Chapter 9

User-centered approaches to interaction design

9.1 Introduction

As you would expect, user-centered development involves finding out a lot about the users and their tasks, and using this information to inform design. In Chapter 7 we introduced some data-gathering techniques which can be used to collect this information, including naturalistic observation. Studying people in their "natural" surroundings as they go about their work can provide insights that other data-gathering techniques cannot, and so interaction designers are keen to use this approach where appropriate. One particular method that has been used successfully for naturalistic observation in the social sciences is ethnography. It has also been used with some success in product development but there have been some difficulties knowing how to interpret and present the data gathered this way so that it can be translated into practical design.

Another aspect of user-centered development is user involvement in the development process. There are different degrees of involvement, one of which is through evaluation studies, as discussed in Chapters 10 through 14. Another is for users to contribute actively to the design itself—to become co-designers. As Gillian Crampton Smith said in the interview at the end of Chapter *6,* users are not designers, but the payoffs for allowing users to contribute to the design themselves are quite high in terms of user acceptance of the product. So techniques have been developed that engage users actively and productively in design.

In this chapter, we discuss some issues surrounding user involvement, and expand on the principles underlying a user-centered approach. Then we describe two approaches to using ethnographic data to inform design and two approaches to involving users actively in design.

The main aims of this chapter are to:

- Explain some advantages of involving users in development.
- Explain the main principles of a user-centered approach.
- Describe some ethnographic-based methods aimed at understanding users' work.
- Describe some participative design techniques that help users take an active part in design decisions.

9.2 Why is it important to involve users at all?

We talked in Chapter 6 about the importance of identifying stakeholders and of consulting the appropriate set of people. In the past, developers would often talk to managers or to "proxy-users," i.e., people who role-played as users, when eliciting requirements. But the best way to ensure that development continues to take users' activities into account is to involve real users throughout. In this way, developers can gain a better understanding of their needs and their goals, leading to a more appropriate, more useable product. However, two other aspects which have nothing to do with functionality are equally as important if the product is to be usable and used: expectation management and ownership.

Expectation management is the process of making sure that the users' views and expectations of the new product are realistic. The purpose of expectation management is to ensure that there are no surprises for users when the product arrives. If users feel they have been "cheated" by promises that have not been fulfilled, then this will cause resistance and maybe rejection. Expectation management is relevant whether you are dealing with an organization introducing a new software system or a company developing a new interactive toy. In both cases, the marketing of the new arrival must be careful not to misrepresent the product. How many times have you seen an advert for something you thought would be really good to have, but when you see one, discover that the marketing "hype" was a little exaggerated? I expect you felt quite disappointed and let down. Well, this is the kind of feeling that expectation management tries to avoid.

It is better to exceed users' expedtations than to fall below them. This does not mean just adding more features, how*, but that the product supports the users' work more effectively than they expect. Inuolving users throughout development helps with expectation management because they can see from an early stage what the product's capabilities are and what they are not. They will also understand better how it will affect their jobs and what 'they can expect to do with the product; they are less likely to be disappointed. Users can also see the capabilities develop and understand, at least to some extent, why the features are the way they are.

Adequate and timely training is another technique for managing expectations. If you give people the chance to work with the product before it is released, either

by training them on the real system or by offering hands-on demonstrations of a prerelease version, then they will understand better what to expect when the final product is released.

A second reason for user involvement is ownership. Users who are involved and feel that they have contributed to a product's development, are more likely to feel a sense of "ownership" towards it and to be receptive to it when it finally emerges. Remember Suzanne Robertson's comment in her interview at the end of Chapter 7 about how important it is for people to feel heard? Well, this is true throughout development, not just at the requirements stage.

