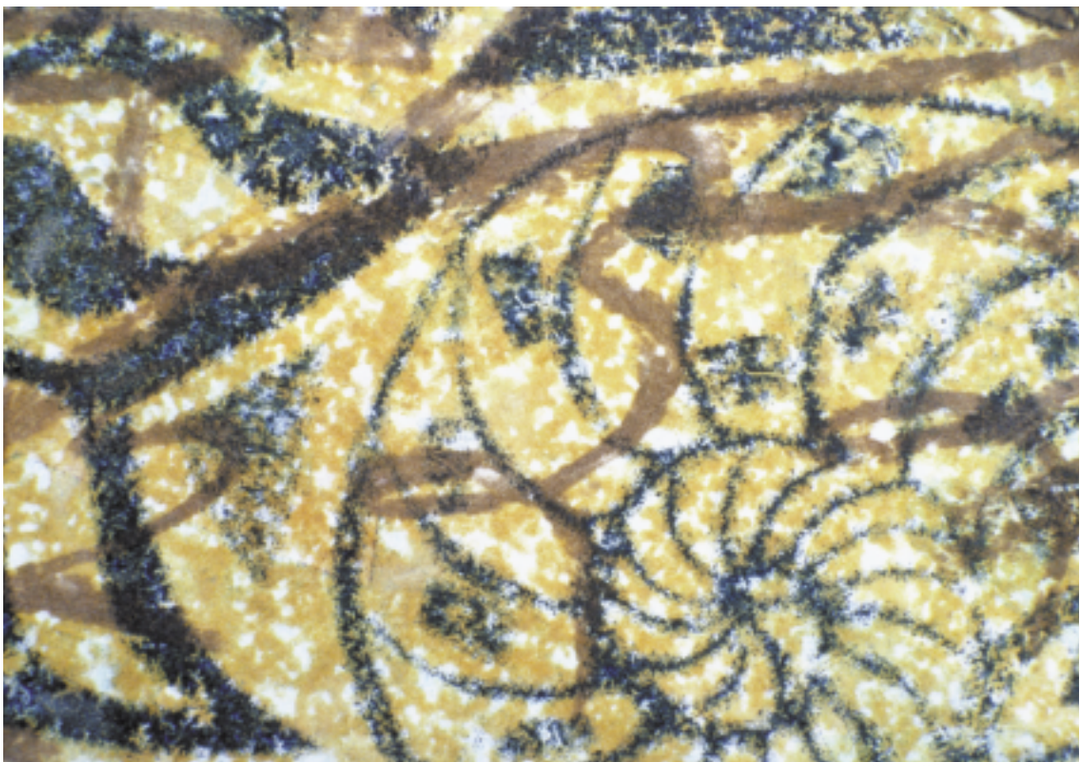

Design for What? Six Dimensions of Activity (Part 2 of 2)

This column is the second half of an essay that I started in the last issue. There I argued that when I think casually about people working with technology, I often instinctively choose a rather narrow view of that activity—the simple case of a person successfully operating the technology. However, from years of experience with design of various kinds, I know that this view of technology in use is too narrow in many ways. Instead I know I must attend to and design for a much broader range of activities.

Over the years, as part of scientific studies and design practice, I have found myself organizing along six dimensions the vast range of human activity that designers must address. I do not believe this structure is complete or even the best; it is just a way I have found useful to think about what I am designing. I use these six dimensions in a checklist to help ensure that I am not inadvertently forgetting any of the lessons that, sometimes painfully, experience has provided.

This essay describes the six dimensions. It does not go into detail on any of them. (For those who are interested, a more thorough treatment will appear in a forthcoming book on task analysis edited by Gerrit van der Veer.)

The six dimensions used to describe our framework for understanding people's activity in using technology are organized to address three aspects of use:

- *Operating:* the activities in which users engage to make the technology do what they want—roughly, "driving" the technology;
- *Enabling:* the activities of arranging things so that the activities of operating are possible—roughly, "preparing" for operating the technology; and
- *Empowering:* the activities of establishing the social circumstances within which the activity has meaning and value—roughly, "justifying" the enabling and operating activities.

Each of these aspects has two dimensions:

Operating

- Dimension 1: Trouble
- Dimension 2: Users Enabling
- Dimension 3. Support
- Dimension 4. Practices Empowering
- Dimension 5. Values
- Dimension 6. Designers

In the previous issue, I addressed the first three dimensions for extending our framework for understanding people's activity in using technology (see Figure 1). In this issue I will discuss the last three and include some thoughts about interactions among the six dimensions.

Enabling

Dimension 4. Practices

CASE: VIDEO IN SUPPORT OF A WORLDWIDE PROJECT

From 1990 to 1994 I led a project for Xerox that involved the participation of more than 50 Xerox user interface design people from around the world, and many more observing. Annette Adler was instrumental in working on the social practices in this community and in making things work well for all concerned.

