

EXPLICIT CHOICES AND EMERGENT WORK PRACTICES IN GLOBAL TEAMWORK

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ABSTRACT

The technical advances in computer hardware, software, and infrastructure have increasingly optimized conditions for the application of Internet-based tools to support collaborative teamwork in the past decade. This paper presents the valuable findings that resulted from a number of studies in industry and education environments that highlight the process, critical explicit choices, and emergent work practices in global teamwork. Key questions are (1) What people experience when interacting with the technologies? (2) Why people practice in the way they do? (3) How the practice fits into the environment and changes the work patterns. Observations indicate that (1) explicit choices of core team values, team's mode of operation, and collaboration technologies affect teamwork patterns and lead to emergent behaviors and work practices, (2) high performance teams that use the collaboration technologies effectively exhibit collaboration readiness at an early stage and manage to define a "third way" to meet the demands of the cross-disciplinary, multi cultural and geographically distributed AEC teamwork. The observations represent the blueprint for innovations and improvements in both the design and development of collaboration technologies and work processes.

KEY WORDS

Global Teamwork, Collaboration Technologies, Work Practices

INTRODUCTION

"The globalization of economic activity is perhaps the defining trend of our time. It is reshaping not only the grand, macro level aspects of economic life but the personal aspects as well, including where, when, how, and with whom we perform our daily work. At every level, from the personal to the team, corporate, enterprise "[O'Hara-Devereaux and Johansen 1994].

The technical improvements in computer hardware, software, and infrastructure have increasingly optimized conditions for the application of Internet-based tools to support collaborative work in the past decades. Many of the necessary networking components do not require high-end hardware or high-level technical support and are commercially available or free to download today. Collaboration technologies such as discussion databases, application sharing, desktop conferencing, instant messaging have emerged in many communities and

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workplaces. Researchers report how context, peripheral awareness, incidental properties of artifacts, and informal conversations allow users to coordinate their activities with others, and how the collaborative technologies can help or hinder those patterns (Fussell et al 2000) (Grudin 1994) (Herbsleb et al 2002 a, b) (Nardi et al 2000) (Olson et al 2000) (Teasley 2001).

This study was performed over the past five years and is based on ethnographic observations of over 20 cross-disciplinary geographically distributed teams. Its aim was to understand what people experience when integrating information technologies into their work process, why people practice in the way they do, how the practice fits into the environment and changes the work patterns. The observations serve as a blueprint to be used every year to improve the design of the learning experience in the AEC Global Teamwork program offered at Stanford in collaboration with universities worldwide.

To establish the context of investigation, the first part of the paper gives a brief introduction to the AEC Global Teamwork program. In reporting the results of the study, the analysis is structured under the following research questions:

- How people make choices – taking into account not only the acquisition and adoption but also the abandonment of of collaboration technologies.
- The roles of collaboration technologies in global teamwork.
- The impact of collaboration technologies on behavior of the team and individual team members and emergent work practices.

The scope of this paper concentrates on the cross-disciplinary geographically distributed team meetings that use synchronous collaboration tools such as desktop NetMeeting Video Conferencing (VC) and application sharing, Instant Messaging (IM), and concurrent video streaming, since these tools play a major role in replacing the face-to-face interaction in this setting. Nevertheless, it is important to note that asynchronous systems such as email and threaded discussions, ftp group spaces, etc. were used complementarily with the synchronous systems by the AEC teams.

THE AEC GLOBAL TEAMWORK TESTBED

The curriculum of the AEC Global Teamwork program is based on a Project-Based Learning Model that has evolved over the years through the course offering in the Civil and Environmental Engineering Department at Stanford University in collaboration with partners worldwide (Fruchter 2003). The five-month course runs from January till May yearly since 1993. It engages M.Sc. students, faculty, and industry practitioners from the three AEC disciplines – architecture, structural engineering, and construction management in a distributed learning environment including universities from Europe, Asia, and USA.

