Designing Together Over the 'Net

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INTRODUCTION

The Information Revolution, like the Industrial Revolution before it, is not only challenging what we are designing but also how we design. With recent advances in computing and telecommunication technologies, participants in the design process, who are often in different locations around the world, could work on a building design at any place, simultaneously together (synchronously) or separately (asynchronously), while the latest state of the design would always be available to all team members. They could collaborate on a shared object and no information would thus be lost in transfer of project data.

The technology itself, however, is not central to remote design collaboration. Design involves frequent making of choices, and underpinning this process are the values and the beliefs of the designer or a group of them. To truly come to terms with designing in a global context, issues such as social, cultural and ideological differences have to be further understood. What makes the geographic, cultural, or ideological cross-boundary collaboration difficult and interesting is the human dimension of trying to work together towards a common goal.

Collective design authorship, as well as associated communication, social, and cultural issues were central in our virtual design studio experiment. Teachers and students in Hong Kong and Singapore worked on a common design project ("Place2Meet on the Water") using traditional and digital media, a central database, World Wide Web, and video-conferencing. We also addressed over the course of semester the issues of teaching methods and whether the quality of design could be improved in a networked design environment based on collective authorship and whether and how such an environment can affect the nature of the produced designs.

BACKGROUND

Computer supported communication and collaboration are no longer mere possibilities, but, given the will and know-how of the participating partners, a reality. What was first achieved in mid-1990s at universities and large AEC firms such as Norman Forster and Partners and Ove Arup and Associates, is now in the reach of small and medium size firms with access to the Internet.

As offices grow to cope with bigger and more internationally oriented projects, the need for internal and external communication increases. Not only that architects have to work with consultants located in other cities or have branches elsewhere in the world, they themselves are increasingly moving beyond their local and geographical strongholds and are becoming global and international.

In structuring a global organization, two models are commonly used (Lucas et al 1994). The vertical integration model is quite simple and is widely practiced. In this model, branch offices are set up and closed as projects come and go. Basically, each of the offices manages its own projects and offers a complete range of services. The horizontal integration model, however, is more sophisticated. It makes use of the geographical, economic and social advantages of different branch offices to maximize their throughput. Offices are specialized and the model relies on a concerted effort of almost all the branches to complete a project (Popova 1997). It requires the support of an excellent and cost effective communication protocol for collaboration among geographically distributed teams.

Apart from the communication problems, researchers have already identified the need to look into the social implications and consequences of the horizontal integration model (Winter and Taylor 1996). Culture, language, social norms, time differences, values and practice are some of the issues identified. "Empirical studies of design have demonstrated that design is a social activity as much as it is an individual practice" (Vervenne 1994). Therefore, "supporting the social communication is as important as supporting communication about the design problem." Previous studies (Poh and Myers 1994, Sasada 1994, Wojtowicz 1995, Mitchell www, Maher et al 1996, Cicognani and Maher 1997, Schmitt 1998) have cast some light in this direction. However, the findings are far from conclusive, as the interactive dynamics are complex and yet to be fully understood.

Last but not least, there is a need to look into issues related to the design process (Lawson 1980, Schon and Wiggens 1992, Schon 1996). Design is "a process which is in continual flux, moving between asynchronous and synchronous activity where group membership over the life-cycle of the design is dynamic and transitory" (Rutherford and Maher 1993), meaning that a large number of the constituting parameters are changing during the development of the design. Different people are involved over limited periods. In order to follow the changes, the design information system has to be sufficiently open to incorporate new participants, including their preferred means of representation.

Ultimately, questions had to be answered as to whether or not the horizontal integration model could yield better design services. Much of the previous studies on virtual design studios have been focused on various aspects of enabling technology, communication, social dynamics and design process, but these are only means to en end: to client and end users, they have no tangible values (Maver 1997).

VIRTUAL DESIGN STUDIO

The virtual design studio (VDS) described in this paper is an experiment in remote design collaboration that explored the issue of collective design authorship. Teachers and students in Hong Kong and Singapore worked on a common design project ("Place2Meet on the Water") using traditional and digital media, a central database, World Wide Web, and video-conferencing.

