sides of communication use QADSO synchronously to record various information from bilateral communication, solve various problems and revise design online in real-time as shown in Figure. 5. The design team uses QADSO to enable fast reaction to design communication and rapid data and information transfer, and utilizes spoken language, written language, and graphic language to reduce design misunderstanding as shown in Figure. 6.

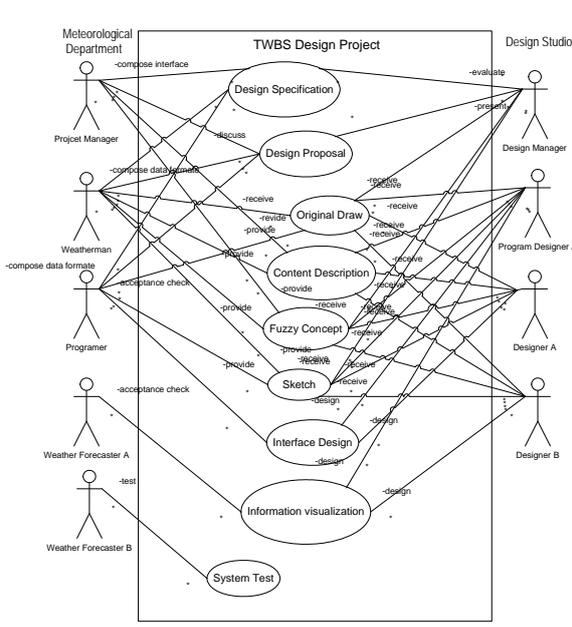


Figure. 3 The situation of Design project before CMCs

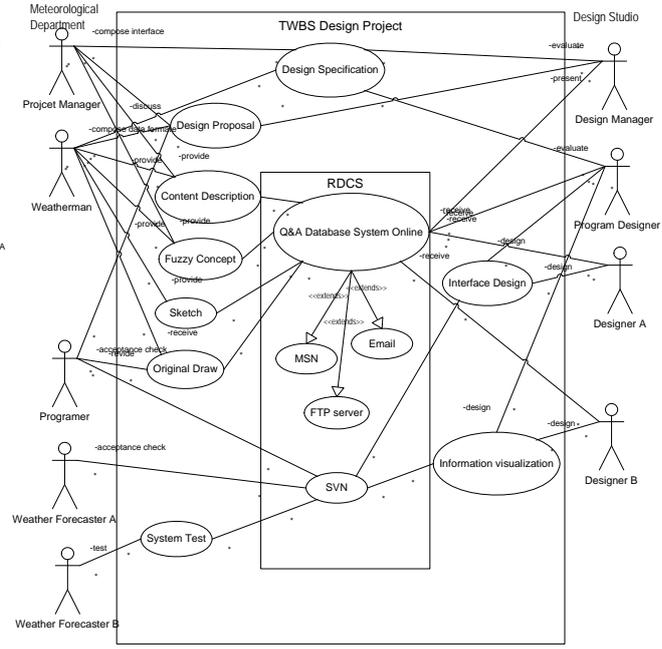


Figure. 4 Using CMCs with TWBS design project

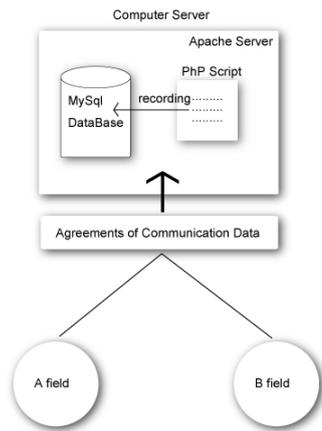


Figure. 5 QADS database

專案資料	
標題	暴風圈資訊錯誤
時間	2008-12-12 21:32:22
相關連結	
內容	您好，那個，暴風圈的資訊好像錯誤了，在XML裡面我記得有給您，但是輸出後，我看到畫面好像暴風圈太小了，麻煩你察看一下
檔案	
圖片	

Figure. 6 Detail contents of QADS

### 3. Combine other CMC software with RDCS:

Other CMC software, such as Email, MSN, FTP are also combined with RDCS. The project connects members by using Email to send and receive formal meeting record and data, MSN to instant communication, and FTP server to deal with large-scale file transfer.

This collaborative design team releases the location limitation both in briefing meeting and design discussion meeting, and greatly reduces the time for communication after introducing RDCS. Both meetings can handle real-time design discussion and design revision and reduce the cognitive difference through online meeting mechanism. A single contact window is unified to avoid chaos, confuse and omission of information during design communication.

## 5. Conclusions

Design communication is extremely important for the design team to perform the design project. It determines the chance of project success based on smooth degree of design communication. As shown in the case study, clear interactive expression, single contact window and consistent design version transfer will influence the whole design project. This paper proposes a framework of managing communication-based collaborative design process in which defines the intension of design communication as work group coordination, relation connection, knowledge sharing and cognitive integration. The cycle of design communication process includes four steps: interpret design, comprehend design, temper mind and generate consensus. A model of design communication has addressed in the case study to show the improvement of design communication. Future study of this research will focus on dynamic process and design knowledge identification for collaborative NPD project.

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