9.2.1 Degrees of involvement

Different degrees of user involvement may be implemented in order to manage expectations and to create a feeling of ownership. At one end of the spectrum, users may be co-opted to the design team so that they are major contributors. For any one user, this may be on a full-time basis or a part-time basis, and it may be for the duration of the project or for a limited time only. There are advantages and disadvantages to each situation. If a user is co-opted full-time for the whole project, their input will be consistent and they will become very familiar with the system and its rationale. However, if the project takes many years they may lose touch with the rest of the user group, making their input less valuable. If a user is co-opted part-time for the whole project, she will offer consistent input to development while remaining in touch with other users. Depending on the situation, this will need careful management as the user will be trying to learn new jargon and handle unfamiliar material as a member of the design team, yet concurrently trying to fulfill the demands of their original job. This can become very stressful for the individuals. If a number of users from each user group are co-opted part-time for a limited period, input is not necessarily consistent across the whole project, but careful coordination between users can alleviate this problem. In this case, one user may be part of the design team for six months, then another takes over for the next six months, and so on.

At the other end of the spectrum, users may be kept informed through regular newsletters or other channels of communication. Provided they are given a chance to feed into the development process through workshops or similar events, this can be an effective approach to expectation management and ownership. In a situation with hundreds or even thousands of users it would not be feasible to involve them all as members of the team, and so this might be the only viable option.

If you have a large number of users, then a compromise situation is probably the best. Representatives from each user group may be co-opted onto the team on a full-time basis, while other users are involved through design workshops, evaluation sessions, and other data-gathering activities.

The individual circumstances of the particular project affect what is realistic and appropriate. If your end user groups are identifiable, e.g., you are developing a product for a particular company, then it is easier to involve them. If, however, you are developing a product for the open market, it is unlikely that you will be able to co-opt a user to your design team. Box 9.1 explains how Microsoft involves users in its developments.

One of the reasons often cited for not involving users in development is the amount of time it takes to organize, manage, and control such involvement. This issue may appear particularly acute in developing systems to run on the Internet where ever-shorter timescales are being forced on teams—in this fast-moving area, projects lasting three months or less are common. You might think, therefore, that it would be particularly difficult to involve users in such projects. However, Braiterman et al. (2000) report two case studies showing how to involve users successfully in large-scale but very short multidisciplinary projects, belying the claim that involving users can waste valuable development time.

The first case study was a three-week project to develop the interaction for a new web shopping application. The team included a usability designer, an information architect, a project manager, content strategists, and two graphic designers. In such a short timeframe, long research and prototyping sessions were impossible, so the team produced a hand-drawn paper prototype of the application that was

BOX 9.1 How Microsoft Involves Users *(Cusumano and Selby, 1995)*

The synch-and-stabilize process of development used by Microsoft was described in Chapter 6. Here we look at some of the main ways in which users are involved in the development process.

Users are involved throughout development in a variety of ways, from product and feature identification to feature development and testing, and via the customer support call centers.

Microsoft bases feature selection and prioritization on a technique called "activity-based planning." This technique involves studying what users do to achieve a certain activity like writing a letter, and using the results of the study to choose product features. Each new release of a software product is limited to supporting about four new major activities. Each of these proposed new activities can be broken down into subactivities and these mapped against features already existing in the software. Any new features required are noted. If a feature can support more than one activity, then it is placed higher in the priority list. The techniques used to gather customer data for activity-based planning do not appear to be prescribed in any way, and can vary from visiting customers through to asking them to use an instrumented version of the software, i.e., a version that records the actions they take. Microsoft also employs contextual inquiry (see below) to learn about their customers' work, although they find that it can be time-consuming and the results ambiguous.

Because the world of applications software changes so rapidly, developers need to continually observe and test with users. Throughout the development phase, usability tests are carried out in Microsoft's usability lab. Each time a developer believes that a feature is finished, then it is scheduled for testing in the usability lab. A group of about 10 users "off the street" are invited into the lab to perform certain tasks while their behavior is observed and their performance recorded. The data is then analyzed and the findings fed back into development. This results in thorough testing of all features. As an example, Office 4.0 (incorporating Word, Excel, PowerPoint, and other common office software) went through over 8000 hours of usability testing.