LEARNING CONTEXT

Students in the AEC Global Teamwork program are grouped into teams with an assigned project right at the beginning of the course. Each team consists of members from the three AEC disciplines from the M.Sc. program in different universities. A team may also have one undergraduate participates as apprentice. Members of a team meet face-to-face during the one week kickoff event at the beginning of January at Stanford. Thereafter, the members

return to their respective Universities. Hence modes of interaction and content sharing of all AEC team span over time (synchronous and asynchronous) and in space (geographically distributed and collocated) and are mediated by collaboration technologies.

The center of the learning experience is a building project based on a real-world setting with a program, a budget, a site, a time for delivery, and a demanding client/owner. The project requires the expertise from the three AEC disciplines, which are interdependent (Fruchter 2003). During the five months period, each team is required to present two building designs and a final complete AEC building proposal. They have to meet tight deadlines, engage in project reviews, and negotiate modifications.

The learning activities are revolving around the building projects. They include structured lectures, professional practice sessions² and project presentations. Students spend most of their time working in teams on their project. Learning is situated and developed collectively through activities and practices in this program. Learners are challenged to cross four chasms – time, disciplines, culture, and technologies. All team rely heavily on technology to overcome the barriers of time and space. Participants are challenged to collaborate with people across different disciplines, languages, cultures, and many time zones. These ever changing challenges (change in technologies, people, conditions, etc.) train learners to be attuned to the constraints and affordances in a setting. At the same time, allow the learners to practice the sophisticated social and information-processing skills that they will need in their future careers (Greeno et al 1996) (Lave and Wenger 1986).

The individual participants and the teams, the activities, as well as the technology tools, are mutually dependent, impact and change each other continuously in this environment. The setting, the technologies, and the people together shape the problem and allow the teams to come up with different innovative solutions. This explains why, in the past decade, every successive generation has produced drastically different designs for the same project requirements. (<http://pbl.stanford.edu>).

COLLABORATION TECHNOLOGIES

The collaboration technology ecosystem available to the students includes:

- Software – Commercial systems that are explicitly designed for person-to-person communication and in-house PBL Lab developed collaboration technologies that are designed for specific collaboration functionalities:
 - Synchronous tools – desktop video conferencing (VC) such as NetmeetingTM; instant messaging (IM) such as MSN Messenger; and speaker phone.
 - Asynchronous systems – email; threaded Discussion Forum; shared WWW workspace for each team.
- Hardware – Fujitsu Tablet PC with touch screen; and network (LAN and wireless), SmartBoards, digital Nokia pens and bluetooth enabled cell phones.

ETHNOGRAPHIC APPROACH

This paper presents observations from an ethnographic study and uses two examples of geographically distributed high-performance AEC teams. They were chosen as they represent

² The professionals are gathered to solve design problems with students observing at the periphery their performance. These activities aim to make explicit the expert's best practice and knowledge (Fruchter 2003)

two extremes of a spectrum of high-performance team instances. Particular attention is placed on the collaboration technologies in practice and the team's emergent work processes. The two teams are referred to in the paper as Team X and Team Y. The teams had participants at Stanford, University Wisconsin Madison, Georgia Tech, Royal Technical University Stockholm Sweden, Chalmers University Goteborg Sweden, and Bauhaus University Weimar Germany.

All the students provided background information collected in a pre-program survey. The data indicated that all the members from these two teams were experienced users of email, PC, web applications, and discipline specific applications (e.g., AutoCAD, MS Project, SAP, ETABS, etc.). All rated themselves at least at level 8 on a scale from 1 to 10 on computer skills. The majority indicated that they have only some understanding of the other two disciplines. All members were high-achievers in their respective institutions, and highly motivated and committed to the goal of the program and team project. Both teams excelled in both their process and final product producing exciting building proposals.

