THE LEVELS OF COMMUNICATIONS ACHIEVED THROUGH NETWORK IN AN INTERNATIONAL COLLABORATIVE DESIGN PROJECT:

An analysis of VDS '96 project carried out by Kumamoto University, MIT, and Kyoto institute of technology

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This paper reviewed the process and the achievements of a five-week-long virtual design studio project the authors carried out with three universities in Japan and the United States in the summer of 1996, in which there was no communication among team members other than network media. After analyzing the use of communication tools in different situations of design communication and the levels of communications achieved in this project, the authors concluded that the present network technology could provide sufficient levels of communication, if only participants could put forth some amount of extra effort for communication among team members.

Keywords: collaboration, VDS project, design-communication

1. Background and the Objectives of the Studies

Practical design projects of any magnitude are almost invariably carried out by multidisciplinary, geographically distributed teams, in which how to improve the environment of design communication among members has long been a critical issue. Because of this, techniques of collaborative design that applied high-bandwidth communication technology have started attracting the interests of design firms. Since Mitchell introduced his idea of the Virtual Design Studio in 19931, several experiments of the Virtual Design Studio were carried out. Some papers reported technical considerations on how to advance the project as well as the positive and negative observations made by advisers on the role of VDS2. However, few have analyzed the roles of communication tools in the design processes or the level of communication achieved among designers with these communication tools.

As it is essential to know these in assessing future prospects of the VDS as a method of practical projects or even as the method of design education, the authors carried out a five-week-long VDS experiment with three universities in Japan and the United States in the summer of 1996: Kumamoto University, Massachusetts Institute of Technology, and Kyoto Institute of Technology.

In this project, three teams were formed with one member from each university. As there was no communication among team members other than network media, it became possible to highlight the ability of various network tools in communicating design information.

The objective of the paper was to analyze the use of tools in different situations of design communication and then, review the levels of communication achieved in this project. The authors used the following materials in this study:
1) design information recorded in the Digital Pinup Board (WWW),
2) records of the e-mails and “the chats” exchanged among students
3) students’ answers to a questionnaire on their use and evaluation of tools.

2. Outline of the experiment

2.1. Theme of the VDS’96-Kumamoto project

Kumamoto prefecture holds an international architectural exhibition every four years: the Kumamoto Art Polis International Architectural Exhibition. The second KAP Exhibition was held in November 1996. Forming part of this exhibition, a group of artists and designers who live in the Kumamoto urban area planned a series of outdoor exhibitions in the central shopping district. Stimulating citizens’ discussions on urban design and public arts were the major objectives. It became the task of VDS’96-Kumamoto project to design three-dimensional structures and spaces for one of these outdoor exhibition sites, originally assigned to Mr. Koji Yoshii.

The site was the 4000 square meter vacant land of the former prefecture’s head-quarter of the Kyushu Electric Company. Some of the conditions assigned by Mr. Yoshii were as follows:
1) Propose three dimensional structures and spaces that will give visitors to the site attractive spatial experiences. Proposals should include landscaping of the site as a public space.
2) Use four large steel drums once used as silos and left as waste in the rural area: the diameter and height of each drum were 4m and 3m respectively. As each drum consists of 8 steel segments bolted together, the segments can be used as well as the entire drum. After the exhibition, these drums have to be returned to the owner, while one of them (eight segments) can be cut or bent.
3) Because of budget limits, designers should not add large structures and should use relatively cheap natural materials. Paints and lighting fixtures may also be used.
4) The construction period should be within the month of October.

2.2. Procedure of VDS experiments

Advisers and technical assistants, besides the three student designers, participated from each school (Figure 1). In the first week of the project, each student worked independently and started collaboration from the second week, forming three teams with one member from each
Figure 1 Participants of the VDS'96 and the System Used

university. As the project introduced the style of competition among three teams, face to face design communication was eliminated in principle. Mr. Yoshii's offer that he would build the best proposal after some necessary revision, gave strong motivation to the students.

The students used communication tools of two different types: synchronous and asynchronous communication tools. The DPB (WWW) and the desktop video conference system, such as the CU-SeeMe or the OTC, took major roles in synchronous communication at the weekly design review sessions with advisers who sat in the three distant sites. The students also used the talk-window and the desktop sharing tool (Timbuktu-pro) that supports synchronous manipulation of digital design tools.

For asynchronous communication with team members or remote advisers, the exchange of ideas or comments was achieved through the use of the DPB, the bulletin board on the DPB, and e-mail. The file transfer and the attached documents of e-mail were simultaneously used when they split or made relay style design works among team members.