Once a product is complete, it is used internally by Microsoft staff (who are selected users and atypical, but are using it in a realistic working environment); then it may be released in a beta version to selected customers.

Microsoft has millions of customers around the world, about 30% of whom call their customer support lines with problems and frustrations resulting from poor features or software errors. This data about customer behavior and their problems with the products is a further source of information that is fed back into product development and improvement.

revised daily in response to customer testing. The customers were asked to perform tasks with the prototype, which was manipulated by one of the team in order to simulate interaction, e.g., changing screens. After half the sessions were conducted, the team produced a more formal version of the prototype in Adobe Illustrator. They found that customers were enthusiastic about using the paper prototype and were keen to offer improvements.

The second case study involved the development of a website for a video game publisher over three months. In order to understand what attracts people to such gaming sites, the multidisciplinary team felt they needed to understand the essence of gaming. To do this, they met 32 teenage gamers over a ten-day period, during which they observed and interviewed them in groups and individually. This allowed the team to understand something of the social nature of gaming and gave insights into the gamers themselves. During design, the team also conducted research and testing sessions in their office lab. This led them to develop new strategies and web designs based on the gamers' habits, likes, and dislikes.

Box 9.2 describes a situation in which users were asked to manage a software development project. There were hundreds of potential users, and so in addition,

DILEMMA Too Much of a Good Thing?

Involving users in development is a good thing. Or is it? And how much should they become involved? Box 9.2 describes a project in which users were appointed as project managers and were actively involved in development throughout. But are users qualified to lead a technical development project? And does this matter, provided there is sufficient technical expertise in the team?

Involving users at any level incurs costs, whether in terms of time for communication, or for workshops, or time spent explaining technical issues. Detailed user studies may also require the use of recording equipment and the subsequent cost of transcription and analysis. What evidence is there that user involvement is productive, or that it is worth putting the required level of resources into development? Research by Keil and Carmel (1995) indicates that the more successful projects do have direct links to users and customers. Kujala and Mäntylä (2000) performed some empirical work to investigate the costs and benefits of user studies early in product development. They concluded that user studies do in fact produce benefits that outweigh the costs of conducting them.

On the other hand, Heinbokel et al. (1996) suggest that a high user involvement has some negative effects. They found that projects with high user participation showed lower overall success, fewer innovations, a lower degree of flexibility, and low team effectiveness, although these effects were noticeable only later in the project (at least 6–12 months into the project). In short, projects with a high level of user participation tended to run less smoothly. They identified four issues related to communication among users and developers that they suggest caused problems. First, as the project progressed, users developed more sophisticated ideas, and they wanted them to be incorporated late in the project. Second, users were fearful of job losses or worsening job conditions and this led to a tendency for participation to be not constructive. Third, users were unpredictable and not always sympathetic to software development matters. For example, they asked for significant changes to be made just as testing was due to start. Fourth, user orientation in the designers may lead to higher aspirations and hence higher levels of stress.

Webb (1996) too has concerns about user involvement, but Scaife et al. (1997) suggest that it is not the fact of user involvement that is in question, but how and at what stage in development they should get involved.

BOX 9.2 Users as Project Team Leaders *(M880, 2000)*

The Open University (OU) in the UK is a large distance education university with many thousands of students enrolled each year in a variety of courses (undergraduate, graduate, vocational and professional) in a variety of subjects (Technology, Languages, Education, etc.). The courses are presented through paper-based and electronic media including video and audio tapes. It has a network of centers through which it supports and distributes courses to students throughout the UK and Europe. The OU employs about 3000 academic and other full-time staff and about 6000 part-time and counseling staff. In 1998/9 the university had over 200,000 students and customers for its education packs, and distributed materials throughout the UK and Europe to over 165,000 students. Such an operation requires considerable computerized support: in 1993 approximately 54 major systems of varying sizes were held on mainframe UN-LX host/workstations, VAX hosts, or PCs.