Data was collected from interviews, observations, logs of IM, messages from the threaded discussion forum and a general background survey. 10 interviews spanned throughout the five-month period from January to May. The interviews were face-to-face collocated or over skype or videoconference. Each interview took about one hour on average. All face-to-face interviews were recorded. During the interviews, students were asked to comment on the technology provided; describe their work patterns; reflect on issues and challenges they encountered. Observations on the team dynamic were gathered from observing more than 35 sessions of team meetings, VC sessions, class meetings, dry runs and the spring and winter presentations. The units of analysis were individual team members, dyads, and the team as a whole.

EXPLICIT CHOICES

The following three key stages were formalized directly related to how teams make choices and the roles of collaboratin technologies

- Stage 1: *Preparation for collaboration* – The adoption and abandonment of collaboration technologies,
- Stage 2: *Adaptation* – The transition from visible to invisible, and
- Stage 3: *Idiosyncratic Usage* – The coupling of present-at-hand and ready-to-hand.

Heidegger (Heidegger 1977) uses hammer and hammering to illustrate the concept that objects and properties are not inherent in the world, but arise only in events that lead to present-at-hand. The essence of this example is in the way in which the hammer moves from being present-at-hand to ready-to-hand, i.e. from becoming present and “visible” as an object of focus and attention to being employed within the action of hammering as an almost “invisible” extension of the arm. When the hammer is present-at-hand, it is separated from its user, while in the ready-to-hand situation, the hammerer's arm and the hammer feature as a single unit in the hammerer's activity (Dourish 2001) (Winograd and Flores 1987). In the case of the study presented in this paper, visible and present-at-hand represent explicit choices that the team is making regarding specific collaboration technologies to be employed for specific communication objectives, where as invisible and ready-to-hand represent the

state in which the chosen collaboration technologies are embedded in the daily work practice and become part of the work and business processes of the team and organization. It is important to note that there is a continuum between these stages as the teams evolve.

HOW PEOPLE MAKE CHOICES

STAGE 1: PREPARATION FOR COLLABORATION – THE ADOPTION AND ABANDONMENT OF COLLABORATION TECHNOLOGIES

Setting up a common “collaboration workspace” is the first task for a geographically distributed team. Even though the same set of tools are introduced to all the participants at the beginning of the AEC program, it was observed that the decision which technology to adopt or abandon later was not pre-determined. Rather, it was the result of a series of evolving actions that emerged over a period of time and was specific to each team. The process revealed the extent to which the members were motivated to work with each other and willing to adapt to the common needs of a team. This “collaboration readiness” is a key factor that affects the success of a global team (Finholt).

Team X – The Instant Messaging (IM) Team

Team X made the following explicit choices

- Team core values – (1) produce a high quality building proposal from all three AEC perspectives, (2) each team member’s time was very valuable, consequently not wasting each other’s time and efficiency was central to their value system.
- Mode of operation – Fast paced, short focused quick meetings, not waisting time to set-up many collaboration technologies.
- Collaboration technologies – Team X tried all technology options for the first two weeks. They abandoned VC after some members failed to setup the camera and audio within the first couple of weeks. Throughout the whole program, they used VC only while they were meeting with the client every other week for project review sessions. For meetings among the members, IM was adopted as the main (synchronous) communication tool. Email was used to compensate when a person was not available online.

The team invested very little effort on troubleshooting the setup problem among the members, in other words, they gave up VC and adopted an alternative. At first glance it seemed that one reason for Team X to abandon VC was attributed to the technical breakdowns. But using VC also meant that the team had to spend time to make prior arrangement, allocate time to set-up all the hardware and software equipment, and prepare the materials for discussion beforehand. The most important criteria for adopting or abandoning a collaboration technology was whether it enabled them to get things done most efficiently and effectively. Hence VC was reserved only for the meetings with the instructor or the client/owner. The explicit choice of IM as their main communication channel was not surprising. It was present-at-hand. All but one team member were already very familiar with IM. To most of them, IM was a tool that was “ready-to-hand” before attending the AEC Global Teamwork course. In addition, the affordances of IM was a good match with the team’s “no time wasted” value system. IM supports short and quick opportunistic conversations for questions and clarifications. It makes intermittent exchanges more straightforward, allowing participants to attend to other tasks and then return to an IM (Nardi et al 2000).