The studio was an attempt to examine some of the issues related to the use of the horizontal integration model in design, namely communication, social and design issues. In contrast to most of the previous works and virtual design studios, this studio was a semesterlong program, with specific pedagogical, academic and design agendas. Throughout the studio, design issues were emphasized and technical requirements like structure, construction, detailing, material and siting were discussed. The studio tried to mimic, as much as possible, the design flow of an architectural practice assuming a horizontal integration model.

In addition, addressing the shortcomings of previous virtual studios, the studio was structured to limit possible variations and contingencies due to culture, time, language, and academic differences of the teams. The University of Hong Kong and the National University of Singapore made an almost ideal pair in that respect. Students of both Universities are mostly Chinese in origin and from a similar cultural background. They are in the same time zone. Both universities use English as a medium of instruction and they have similar academic structure. By relying on these similarities, the idea was to minimize the distracting elements (the "noise") and to concentrate on the few identified critical issues.

In the first part of the studio, which was three weeks long, students were required to analyze some precedents and present their analyses as web pages. They had to study the following aspects of the selected buildings: design concept, structural behavior, assembly process, details, building materials, building services, and the integration of architectural design and technology. Students worked in teams of five, made up of two students from Hong Kong and three students from Singapore. They had been advised to pay attention to and seek, on their own, efficient communication and information protocols to work with each other.

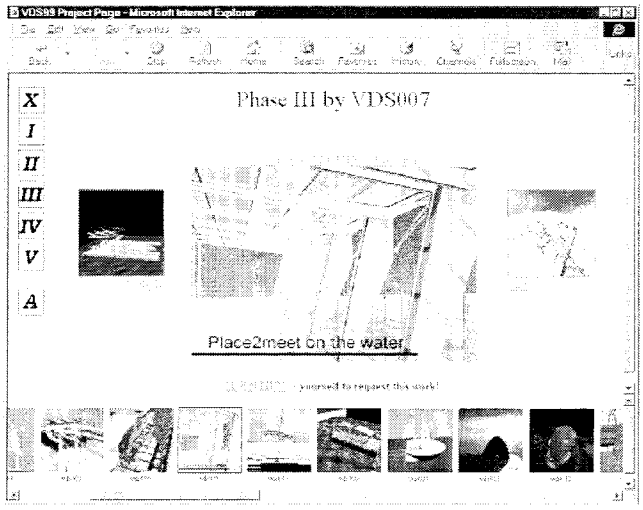

Fig. 1. The VDS database (http://home.arch.hku.hk/vds99/) accessible through a web browser. The browser window is split into three parts (frames). "Buttons" in the frame along the left edge permit viewing of the projects produced in each phase, which are shown in iconic form in the frame along the bottom edge. The selected project can be then reviewed in the main frame.

In the second part of the studio, students were required to design a "Place2Meet on the Water" over seven weeks in a collective, collaborative fashion. The collaboration, however, took a different form in this part of the studio. It was modeled after previous, weeklong experiments conducted at the University of Hong Kong with various partners around the world (Kolarevic et al 1998). The project was divided into five phases, each one or two weeks long. At the end of each design phase, students placed their work into a common design database, a "digital pinup board" (Wojtowicz 1994), which was accessible through a web browser (Figure 1). Then, at the beginning of each phase, students selected the best work they could find in the previous phases by browsing through the database. They were not allowed to continue with their own design. Since in each phase they had to select someone design, they implicitly formed teams (Kolarevic et al 1998).

The final results were design projects with shared authorship that could be traced back to the contributing authors and co-authors using the database (Figure 2). In this process of "evolutionary" design, the authorship was not a question, as the contribution of all students involved in the design was recorded in the database (Kolarevic et al 1998).