Traditionally, the systems had been built by an in-house software development team, who, due to resource constraints, sometimes needed to make business decisions although their expertise was in technical issues, not in the business side of the university. When it was time to re-develop these information systems, the OU decided that a new approach to development was required: users were to have a much more significant role.

Development was divided into a number of areas, each with its own project team and its own schedule. Consistency across the areas was maintained through the development of a GUI interface standard style guide that ensured that all systems had the same look and feel (style guides are discussed in Chapter 8). Users were involved in development on a number of different levels, typically 30–80% of their time. For example, in one area (Area E), one user was appointed full-time to manage the project team, two others joined the project team part-time for a limited period (about 18 months each), one user was consulted on a regular basis, and a wider set of users were involved through workshops and prototyping sessions. The project team also included technically trained analysts and developers.

When asked for the most successful and the least successful aspects of the project, both users and technical developers agreed that the most successful had been getting users involved in development. They said that this had made the system closer to what the users wanted. One user commented that, because users were part of the team for only a limited time, they did not see the development through from the beginning, but saw only some of the phases, and that this led to lack of continuity. Another user commented on the fact that the business had changed faster than the software could be developed, and hence the system had to be changed. The users' reactions were not all favorable, however. Another group of users who were consulted mainly through workshops and prototyping sessions did not feel that their needs had been adequately addressed.

One of the user project managers had this to say:

> The most successful thing has been getting people to go back to basics. We didn't look at existing systems and say, "We want the same thing but with go-faster stripes." We've examined what the University wants from the area. The most disappointing part has been that increased user involvement has not brought about ownership of the system by user areas. There was an expectation that we could move away from the traditional view of, "This is a computer system devised by computer people for you to use." In practice it's been far more difficult to get users to make decisions; they tend to say, "That's part of development. You decide."

This lack of ownership was commented upon by users and developers alike. One of the analysts commented:

> The user-led aspect has resulted in [the system's][1] greatest successes and greatest failures. User project managers do not have a systems background. Depending on their character they can be open to ideas or very blinkered. If they come from a user area with a system already it can be hard for them to see beyond their current system.

[1]When reporting raw data such as quotations anonymously, it is common practice to replace specific words or phrases that might compromise anonymity with similar words enclosed in square brackets to indicate that they are not the speaker's original words.

users became design team members on a full- and part-time basis; regular design workshops, debriefings, and training sessions were also held.

How actively users should be involved is a matter for debate. Some studies have shown that too much user involvement can lead to problems. This issue is discussed in the Dilemma box below.

9.3 What is a user-centered approach?

Throughout this book, we have emphasized the need for a user-centered approach to development. By this we mean that the real users and their goals, not just technology, should be the driving force behind development of a product. As a consequence, a well-designed system should make the most of human skill and judgment, should be directly relevant to the work in hand, and should support rather than constrain the user. This is less a technique and more a philosophy.

In 1985, Gould and Lewis (1985) laid down three principles they believed would lead to a "useful and easy to use computer system." These are very similar to the three key characteristics of interaction design introduced in Chapter 6.

1. ***Early focus on users and tasks.*** This means first understanding ***who*** the users will be by directly studying their cognitive, behavioral, anthropomorphic, and attitudinal characteristics. This required observing users doing their normal tasks, studying the nature of those tasks, and then involving users in the design process.
2. ***Empirical measurement.*** Early in development, the reactions and performance of intended users to printed scenarios, manuals, etc. is observed and measured. Later on, users interact with simulations and prototypes and their performance and reactions are observed, recorded, and analyzed.
3. ***Iterative design.*** When problems are found in user testing, they are fixed and then more tests and observations are carried out to see the effects of the fixes. This means that design and development is iterative, with cycles of "design, test, measure, and redesign" being repeated as often as necessary.