Consequently, the choice of tools by Team X indicates that the team's actions were affected by: the team's prior experience (familiarity with IM), their needs (need a tool to communicate, need to complete the project, etc.), shared prejudice and values (efficient and "no time wasted," "there was no need to have everybody there, people are there only when they are needed to be there," "video and audio in VC are not important" even though they have either no experience or only little experience in using VC, their existing work pattern "find a time that is common for everybody is almost impossible" and their life-style - going online was part of the daily routine for A, C and the apprentice.

STAGE 2: ADAPTATION – THE TRANSITION FROM VISIBLE TO INVISIBLE

It is important to notice that a choice for a team is not necessarily the choice of every member. In this situation, one team member had no prior experience in using either IM or VC, he simply followed the choice of his teammates, even though he indicated that "sometimes it's hard to ask the right question and to understand the answer over IM,....", IM remained the main communicative tool for Team X throughout the project. This illustrates also how one was "thrown" into action, he needed to respond to the adopted technology and process and "flow with the situation." (Winograd and Flores 1987). Another key observation was the commitment of all team members in Team X to be almost all the time on line and on IM. This enabled all team members to be visible and available to each other on an as-needed-based 24X7.

TEAM Y – THE UNIT

Team Y made the following explicit choices

- Team core values – (1) produce a high quality building proposal from all three AEC perspectives, (2) "to build a strong team spirit," and sense of belonging, (3) building common ground.
- Mode of operation – decisions based on common ground and deep understanding of all discipline aspects of the project, and all participants present and active in the decision process.
- Collaboration technologies – Team Y tried all technology options and encountered similar problems with the camera and audio setup for the VC (NetmeetingTM). But instead of abandoning it, they worked around it and coupled it with another new product VSeeTM. The team took the time and effort to creatively combine the tools in order for all the members to meet together and be able to see and hear each other in real-time, i.e., using NetMeeting for application sharing, skype for audio, and Vsee for video. Besides the need to set up a platform to work and communicate, the driving force behind this effort was "to build a strong team spirit."

Like all teams, they used IM to initiate their team meeting and all the connection details. Even though the reason Team Y adopted the tools was very different from Team X, it was observed that their decision too was influenced by: their prior experience, e.g., familiar with VC and technically savvy; shared prejudices and values - "Team meeting means everyone in the team meet together," "There is a risk if only 2 meet, the others may feel excluded from the team." and the motivation for them to work as a team, to see and hear each other and make decision together.

STAGE 2: ADAPTATION – THE TRANSITION FROM VISIBLE TO INVISIBLE

It is important to note that Team Y's choices required all team members to coordinate their schedules to ensure they participate at all meetings. Most importantly, they had to allocate formally time to set up all collaboration technologies and channels before starting the team meeting. This took the team 45 min for the first couple of weeks until they established a routine and reduced the set-up time to 15min. This set-up time is very important to consider and allocate for in global teams. Team members can not assume that they can just walk into the meeting and get started as would be the case in a collocated scenario.

The fact that there were no two teams among the cohort operating in the same manner and using the same set of tools suggests that the presence of technologies does not guarantee their successful adoption and ways of implementation. Rather, systems that are easily integrated into the team's existing working environment (e.g. IM for Team X) or systems that provide evidence that they will serve the common goal of the team (e.g. VC for Team Y) will be adopted. This indicates that people's action is social and situated within their community of practice. The community determined their choices and shared systems of meaning and values, norms and rules of practice, mode of operation, and collaboration technologies. For Team X and Team Y, the process of setting up the collaboration workspace revealed the personality and preference objectives of their members and at the same time, allowed them to discover their shared values and differences. E.g. Team X valued "*no time wasted*" and Team Y valued "*team spirit*". The process shaped the norms and rules of practice of the teams as well as their collaboration workspace. Collaboration readiness exhibited by the two teams in this early stage set the ground for the teams to develop a "third way" (O'Hara-Deveraux and Johansen 1994) to work in this challenging environment.