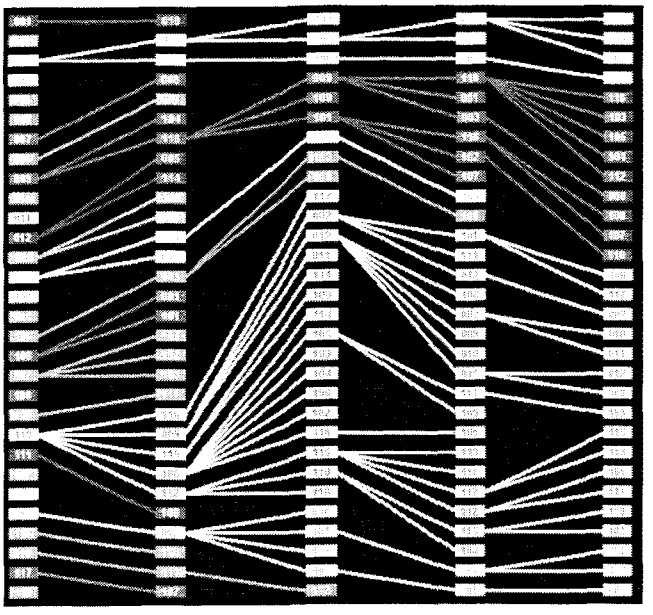

Fig. 2. The genealogy of designs. Note that there are four identifiable "families" of designs at the end of the "evolutionary" process.

OBSERVATIONS

Two surveys were designed to capture feedback related to the key issues that were investigated in this studio, namely modes of communication, collaboration, collective design, social processes, and pedagogy. Recognizing that the use of technology in the design process is a matter of critical judgment rather than a fact, the questionnaires included sections where respondents can explain the rationale behind their choices. Two general essay type questions were also included to capture some of the general observations about the virtual design studio. Apart from this more structured approach, informal inquiries were conducted during the studio sessions to collect views and feedback. We also monitored the design progress through the VDS database to formulate observations on the collaboration process as well as the design evolutions.

A Socio-technical Perspective

A socio-technical system perspective has been adopted in this studio. It is believed that it is essential to allow flexibility for individuals to seek means to construct their own communication protocols (Winter and Taylor 1996). While it has always been assumed that higher bandwidth and resolution will lead to an improvement of communication (Chen and Maver 1996, Chiu 1997)), our findings indicate otherwise. The availability of technology allows but does not necessary change the established behaviors of the users; at times, it might be necessary to "de-optimize" technology to accomplish the behavior of the individuals (Yamaguchi www). A number of communication models or roles were identified:

- "Philosophers" – They generally prefer slower, simpler and more direct communication methods. They use email to compose their thoughts and prefer a lag between dialogues. They use web pages to publish their thoughts. They participate in synchronous exchanges only when it is absolutely necessary.
- "Misers" – They prefer using and maximizing a particular means of communication. They perceive communication as necessary but generally prefer to work and contribute quietly. For them, the meetings should be over quickly. The only thing they want to achieve is what needs to be done next.
- "Party goers" – They like meeting people and being seen. Their outgoing characters mean that they also generate most of the exchanges on the network. They like experimenting with various means to communicate. To them, communication can sometimes be an end in itself.
- "Followers" – They communicate to maximize their own work. They generally position themselves at the receiving end of the communication chain. They like to be online to ensure that they don't miss anything. They like asking questions so that they could get useful answers and information.
- "Initiators" – They are the opposite of followers. They are at the front end of the communication and always wish to broadcast their ideas and contributions. These would often provide help to ensure that everybody in the team gets their message. They like instant feedback so that they could contribute more.
- "Loners" - These people have their agenda somewhere and do not normally wish to be bothered. Communication has little purpose except to put various "individual" contributions together. For them, high bandwidth and resolution is a waste of time and energy.

The choice of technology at any one time of the design process is not entirely a technical decision. ICQ ("real-time chat" software) has been the most preferred communication protocol among the different user styles (for 83% of the survey respondents). Two thirds of surveyed students (68%) thought it essential for VDS collaboration and communication. Students found it "the most convenient way to communicate," "informal," "fast," "instantaneous" and welcomed its low system overhead, autosave and built in file transfer features. However its text-based interface poses limits to support design activities. Whiteboard feature in NetMeeting was used extensively to supplement ICQ for its ability to share graphical information (Figure 3), and more importantly to exchange sketches. One third (32%) thought that the whiteboard is essential for VDS.