For the first 2 years, we met for a week in various locations about every 2 months, shared progress, solved problems, focused on next steps, and returned to our various locations to work further. In January 1993, Xerox acquired commercial videoconferencing equipment. Annette arranged for this equipment to be available to our team worldwide. For the next 2 years of the project, because of the effectiveness of the video connections, the time between worldwide meetings increased, and our contact with each other increased dramatically. Instead of meeting physically every few months, we met every few days through video; the planning horizon was for next week rather than next quarter. Using video to support distance collaboration was new to us, and we had to learn—indeed invent—many practices. We were amazed at how many of these practices existed.

ACTIVITY: USE OF TECHNOLOGY INCLUDES PRACTICES: GENRES, ROUTINES, AND MORÉS

For groups of people to use technology, patterns that show how the technology fits into their activities must appear that they grow to understand and share with others. Because these activities may include any human endeavor, the patterns must be correspondingly broad. However, a crude analysis of the types of patterns is as follows:

- **Genres:** It is tempting to define usage by the technology being used (e.g., sending e-mail, putting up a website, holding a teleconference). However, for any technology, there are many "genres" of using it, each with its own purposes and practices.

Figure 1: Six dimensions along which to describe the activity in which people take part while making use of technology

For each of these genres—technology used in a certain way for a certain purpose, activities vary widely; indeed part of the work of acquiring a new technology is discovering the genres that it makes possible. For full-duplex video of moderate interactivity, we discovered at least four distinct genres: one-to-one meetings, small-group discussions, larger group presentations, and project meeting attendance.

- **Routines:** For each of the genres, routine ways of working also had to be discovered. In our case, we learned how to join in and leave video activities; make introductions; control and manage microphones, cameras, and monitors; use drawing surfaces (whiteboards, paper, computers); interleave the talk ("manage the floor"); and execute interruptions. We learned or developed rules of the road that provided the feel of connection and interaction that was appropriate for a particular genre.
- **Morés:** On an even wider front, we had to identify users' expectations for activities and work to establish morés—norms for acceptable behavior. And as we saw in the last issue in discussing users (Dimension 2), this means considering all the users, including ourselves, that are affected by the use of the technology. For example, when holding large project meetings, we used video equipment that was in special large conference rooms. These were often "owned" by more senior managers. We had to learn how our using their conference rooms could upset their patterns of work and, in negotiating for the rooms, ensure both that the owners understood the potential impact and that we agreed on what would be mutually acceptable. On occasion, learning these lessons was painful for all concerned. Another example: when we began using the new technology, we did not clearly understand the costs of communication involved, because having video channels open for significant periods of time day after day was new. In the end, we discovered that meeting by video did not necessarily cost less than flying. However, we also learned that the shortening of the design horizon and corresponding ability to respond to changes clearly justified the expense. In the end, we had to learn, understand, articulate the value of, and set expectations for our usage of communications.

DESIGN REQUIREMENT: IDENTIFY, UNDERSTAND, AND SUPPORT PRACTICES: GENRES, ROUTINES, AND MORÉS

Designers must address technology use in the larger context of practices: genres, routines, and morés. The technology must be developed to support the demands of these different practices. More important, the activities that people take part in to discharge the demands of these practices must be understood and supported. For example, if practices have been established for splitting between visitors and host organizations the costs of communication, people will have to take part in some activities to track the usage of communication methods and produce the information needed to support those splits, and means will have to be provided to enable all parties to reassure themselves that the information produced is accurate. Establishing and meeting expectations at all levels is work; the activities that result in that work must be understood and supported as part of design.

Empowering

The first two aspects of activities (operating and enabling) address what must be done. The third aspect addresses why it should be done. I find myself breaking this aspect into two issues: what values drive the activities, and how those values—and indeed the whole design—are determined. As with the other dimensions, certain activities associated with these issues must be carried out by people using technology, and consequently work must be done in design to understand and support those activities.

Dimension 5. Values

Case: Building buttons

In 1988 and 1989, I and others at the Xerox Research Center in Cambridge, UK (formerly EuroPARC) developed a computer-based technology that we called "Buttons." Originally created as part of the Rooms research [3, 8] at PARC, Buttons became a construction set for EuroPARC lab members to capture and share useful routines: One person would build a button (by writing an expression in Lisp, EuroPARC's local "scripting" language) to do something useful, then mail the button to others, who could get that task done simply by clicking the button. People using buttons could copy them, open them, and look at how they did what they did and modify them. Through use, we discovered patterns in their practices of modifying buttons and developed support for those activities as part of the Buttons technology [11]. (This work was further developed in an X environment [10].) As the work proceeded, we noticed that although buttons were being used throughout the lab, the administrative staff were not creating their own buttons. Assuming that this was due to lack of familiarity with the Buttons mechanisms, Kathy Carter spent time working with the administrative staff. She discovered that although buttons could actually support the administrative staff's work, and although they agreed that using buttons would help, and although they now understood the mechanisms, they *still* were not creating their own buttons. One day, a senior manager in the lab encouraged a senior administrator to make a button to automate a repeated task. Immediately, everything changed: The administrators began to use Buttons to improve their work, particularly on tasks involving repeated routines. An elaborate practice resulted.