THE ROLES OF THE COLLABORATION TECHNOLOGIES IN A GLOBAL TEAM

Stage 3: From Adaptation to Idiosyncratic Usage

The roles of technologies transcended from being visible "present-at-hand" to their users who were acting consciously in adopting and abandoning the tools, to becoming "ready-to-hand." For both teams, the technologies had integrated into their "world" and work practice in such a way that they turned IM or VC, NetMeeting and VSee into their meeting room, socializing place, working area, and a "window" to "see" each other (Lave and Wenger 1986). The availability of information such as visual/audio alerts of active/inactive, online/offline, provided by IM allowed its users to track down people who were difficult to find by other means. IM created a virtual environment similar to a shared physical office for Team X. In this environment, members engaged in work related tasks, interspersing sporadic interchanges throughout their individual work (Nardi et al 2000). Similarly Team Y used VC Vsee and NetMeeting creatively to respond to their needs. Most of the times, one laptop was running skype for a 5-multipoint conference call, another laptop was running VSee so all participants could see everyone at all times, and the third laptop was running NetmeetingTM with application sharing. VC, skype, and VSee transcended from "visible" "present-at-hand" to a "ready-to-hand" technologies. IM, VC, skype, VSee were *appropriated* by Team X and Team Y, respectively, were "invisible" to their users, and put to work within the specific emergent work processes by Team X and Team Y (Dourish 2001). Transcending from being "present-at-hand" (visible) to "readiness-to-hand" (invisible), the "appropriateness" and the

“invisibility” of these tools was an important phenomenon in this learning environment. Invisibility or “readiness-to-hand” of mediating technologies is necessary to allow the participants to focus on, and thus support (the visibility of) the learning tasks at hand, i.e. the invisibility of the technology allows the members to concentrate on their building project and coordinate their tasks with their partners. The sooner these tools become “ready-to-hand” for the learners, the sooner they are able to concentrate on their learning activities. On the other hand, “present-at-hand” or visibility of the significance of the technology is necessary to allow the team to use the tools effectively as a medium for communication. For instance, members of Team X had to be consciously aware that going online (login to IM) and being available for their partners through IM are crucial to their team dynamic. Whereas for Team Y, they needed to realize that setting up a VC, skype, Vsee and Netmeeting and ensuring that audio, video work properly during the meeting is essential for them to focus on the discussion. The effective use of the tools is thus a matter of providing a good balance between these two interacting requirements – synergy and tension between invisibility and visibility (Lave and Wenger 1986), the tools fade in and out from the background to the foreground and vice versa as and when they are needed during the practice.

EMERGENT WORK PROCESSES: HOW THE TECHNOLOGIES IN PRACTICE AFFECTED THE TEAM’S WORK PATTERNS

As shown in Figure 1, Team X was a team of networked dyads. Most of the meetings among the members were carried out in dyads engaging a third or all members only on an as needed basis. Meetings were short, focused on specific problem solving issues, and launched on a needs basis. Information circulated only to those who were deemed “needed.” Team Y worked as one unit. The team considered the work process and practice for them to produce the best product was to establish a good understanding and sense of belonging among its members. They made an explicit effort to set-up and prepare for their team meetings. All members gathered, discussed and made decisions in the collaboration cyberspace determined by their collaboration technology choices. All information was sent to all three members and decisions were made by consensus during their weekly meetings that were typically two hours long.

Despite the very different work patterns exhibited by Team X and Team Y, both teams excelled and produced high quality building proposals at the end of the program. Both Team X and Team Y developed a “third way” (O’Hara Devereaux and Johanson 1994), which is idiosyncratic to each team, to meet the demands of work in the diverse physical, cultural, cross-disciplinary and electronic workspaces.