Iteration is something we have emphasized throughout these chapters on design, and it is now widely accepted that iteration is required. When Gould and Lewis wrote their paper, however, the iterative nature of design was not accepted by most developers. In fact, they comment in their paper how "obvious" these principles are, and remark that when they started recommending these to designers, the designers' reactions implied that these principles were indeed obvious. However, when they asked designers at a human factors symposium for the major steps in software design, most of them did not cite most of the principles—in fact, only 2% mentioned all of them. So maybe they had "obvious" merit, but were not so easy to put into practice. The Olympic Messaging System (OMS) (Gould et al., 1987) was the first reported large computer-based system to be developed using these three principles. Here a combination of techniques was used to elicit users' reactions to designs, from the earliest prototypes through to the final product. In this case, users were mainly involved in evaluating designs. The OMS is discussed further in Chapter 10.

The iterative nature of design and the need to develop usability goals have been discussed in Chapter 6. Here, we focus on the first principle, early focus on users and tasks, and suggest five further principles that expand and clarify what this means:

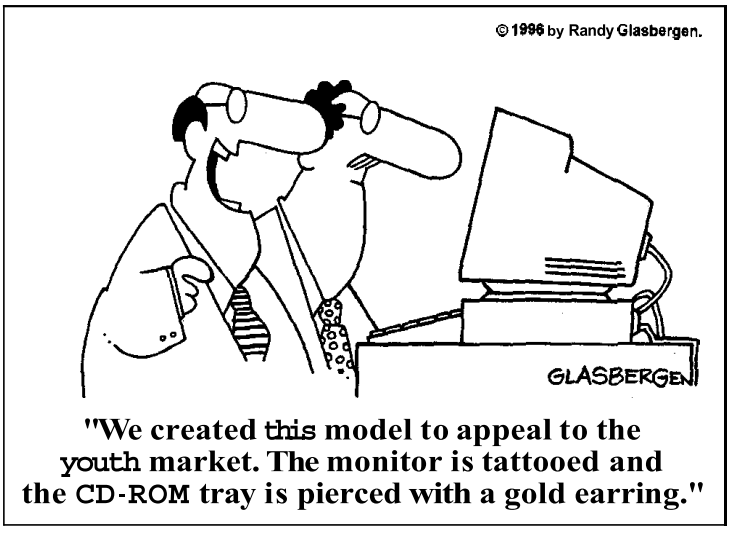
1. ***User's tasks and goals are the driving force behind the development.*** In a user-centered approach to design, while technology will inform design options and choices, it should not be the driving force. Instead of saying, "Where can we deploy this new technology?," say, "What technologies are available to provide better support for users' goals?"
2. ***Users' behavior and context of use are studied and the system is designed to support them.*** This is about more than just capturing the tasks and the users' goals. How people perform their tasks is also significant. Understanding behavior highlights priorities, preferences, and implicit intentions. One argument against studying current behavior is that we are looking to improve work, not to capture bad habits in automation. The implication is that exposing designers to users is likely to stifle innovation and creativity, but experience tells us that the opposite is true (Beyer and Holtzblatt, 1998). In addition, if something is designed to support an activity with little understanding of the real work involved, it is likely to be incompatible with current practice, and users don't like to deviate from their learned habits if operating a new device with similar properties (Norman, **1988).**
3. ***Users' characteristics are captured and designed for.*** When things go wrong with technology, we often say that it is our fault. But as humans, we are prone to making errors and we have certain limitations, both cognitive and physical. Products designed to support humans should take these limitations into account and should limit the mistakes we make. Cognitive aspects such as attention, memory, and perception issues were introduced in Chapter **3.** Physical aspects include height, mobility, and strength. Some characteristics are general, such as that about one man in 12 has some form of color blindness, but some characteristics may be associated more with the job or particular task at hand. So as well as general characteristics, we need to capture those specific to the intended user group.
4. ***Users are consulted throughout development from earliest phases to the latest and their input is seriously taken into account.*** As discussed above, there are different levels of user involvement and there are different ways in which to consult users. However involvement is organized, it is important that users are respected by designers.
5. ***All design decisions are taken within the context of the users, their work, and their environment.*** This does not necessarily mean that users are actively involved in design decisions. As you read in Gillian Crampton Smith's interview at the end of Chapter 6, not everyone believes that it is a good idea for users to be designers. As long as designers remain aware of the users while