Activity: People create and spread the values of the environment through the technology

The arrival of a new technology (in this case, Buttons) did not necessarily imply that time should be spent on using it. A separate set of activities was needed to establish who is responsible for what aspects of using the technology and on what it was acceptable for whom to spend time. In this case, until the values of the manager were observed to include working on Buttons, the activity of the administrators did not stretch to include manipulating (creating or modifying) Buttons. The suggestion that making a Button might save the administrator work did two things: it redirected the work, and—much more important—it legitimated the time spent manipulating Buttons to get them to do what was needed. That is, what had to be created was not only a technology capable of meeting the needs of those that would use it, but also an environment in which the use of that technology was regarded as being of value [4].

Design requirement: Understand and design for the values of the users' circumstances.

Use is given meaning by a value structure that frames it with power, purposes, and feelings. As designers, we need to be particularly aware of which participants have what power in the activities our technologies are supporting, what are their various purposes and value systems, what are their feelings about the system and existing practices, and how proposed changes will shift that power and support or conflict with the purposes and values of various participants. Significant changes in such arrangements will be possible only through considerable work in setting expectations; involving users in design; generating feelings of ownership, involvement, and responsibility; and supporting the deployment of not only the system but the practices that make it useful and usable.

Dimension 6. Designers

Case: Address change

In 1978 Eleanor Wynne studied Xerox clerks who took telephone orders for copier supplies (such as paper and toner) from customers (discussed in [6]). She observed a clerk's asking a customer for a shipping address and in turn being asked about shipping dates: "You see, the copier is on an oceangoing barge; you tell

me *when* Xerox will ship the supplies, and I'll tell you *where* to ship them." The clerk coped with this novel requirement by taking a telephone number and a name and filled in the shipping address on the order form with the instruction to call and ask for an address when the supplies were being shipped. In this confrontation with reality, Xerox—through this clerk—collided with the fact that not all addresses are fixed: this address was a function of time. And in that moment, the meaning of "address" drifted. Unfortunately, the ordering form could not drift with it. The clerk's solution went beyond the assumptions of the form, creating an extension to how Xerox did business (for time-varying addresses). Because the form was on paper that had margins, there was a way to redesign on the spot how Xerox's addressing was done.

ACTIVITY: ULTIMATELY, END USERS DESIGN THE SYSTEM

The socio-technical practice of using technology continues to be developed throughout the life of the technology by many designers, most important the "end users." Although professional designers may design the technical system and managers may design the socio-technical systems (the genres), design of the socio-technical practice occurs while people use the technology and carry out their work. Design continues in use [9]. The end user is the final designer.

With modern computational systems, the potential for people who use software-based technology to change that software in the midst of use ("pliancy") is becoming progressively more difficult to provide within the system, particularly as the systems become larger [7]. This is primarily because designers do not consider how the user will deal with changes that the designer has not anticipated. Our current mythology of system development suggests that by thinking hard about use, designers (including users) can get it right "up front" during design. As a result, little effort is spent on addressing how people and systems cope with novel situations.

DESIGN REQUIREMENT: DESIGN FOR UNANTICIPATED CHANGE, AND SUPPORT USERS IN RESPONDING TO IT WHEN IT HAPPENS ("CONTINUING DESIGN")

As designers of technology, we must understand the activities that make up continuing design and must provide for people to capture and carry those changes in that technology. For example, Xerox copiers used to let you identify on the copier the "key operator"—the person locally responsible for the machine. With the advent of electronic instructions, this ability was lost. Luckily a new convention has taken the place of manual instructions: sticky notes. Institutionalizing the location for sticky notes on machines would be an open-ended response to the need for continuing design. For electronic forms, institutionalizing and designing an electronic equivalent of a margin (the place where annotations are placed) could make the rigid computational system more pliant.

When people try to continue the design of the socio-technical practice as part of their use of the machine, they can be regarded as entering the realm of professional designers. However, they have the skills of amateur rather than professional designers. In particular, design itself may be of little interest, as may achieving elegant or generalizable solutions. To support amateur design, we must study amateur designers at work; we must seek to understand how people can be supported in being amateur, not professional, designers.

Putting It Together

In this column I have suggested six dimensions of the activity of people using technology. Correspondingly, designers should ensure that their design work is broad enough to encompass all these activities. However, these dimensions are relatively independent, and therefore each applies not only to the simple case of a person using a machine successfully, but also to all of the other activities. For example, design for learning must encompass learning the genres of making changes in the management of supplies. And there are morés for learning, and designing for change in users, and so forth. The combinations are endless.

Moreover, activities often serve more than one purpose, and therefore any real-world,

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full-bodied human activity will be understood as consisting of different components, each a combination of these dimensions of activity. For example, setting out letterhead so that people can find it is not only about managing resources, it is also about arranging for learning. It may even be about the person making the change positioning herself as someone with the interests of the whole user community at heart [2].

Conclusion

In these two columns, I have addressed six dimensions for extending our thinking about people's activity in using technology. This framework suggests that the activity of using a machine is complex, covering not only many additional maintenance and management functions, but also the activities of the designers of the system; and combinations of them.

Correspondingly, technology should consider supporting, and design should consider addressing, this broad range of user activities. In my practice of design, this framework has helped me check that I am not forgetting significant users, and that I am considering the full range of activities in which they are engaged in using technology.

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