The weekly cycle of design work consisted of the following four stages:
1) Each member posted comments or key-words, sketches of design images, or reports of collected data on the personal web of the DPB.
2) Team members made both synchronous and asynchronous discussion reviewing the personal web of the team members, with a desktop video conference tool, e-mail, or the bulletin board, etc.
3) After repeating 1) and 2), the team leaders posted design images and collected data on each team web of the DPB.
4) At the end of each week, the advisers and the students from all teams held a design review session using the desk-top video conference tool and the team web of the DPB.

A system failure at MIT prevented students from MIT from attending the pinup #3, the extra review session (pinup #3 extra) was added, shifting the session that was scheduled in week four.

3. Results of the project

Figure 2- Figure 4 shows the over-view of how each team developed their design proposals in the last four weeks. In the early weeks, most teams simply exchanged comments or proposals, but in the later weeks, they performed complicated collaboration, splitting or relaying tasks among team members.

The authors observed different types of leadership and role-playing in their design processes. In team A, the leader's ability to mediate or to reorganize the proposals of his team members was the key factor for their design progress, while in team B, strong guidance by the team leader stimulated the ideas and images of his team members. In team C, in spite of the leader's effort to consolidate ideas in week two and three, "an attractive idea" came after pinup #3 caused the delay of developing the final proposal. Impatience in the last week, as well as the lack of force to make them work together, caused them to produce two sets of proposals.

The changes seen in the number of alternative designs discussed by each team that appear in the second bottom row of the team's summary tables in Table 1 support these observations. Team A discussed eight alternative ideas in the first week, though. In the following weeks, the number of alternatives was gradually reduced, and then, was finally reduced to one after pinup #3 extra. Team B followed a similar process, while the number of alternatives was three from the beginning. In the case of team C, while they discussed two or three alternatives in week two, the number rose to five in week three, and team C ultimately failed in submitting a single design.

4. Analysis of communication among team members

4.1. The Students' Use of Communication Tools

Table-1 suggests that team A and B followed different approach. Team A frequently used asynchronous tools while team B used synchronous tools. Team B is the only team that used the Timbuktu and the real-time FTP)3). The number of e-mails and comments on team-B's bulletin board remained at one third of those exchanged by team A, while team B used the synchronous tools twice as many days as these of team A. Team C's difficulties in design development and integration seemed to have been caused by their inactive communication for both types of tools.
“Rural scene in urban space” as the keyword, members respectively explored images of monumental spaces.

Yasu proposed gridiron landscape design covered with sand, grass, gravel so that visitors could sense rural touch with their feet. Mike decided to use one of Kazuo’s models as the major unit of design.

Attaching reflective material to the concave surface of unit models. Mike proposed to locate them in a semi-circular form, reflective sun tower at their focal point. As the sun moves, differing model will reflect sun ray toward the tower.

Advisors criticized the idea of sundial because it gives off expressive impression and advised to focus “cricket” shaped structure randomly in the grass field and to attach small torches on each.

Splitting tasks, members produced presentation materials, such as animation, perspective view images, and a report on technical issues. Because of leader’s ability to harmonize team members who have different characters, the team succeeded in submitting attractive proposal.
Team B
Pinup #1 (1996.08.07)
Team A: M. Matsumoto
M. Morozumi
Ryuji Sasaki
Soetsu Sakai

Pinup #2 (8.15)
As Kumamoto has many spots that relate to fire or fire ritual, “torch tower” become major key word of design. They respectively designed torch tower.

Pinup #3 (8.22)
Ryuji proposed to produce differing scene for day time and night time. [day time] pocket park with gridiron pattern that followed urban axis. [night time] lighting fixture regenerate plan of the building located once torch generates the third coordinate.

Pinup #3-Extra (8.27)
The team selected three pairs of keywords as the design guide: "day time - night time", "urban - natural", "past - present". They used CG simulation heavily to check spatial images of different times.

Pinup #4 (8.31)
Ryuji decided to use "chokkon-mom" geometric pattern of the old tamon painting as the guide of landscaping. Masashi refined torch tower design to express internal energy of living creature.

Pinup #5 (9.06)
With the strong guidance by the team leader, the team succeeded in developing the proposal. Splitting tasks, members produced well-designed presentation materials. The comment, "Children's graffiti will become a message to the rural area, when the old segments will be reassembled after the exhibition," impressed the advisers.

Figure 3 Design Process of the Team B
Team C
Pinup#1(9.30)
Team members
Masayuki Takahashi
Gaku Sasaki
Partha Dutta

Pinup#2(8.22)
"Gate square tying urban and rural regions," "water and sound representing flowing time," have become the key concepts. Taka & Gaku decided to use sand and gravel pattern of Zen garden as the representation of water and sound, or the flowing times.