Email was the least preferred technology for two thirds of surveyed students, as it was perceived to be "formal," "only good for giving instructions" and "slow." Surprisingly, half of the students who were surveyed thought that it was barely needed. It was used mostly when it was understood that other party was not there. The use of web technology was, on the other hand, enthusiastically endorsed. Sharing and obtaining information have been the main motives behind its support. Beyond the technological need to exchange infor-

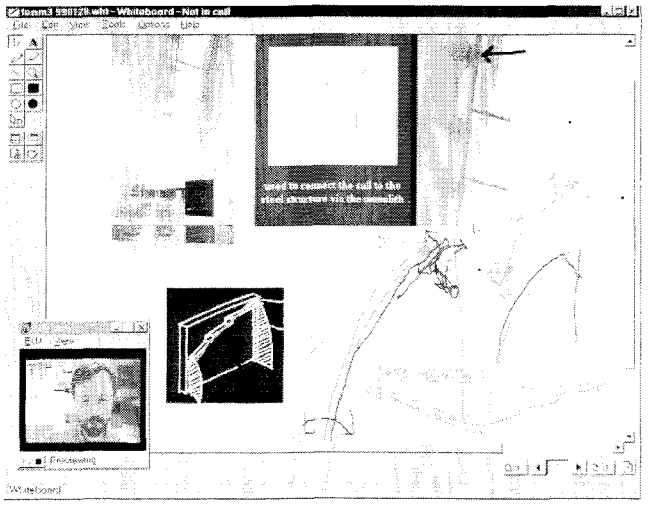

Fig. 3. Whiteboard was used to share images, drawings, and sketches. Students prepared their presentations as web pages. Images were copied from web pages into the whiteboard software as underlays for sketching.

mation, the existence of a common design database somewhere provided a psychologically comforting proof of the existence of the teams.

The mixed feeling expressed in whether or not it is important to "see" the face(s) of the party was illuminating. Contrary to popular belief, our findings indicate that seeing the others is not an essential feature needed for effective collaboration. According to our survey, only 4% found it essential, while 32% though it is not important (16% thought it was often needed, 28% sometimes, and 20% barely). There are some concerns of privacy here, but the main reason given is that seeing the work is more important than seeing the face(s). However, at this point, it must be pointed out the students "prefer" seeing the face(s) of their tutor(s) during tutorial and review sessions.

A Design Perspective

Whether or not design could be improved with the horizontal integration model was another inquiry of this studio experiment. Design is a response to a situation thus it is difficult to develop objective measurements to quantify its quality (Schon 1996). What this study investigated instead is whether or not the horizontal integration model could be "perceived" to provide a more conducive environment for better design.

Design has been traditionally seen as a continuous and integrated process (Schon and Wiggens 1992). In an idealized situation, the designer, like an artist, would wish to have the control of the entire process. A good design has always been seen as one that has a coherent concept throughout. It is therefore not difficult to understand that some students would express disjoined feeling of the idea of shared authorship. Two thirds of the surveyed students stated that they could accept some "sharing" but not all. For some students it was "difficult to work on others' ideas while they still had their own in mind", i.e., to "shift from one's initial design framework into somebody else's." On the other hand, some noted that collective design provides an opportunity to try out different approaches to the project and to discover potentially interesting ideas that might not be noted if one was working alone.

Discussion with the students and surveys revealed that most of them tended to choose designs that were "similar" to theirs for further development. Only a few of them admitted that they chose the design because it was different and "better". One assumption of the shared authorship concept is that designs would evolve for the better and that the fittest would survive. However, underlining that is another assumption that the rules and principles of what could be considered good design have been established and understood. This was not the case in this studio. It would therefore be interested to see if the evolutionary theory of design holds in a more objectively defined design situation.

On the positive side, feedback on whether or not the virtual studio could yield a richer and more diverse design and learning environment has been reasonably positive. For example, more than two thirds of the students thought that having to work on somebody else's idea was a good learning experience; one quarter could imagine being thought design in that fashion alone. In summary, an enlarged knowledge pool and the availability of a large database of different ideas were seen as valuable learning resources. This observation is in agreement with Schmitt's and Hirschberg's findings in their "Phase(X)" and "fake.space" experiments (Schmitt 1998, Hirschberg 1998).

