What Ideal End Users Teach Us About Collaborative Software

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ABSTRACT
Many studies have evaluated different uses of collaborative software. Typically, the research has focused on the shortcomings and, sometimes, the ways end users succeed or fail to work around these shortcomings. In a recent field study, surprisingly, a group demonstrated unimpaired dexterity using a full range of collaborative software. Some interesting lessons emerged from observing these "perfect" collaborators. Lessons include implications for more typical or "less than perfect" end users, especially around the adoption of collaboration technology. Also, there is a general, but subtle, lesson that studying successful users of technology (or "ideal end users" as we put it) can be as valuable as studying those who struggle with technology and highlight its shortcomings.

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General Terms
Management, Human Factors

Keywords
Workplace collaboration, groupware, CSCW, cooperative work

1. INTRODUCTION
A myriad of software tools exist to support collaboration. Various studies have evaluated different aspects of their uses, ranging from the social aspects of everyday practices that are affected by these tools to their advantages and disadvantages in supporting these practices. In our own work as well as in the literature, we have observed that the relationship between the technological and social elements is a reciprocal one, which often requires a great deal of mutual adjustments in order for users to come to effectively use technologies.

De Souza [3] and Grinter [4] highlight the social methods users employ to make process tools work in projects. Mark [7] shows the importance of conventions for the use of CSCW tools by distributed groups in order to facilitate communication and coordination and more recently, with a colleague [8], shows the ways in which different characteristics of management in different workplaces affected the adoption of NetMeeting in a large organization. Bansler et al. [2] describe the role of "mediators" in the adoption of a CMC technology, who adapted and modified it to fit the needs of end users.

In a recent field study, much to our surprise, "all was well." Group members demonstrated unimpaired dexterity with a full range of collaborative tools available today: workflow, instant messaging, web conferencing, email, as well as common office tools such as the telephone and "white board." Our analysis of the field data is ongoing, however some interesting findings are emerging. We identified common elements of the practices and history of the group. We also noted several everyday group member activities, such as customer support, product creation and evolution, and work practice improvement. Our experiences, however, tell us there is even more to be learned.

In this field site, the lack of obvious problems with technology challenged us to observe more subtle effects. Despite the challenge, our experience so far showed us that there is indeed benefit in scrutinizing field sites where no problems with collaborative tools arise. One kind of information that can be learned is what are the most essential elements facilitating effective collaboration. Indirectly, the characteristics that make a set of people successful at tool use inform us of the limits that less apt performers are likely to face. Finally, we asked ourselves: how could a group such as this evolve, how could an organization learn from it, and thereby promote and sustain this group's practices to the rest of the organization?

2. SETTING AND RESEARCH METHOD
The research providing the basis for this paper took place as the latest in a series of studies in a research program to learn about collaboration and the uses of collaborative tools in practice. We

sought out this site initially because of the variety of tools they were employing for collaboration – more than others we had studied before.

2.1 Site

We studied a tightly knit software services group of a large aerospace company with campuses across the U.S. This particular group consisted of eight members, including the leader. The group members were collocated and worked in separate cubicles spread out across one floor. They were teamed up in various combinations to work on a variety of projects. It was typical to find a member working individually on one software project, collaborating with just the customer on another task, while concurrently working with other group members on other items. Projects varied but included the following kinds of work: supporting the group itself, supporting customers across the campuses and groups at other business partner or supplier companies, which were located throughout the U.S.

2.2 Data Collection and Analysis

The goal of the study was to observe how the group members performed their work collaboratively and to reach some conclusions regarding the ways that computing technology supported (or failed to support) their collaboration. In this regard, the study was very open ended. We had performed a number of such studies previously, taking a grounded theory approach and allowing effects to emerge [10].

The study took place over a three-month period. There were constraints on accessing the site as is common in real-world observations; we collected as much data as we could within these limitations. Specifically, we performed eight semi-structured, open ended interviews. Each one-on-one interview took about forty-five minutes. We then selected three members of the group to shadow for approximately 90 minutes each. The group leader was selected for shadowing because her role was different from the rest of the group. Two others, whose roles were representative of the remainder of the group were chosen. Tasks performed included: systems analysis, design, coding, testing, peer reviews of other group members' code, and interfacing with the customers. We also observed seven staff meetings. All of these study activities were carried out in the group members' normal workspaces—primarily their cubicles and conference rooms.

3. RESULTS AND OBSERVATIONS

3.1 Overview of Group Function

In 1999, the group was formed to assist with the adoption of Lotus Notes throughout the company. Their success with quick turnaround of collaborative applications led to their formal recognition as a new group specializing in collaborative computing. The group's primary mission is to develop, enhance and sustain web-enabled collaborative computing applications. System projects originate from long-term customers as well as new customers who were referred to the group by satisfied customers.