Pinup#3(8.32)
Partha proposed to use two different grids as the guide of landscape design, that respectively represent orders of region's nature and urban culture.

Pinup#3-Extra(8.37)
Each member studied designs in a different scale.
Taka studied the gate structure with open work then tested the effects of shadow castings.

Pinup#4(8.31)
To remove static impression, Partha proposed to introduce whirl wind pattern to the site design, as well as whirl wind shaped gate structure and small floating structures blown apart. According to him whirl wind represents negative impact highly developed industrial society. Though his idea seemed attractive, it felt too late to follow.

Pinup#5(9.6)
The impatience in the last week and the lack of force to make them work together caused them to propose two different proposals.

Figure 4 Design Process of the Team C
Table 1: Summary of Teams’ Communication by Media

<table>
<thead>
<tr>
<th>Team</th>
<th>WWW</th>
<th>Video Conference</th>
<th>Chat</th>
<th>Team-Talk/Chat</th>
<th>Team-Talk/FTP</th>
<th>Group</th>
<th>Peer</th>
</tr>
</thead>
<tbody>
<tr>
<td>QA</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>QA+1</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>QA+2</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>QA+3</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>QA+4</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>1</td>
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<td>5</td>
<td>5</td>
</tr>
<tr>
<td>QA+5</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

According to the result of the questionnaire, there are two main groups of communication purposes: first, design discussions on concepts or spatial images, and second, administrative communication such as adjusting schedules, checking the progress at each site, and questioning or requesting other members’ design. How to secure channels for that communication became essential when geographically distributed members collaborate. A rapid increase in e-mails exchanged by team A, whose purposes are mostly the latter, suggests that administrative communication will increase toward the end of a project, while the needs for design communication gradually decrease.

4.2. Achieved level of communication

For the administrative communication all teams used e-mail. The case of team A suggests that e-mail could sufficiently support administrative communication needs. Because it took at least half an hour to exchange mail between the US and Japan, when a team needed quick interaction, it 
Table 2: Purposes of Communication and Used Tool

<table>
<thead>
<tr>
<th>Week 1</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present design concept</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Present spatial images</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Discuss design concepts and spatial images</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Conclude work status</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Adjust schedule</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Review progress of work</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Week 1</td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>Present mental images</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Exchange mental images</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Discuss design concepts and mental images</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Conclude team issues</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Exchange material</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Review progress of work</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

could not keep up with these needs. In the last week, team B and C, kept video conference tools connected all the time and conveniently used spontaneous information exchange.

For design communication, the common tools for each team were the DPB, e-mail, the video conference tool, the talk window, all of which provided a convenient environment for both synchronous and asynchronous communications, except that in the last three weeks, after the vacation season, the network congestion obliged students to work during the night, Japanese Standard Time.

Team A used a bulletin board as the main tool of asynchronous design discussions until the refreshing speed became too slow after the number of comments exceeded a hundred. Its ability to regroup and post comments in a Q&A style appeared convenient for tracing discussions later. Considering the fact that synchronous tools tend to suffer from network congestion, and that it asks team members to put in extra efforts to meet at one time under the 13-hour time difference, the asynchronous nature of the bulletin board seemed to have speeded up design studies of team A.

Each team also made full use of the advantages of the video conference tool: first, speedy dialogues often stimulate new ideas; second, the countenances and gestures of the participants sent through video conference tool could improve the process of persuasion and bargaining essential to design discussions. Team B used a desk-top sharing tool (Tinuku) and real time FTP between Kyoto and Kumamoto. The shared use of the white board, in which they made sketches on the
screen captured images of modeling tools or rendering tools, accelerated their design development. After the project, the students expressed a strong hope for an interactive 3-D modeling tool that could support design communication through the network.

5. Conclusion

Considering all the language barriers and that all members met for the first time through network, they succeeded in developing attractive proposals in relatively short period. As it seems doubtless that team C could submit an attractive proposal in two or three extra days of work, it is possible to conclude that the network could provide sufficient level of communication if only participants could put forth some amount of extra effort for communication among team members.

I very much enjoyed the many issues that had to be addressed from integrating various digital design technologies and communication to the pure architectural aspects of what it means to design a monument. This alone would have been more than enough to keep me busy and interested for month, but coupled with a language and culture barrier, a site never seen, and a 13 hour time difference didn't seem like a lack of excitement (Scott Schiumberg: MIT).

[Footnotes]
1) W.J. Mitchell used this term for the first time in his talk at the MIT Media Lab, in 1993.
2) See references [1]-[7]
3) Operation to copy files in the desk-top sharing utility (Timbuktu-Pro)

[References]