A Teaching Perspective

The studio also examined the issue of teaching pedagogy. During the review sessions, tutors, or the clients, do not normally draw (Schon and Wiggens 1992). The way information is transferred is mainly through verbal means and facial and body expressions. And more importantly, feedback is spontaneous. This means that the bulk of the information flow is intangible, perishable and unrecorded. To better understand this dynamics of information flow, four styles of teaching/tutorial were experimented with:

- Real" - tutors tutoring physically in a well-experienced and understood process.
- Real/virtual" - tutors tutoring a team of real and virtual students in a single session.
- Virtual" - tutors tutoring virtually over the Internet.
- Reverse virtual" - tutor from Singapore virtually tutors from Hong Kong students in Singapore.

On the whole, and as expected, students preferred "real" tutors. Some concerns were expressed during "real/virtual" tutorials. The problem is more to do with the fact that while it is not difficult to tutor either virtually or physically, it has not been easy finding ways to teach both simultaneously. For example, for the benefit of the virtual tutee, a tutor might wish

to speak slowly and use no body language. This restricted communication mode, however, is not very suitable for the "physical" tutee. On the other hand, it was difficult to ensure attention of the virtual tutee while the tutor talked to the physical tutee.

"Virtual" tutors were welcomed, as they were perceived to have brought with them additional expertise to the studio. However, students in general find them "remote" and more difficult to "engage." Spontaneity has been the major concern. Students generally feel that one of the main differences between real and virtual tutors is the lack of spontaneity. Even with the aid of high quality PictureTel based video conferencing, it has been felt that there is a lack of intimacy. This perceived distance, entirely psychological, deterred students from attempting to build a relationship with the tutor. It has been felt that while video conferencing is useful in a lecturing environment, a tutoring environment is much more personal than that. Tutorial works the best when the students know the tutor personally; time is required to build that relationship.

Comments expressed by students towards "virtual" tutors shed some light on how "reverse virtual" tutors were received. It was of no surprise to note that students regarded the "reverse virtual" tutor almost as real as the "real" tutor. Previous relationships built between the tutor and the tutee obviously help here. On further examination and discussion with students, it was revealed that the missing body language was inferred, though past experience with the tutor, by the tone and rhythm of his verbal expression.

CONCLUSIONS

The net-enabled collective design authorship is an instance of a wider concern for validating the effectiveness of the emerging horizontal integration model in architectural practice. Although the model has been used with some success by other, mainly engineering based, design professionals, its usefulness in supporting architectural design process is yet to be proven.

Architectural design process is solution-led and highly "wicked" (Lawson 1980). As such, there is a need for information to loop-back to the previous stages of the design process. A lot of these loops are unstructured and unpredictable. Our studio experiment demonstrated that flexibility in the provision of technology is more important than its optimization. It demonstrated that to facilitate and encourage the loop back mechanism, it is important to ensure that the information system is designed to cater for, or tolerate, minor and informal channels to exist within the more formal and structured framework. At present the two are rather dissociated. The challenge for future technological development will surely be in seeking ways to integrate them.

Coupled with the provision of technology is the social dimension of engaging technology for a purpose. People communicate for a need, and they will seek the best means to accomplish that need. This studio has identified some of the styles and needs of the individuals in the virtual world. However, this socio-technical interface is a dynamic one, and behaviors will be affected by the development of new technologies. The challenge here is to continue monitoring and capture where the balance points are in the rapidly changing world of information technology.

The encouraging news is that the studio is perceived to have provided a more enriching environment for design. Unfortunately, it is still inconclusive as to whether or not this studio arrangement could yield better design. Design quality is judgmental and is experience based. The problem with this studio is that the designers are mostly inexperienced and may not fully appreciate the nature of architectural design process. To address the problem more adequately, a similarly structured studio should be conducted with more advanced students or even with design professionals.