The group measures success through the eyes of their customers, (e.g. were commitments on delivery dates, cost, quality, functionality and support met or exceeded). Customers are surveyed after every major system implementation. Customers with applications that the group provides operational support for are polled bi-annually. From this perspective, the group's work practices have been highly effective and successful.

The group members were continually evolving their computing environment to support their work, their customers, and in the creation of new products. These activities involved software upgrades to servers, adapting process tools provided by another group, sending change requests to other groups for improvements to tools and environments they use, transitioning existing products to new software architectures and platforms, and more. Related efforts included having a portion of their budget dedicated to training and supporting experimenting with new software.

Practices and collaborative tool uses are highly affected by organizational structure of the group activities. As a member of the group put it, "the group is a 'code for food' type of unit." Much of the work is conducted under a fixed price, or the customer has a specified, limited budget for the project or the year. This member continues: "if a member is stuck on one task he or she will put that task on hold temporarily and ramp up on another task." This has great implication to the ways in which group members carry out their everyday work practices as well as employ collaborative tools for their support. For instance, it is common that the group members have more than one task active at a time, so that whenever they are at a stopping point on one effort, they can transition their attention to another task. We further illustrate this behavior in the next section in the context of the uses of the tools.

3.2 Collaboration and Development Software

The group used a number of computing technologies for their communication and coordination. Some of the tools employed included: email, web conferencing, chat, IM, and two types of process tools. In addition, they used the phone, face-to-face interactions, and group meetings to communicate, coordinate and collaborate. During shadowing, we observed the group members switching among all these tools and applications easily. Although these tools pose challenges to many users, for these group members, the tools were truly "ready-to-hand" (c.f. discussion of Heidegger in [11]).

To illustrate this idea that the tools were "ready-to-hand," we briefly describe the ways in which the group members used different tools to support their customers or interacted with other members. It was not uncommon for a member to initiate a conversation with a customer or group member via IM. The sessions would be used to get a quick answer or to respond to a query. If the "discussion" became too involved, then an impromptu web conference would be launched, with the hosting role being transferred among participants during the session. These sessions were used to demonstrate proof of concept prototypes, to display the GUI, to review code, etc. Frequently, as the requirement or problem was understood, the design would be changed on the fly, allowing for multiple iterations during a single session.

In a more specific example, a group member used various tools to perform her tasks. First, she checked the problem report email from a customer and then she left a message in the customer's voice mail. She switched back and forth between a design tool, the email message, Lotus Notes and Domino Server help to try to resolve the problem. When she realized that she could not continue her task without getting more information from the customer, she exclaimed "Next task" and, immediately, switched

to another task without a pause. She continued swapping tools to perform the next task - chat, a web tool, an application, email to transfer the cut and paste of an error message. She used chat to ask a quick question to another member. They "upgraded" the conversation from chat to face-to-face conversation when her group member needed to explain the complex rationale of why his tabs were better than the tabs provided by the user interface application.

They employed off-the-shelf tools, such as IBM Domino, IBM WebSphere, Plumtree Portal, Team Studio, Microsoft SharePoint, Macromedia Dreamweaver, Macromedia Flash, Oracle and Microsoft SQL Server, for their application development environment. Some of the tools were used at many places in the company. These tools were also part of the group's technology infrastructure. The end users at this campus had been using the Lotus Notes suite for simple collaboration tasks for many years. The initial applications were client-based; however, as soon as the web-based collaborative technologies became available, the group transitioned to developing web-based applications for its customers. Therefore, the group was *collaboration ready* and *collaboration technology ready* and it was easier for them to adopt collaborative tools.

3.3 Group Characteristics

A majority of the members have many years of work experience, ranging from 9 to 31 years, with four of them having more than 20 years of work experience. The most noticeable observation about this group was that the members were aggressive and early adopters of technology [8]. The members seemed to possess a common desire to continuously improve their work. They selected tools and discovered enhanced or innovative ways that the tools could help provide the customers with the desired functionality and faster response times.

The interviews revealed that almost all the participants had some experience with developing technology to make a previous job more effective. Some even learned programming skills to accomplish this objective. All of them considered themselves to be learners. Each member had a unique story about learning technology and adoption, such as learning to program to develop an inventory management system. We also observed that technical books, such as Java programming, and technical magazines were typical artifacts in their work areas. Factors cited for learning included: a perceived need to enhance and extend their technical IT skills; an aversion to performing routine and assembly-like work; curiosity; personal challenge; and "just plain fun."

3.4 Group Reflection

Two of the staff meetings observed involved explicit exercises in self-reflection. On one occasion, the group was asked by upper management to define measurable goals regarding what aspects of their work they wanted to improve. The implication was that these goals would then be self-assessed by the group periodically in the future. The exercise proceeded with a degree of difficulty. The group members struggled while trying to explicitly verbalize descriptors of their work. In the end, the group discussion turned out to be not particularly about self-improvement, but rather about the area of soliciting feedback from customers and monitoring customer satisfaction in general.