As O’Hara-Devereaux (O’Hara-Devereaux and Johansen 1994) states, “*there is no “best way” of team management.....If there is a best way, it is usually a new “third way” that has to be invented anew for each team.*” The work processes and patterns that emerged in these two teams showed that on one hand, the practice is the process of continual response from the people as well as the tasks to the circumstances within which it was being produced. On the other hand, it was also the consequence of the technologies they adopted in their practice. For example, Team X’s style of working in dyads and constantly engaging in quick and short questions and problem solving sessions were the response *from* its members, whose top priorities were “*Efficient and no time wasted*”, as well as the emerging tasks, i.e. the short

and direct questions such as “how long should the beam be?” “What is the cost of the materials?” etc. Nevertheless, this work pattern was directly linked to the functionality of the tool adopted by the team. A comparison shows that the work pattern of Team X arose from the affordances of IM. IM is a tool that supports dyads (Nardi et al 2000). It encourages instant and quick exchange of information. The iconic display and the alerts about the status of the user’s contacts (online or offline, available or busy, etc) allowed the members to know the availability of each other and thus encourage impromptu contacts.

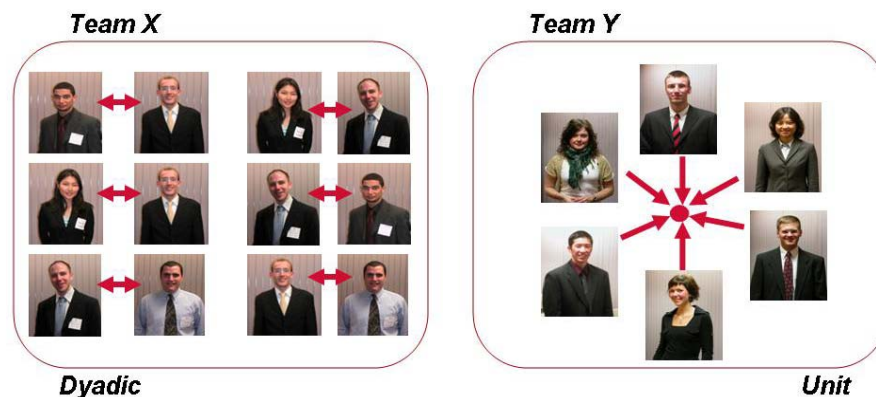


Figure 1: Two Distinct Patterns of Interaction as a Result of Explicit Choices of Team Core Values, Mode of Operation, and Collaboration Technologies

Consequently, team practices and work processes were directly affected by the way each team adopted the technologies. Depending on the communication technologies adopted by the team, the affordances and constraints of the tools influence and shape how the messages can be produced and received, how the members interact and negotiate meaning, and the construction of thoughts. But on the other hand, it was also the team’s decision, their heritage and their pre-set goals that drove them to adopt the technologies. This observation showed the intricate and dynamic embodied relationship between the people, technologies, activities and the setting. Consequently, technology should not be treated as a given. Its affordances play a key part in affecting the work practice and process of a team.

CONCLUSIONS

The paper offers a number of take away findings: (1) *explicit choices of core team values, team’s mode of operation, and collaboration technologies affect teamwork patterns and lead to emergent behaviors and work practices*, (2) high performance teams that use the collaboration technologies effectively exhibit collaboration readiness at an early stage and manage to define a “third way” to meet the demands of the cross-disciplinary, multi cultural and geographically distributed teamwork, i.e., “*there is no one size fits all.*” As shown, both team X and team Y represent high-performance team examples with two very distinct and successful products and emergent work practices. (3) *Change takes time and explicit effort.* Consequently, decision people, the team and team members should allocate time, resources, and effort to facilitate this change in behavior and work practice. The three stages - *Preparation for collaboration, Adaptation, and Idiosyncratic Usage* – represent a useful self assessment method for any team to know where the team is in the process of change, how far

from the goal the team is, or if the goal of change was achieved. The observations represent the blueprint for innovations and improvements in both the design and development of collaboration technologies and work processes.

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