The roles and styles of the teachers in the information age has been a subject of some debates by education theorists (Penz 1992, McCullough 1996, Popova 1997). Virtual design studios add another level of complications. Apart from some of the concerns expressed so far, this studio highlighted the need to "know the tutor" at a more personal level as a pretext to the need for a more spontaneous exchange. If virtual tutoring is ever to be promoted to replace real tutoring, solving the contextual issue of what goes behind the tutorial session is as important as providing higher technology to enable the session itself.

REFERENCES

Chen, Y and Maver,T. "The Design and Implementation of a Virtual Studio Environment," *Proceedings of 2nd East-West Conference on IT in Design*. Moscow, 1996.

Chiu, M. L. "Representations and Communication Channels in Collaborative Architectural Design," *Proceedings of IFIP Conference*. Sydney, 1997.

Cicognani, A. and M.L. Maher. "Models of collaboration of designers in computers in computer supported environment," *Proceedings of IFIP 97 Conference*. Sydney, 1997.

Hirschberg, U. and F. Wenz. "PhaseX: Memetic Engineering for Architeture," *Proceedings of ECAADE'97 Conference*. Vienna, 1997.

Hirschberg, U. "Fake.Space - An Online CAAD Community and a Joint Enquiry into the nature of Space," *Proceedings of CADDRIA'98 Conference*. Osaka, 1998.

Kolarevic, B., G. Schmitt, U. Hirschberg, D. Kurmann, and B. Johnson. "An Experiment in Design Collaboration," *Proceedings of ACADIA'98 Conference*. Quebec, Canada, 1998.

Lawson, B. *How Designers Think*. London: The Architectural Press, 1980.

Lucas, H. C., D.B. Roitman, and E. Roskies. "The Role of Information Tehnology in Organisation Design," *Journal of Management Information System* (1994): 10-4.

Maher, M. L., S. Simoff, and A. Cicognani. *The Potential and Current Limitations in a Virtual Design Studio*. University of Sydney, 1996.

Maver, T. "Added Value for CAAD in Education," *Proceedings of AVOCAAD Conference*. Brussels, Belgium, 1997.

McCullough, M. *Abstrating Craft: The practiced digital hand*. Cambridge: MIT Press, 1996.

Mitchell, W. (www). *Creative Design in the Computer Era: The Design Studio of the Future, MIT*. http://sap.mit.edu/dsof/research/creative_design.html.

Penz, E., ed. *Computers in Architecture: tools for design*. London: Longman, 1992.

Popova, M. *IT and the Architect's role*. Gothenburg: Division of Design Computing, Chalmers University of Technology, CTH-A CADLAB, 1997.

Poh, L. and L. Myers. "A Distributed Co-operative Model for Architectural Design," *Automation in Construction* (1994): 3-2/3.

Rutherford, J. H. and M. L. Maher. "Video Conferencing and CAD," *Proceedings of the 27th Annual Conference*. Australian and New Zealand Architectural Science Association, 1993.

Sasada, T. "Open Design Environment and Collaborative Design," *Proceedings of ECAADE'94 Conference*. Glasgow, Scotland, 1994.

Schmitt, G. "Design and Construciton as Computer-Augmented Intelligence Process," *Proceedings of CAADRIA'98 Conference*. Osaka, Japan, 1998.

Schon, D. *The Reflective Practitioner: How Professionals Think in Action*. New York: Basic Books, 1996.

Schon, D. and G. Wiggens. "Kinds of seeing and their functions in designing," *Design Studies* (1992): 13-2.

Vervenne, D. "Interactive annotation processing for extraction of strategic knowledge," *Proceedings of Management of Industrial and Corporate Knowledge Conference*. Compiegne, France, 1994.

Winter, S. J. and S. L. Taylor. "The Role of IT in the Transformation of Works: A comparison of Post-Industrial, Industrial and Proto-Industrial Organisation," *Information Systems Research* (1996): 7-1.

Wojtowicz, J., ed. *Virtual Design Studio*. Hong Kong University Press, 1995.

Yamaguchi, S. (www). *The Next-Generation Architetural Design Environment*. http://archigraf.kit.ac.jp/INT/Res.