On another occasion, the group reached what might be called a point of apathy about staff meetings. Although they started the staff meetings because there were complaints about a lack of communication and technology transfer from the members, the group leader could not get sufficient participation from the members. The group leader then challenged the members to identify a better format for the group meetings; however they could not envision a format that better matched their work practice. The remaining meetings consisted of progress updates and mutual assistance with software issues, such as a discussion about new software tools or new features, as well as suggestions about debugging project work.

4. DISCUSSION

What is unusual in this group is the degree to which they succeed with technology. In our experience, success cases with off-the-shelf technology occur when end users employ various *workarounds* – manual actions that supplement automation. Workarounds are conspicuously absent so far in this group. Although the findings are preliminary, they point to individuals' personal motivation; group identity and intra-group bonding resulting from occupational subculture; face-to-face and informal communication attributable to physical proximity; small group size that may lead to intensified peer pressure; unimpaired dexterity with collaboration tools; and difficulties during group reflection exercises.

4.1 Individual and Group

In general, we can point out several factors that may contribute to explaining how the group has evolved to its current level. First, the occupational subculture as IT professionals helped the members establish their group identity and intra-group bonding. Second, physical proximity allowed them to have face-to-face and informal communication, which is an important mechanism for not only achieving production goals, but also establishing social relations among the members [6]. Third, the size of the group, eight members, contributed to more intense peer pressure to perform well. Peer pressure is considered as one of the factors for successful adoption of collaborative tools [9]. Fourth, immediate management provided an environment that encourages the members to utilize company-provided training resources.

These characteristics of the group, to a certain degree, correspond to some of the findings on IT professionals – unique technical knowledge, jargons and vocabulary, unique stories, unique physical settings and needs for constant self re-education [5]. For instance, the members used jargons such as ".jar file," "memory leak" and "parsing string" during their hallway conversations and staff meetings, which sounded particularly esoteric to outsiders.

We think that these kinds of interactions are particularly relevant to our understanding of this group's dynamics, because they help establish group identity and form intra-group bonding [5]. This process of identity formation through the development of shared language and practices helps not only define the boundaries of the group, in terms of insiders and outsiders, but more importantly, it reinforces their self-motivating characteristics. It then helps create a sustained and long-term group organization. In other words, their practices reify their beliefs and goals, which in turn help sustain these successful practices.

4.2 Group Reflection

Despite their expert, "guru," or "ideal" facility with tools, the group members were not completely without group challenges. A major challenge we observed pertained to the tacit nature of their technology uses, interactions, and practices. Although highly successful, their skills did not lend themselves well to reflection and self-evaluation.

The difficulty of reflecting on their own practices can be associated with the lack of breakdowns. By analyzing the particular characteristics of this group and their particular uses of collaborative tools, we also observed that while, at the technological level, they were able to articulate the problems and realize solutions, they had difficulties reflecting on their own practices and even articulating process and procedures. It was intriguing to observe a high level of agility with regard to technological means, while working very tacitly. While this should come as no surprise (i.e., a great deal of work is tacit), we believe this is an important topic worthy of further exploration.

The group members performed their tasks and collaborated with each other without difficulty. We did not observe any breakdown at these levels, however, as mentioned earlier, they showed difficulties in the group reflection process. Theoretically, the group should have been able to employ staff meetings as means to reflect upon and envision the future state of their work. We thus postulated that the lack or low level of breakdown hindered their ability to reflect. That is, the transformation from plainly doing the work, reflecting and evolving it, is caused and motivated by reflections of the objective of the group work that are usually sparked by breakdowns or deliberate shift of focus [1]. Without breakdowns, it is then difficult for the group to achieve self-awareness.

We are interested in further exploring this hypothesis by studying the ways in which a group like this one learns from a "perfect situation." For the most part, people are likely to reflect through breakdowns, and it has been shown that through breakdowns and contradictions a system, including people, norms, and practices, is able to evolve.

5. CONCLUSIONS

In this paper, we briefly described and analyzed the work of a particular group that demonstrated unimpaired dexterity in using and evolving collaborative tools. Typically, contributions to our understanding of the social and technical issues pertaining to the use of collaborative technologies have relied on failures and breakdowns, which may be a case simply of underreporting of successes. In any case, we raised the issue that much can be learned from studying success stories. For instance, success, or rather, lack of breakdowns may lead to difficulties in groups reflecting on their work practices. We hope to further explore these issues in the future.

Our observations allowed us to gain deeper insights into a number of the factors enabling this group to sustain a work environment that is highly conducive to collaboration and new technical developments. In particular, we looked at individual traits and group characteristics. Indeed, the group's success was almost a matter of self-selection and tightly knit culture.

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