making their decisions, then this principle will be upheld. Keeping this context in mind can be difficult, but an easily accessible collection of gathered data is one way to achieve this. Some design teams set up a specific design room for the project where data and informal records of brainstorming sessions are pinned on the walls or left on the table. (This is discussed again in Section 9.4.2 on Contextual Design.)

ACTIVITY 9.1 Assume that you are involved in developing a new e-commerce site for selling garden plants. Suggest ways of applying the above principles in this task.

Comment To address the first three principles, we would need to find out about potential users of the site. As this is a new site, there is no immediate set of users to consult. However, the tasks and goals, behavior, and characteristics of potential users of this site can be identified by investigating how people shop in existing online and physical shopping situations—for example, shopping through interactive television, through other online sites, in a garden center, in the local corner shop, and so on. For each of these, you will find advantages and disadvantages to the shopping environment and you will observe different behaviors. By investigating behavior and patterns in a physical garden center, you can find out a lot about who might be interested in buying plants, how these people choose plants, what criteria are important, and what their buying habits are. From existing online shopping behavior, you could determine likely contexts of use for the new site.

For the fourth principle, because we don't have an easily tapped set of users available, we could follow a similar route to the Internet company described in Section 9.2, and try to recruit people we believe to be representative of the group. These people may be involved in workshops or in evaluation sessions, possibly in a physical shopping environment. Valuable input can be gained in targeted workshops, focus groups, and evaluation sessions. The last principle could be supported through the creation of a design room to house all the data collected.



"We created this model to appeal to the youth market. The monitor is tattooed and the CD-ROM tray is pierced with a gold earring."

9.4 Understanding users' work: applying ethnography in design

Kuhn (1996) provides a good example illustrating the importance of understanding users' work. She describes a case where a computer system was introduced to cut down the amount of time spent on conversations between telephone-company repair personnel. Such conversations were regarded as inefficient and "off-task." What management had failed to realize was that in the conversations workers were often consulting one another about problems, and were pooling their knowledge to solve them. By removing the need for conversation, they removed a key mechanism for solving problems. If only the designers had understood the work properly, they would not have considered removing it.

Ethnography is a method that comes originally from anthropology and literally means "writing the culture" (Hammersley and Atkinson, 1983). It has been used in the social sciences to display the social organization of activities, and hence to understand work. It aims to find the order within an activity rather than impose any framework of interpretation on it. It is a broad-based approach in which users are observed as they go about their normal activities. The observers immerse themselves in the users' environment and participate in their day-to-day work, joining in conversations, attending meetings, reading documents, and so on. The aim of an ethnographic study is to make the implicit explicit. Those in the situation, the users in this case, are so familiar with their surroundings and their daily tasks that they often don't see the importance of familiar actions or happenings, and hence don't remark upon them in interviews or other data-gathering sessions.

There are different ways in which this method can be associated with design. Beynon-Davies (1997) has suggested that ethnography can be associated with development as "ethnography *of,*" "ethnography for," and "ethnography within." Ethnography of development refers to studies of developers themselves and their workplace, with the aim of understanding the practices of development (e.g. Button and Sharrock, 1994; Sharp et al., 1999). Ethnography for development yields ethnographic studies that can be used as a resource for development, e.g., studies of organizational work. Ethnography within software development is the most common form of study (e.g., Hughes et al., 1993a); here the techniques associated with ethnography are integrated into methods and approaches for development (e.g., Viller and Sommerville, 1999).

Because of the very nature of the ethnographic experience, it is very difficult to describe explicitly what data is collected through such an exercise. It is an experience rather than a data-collection exercise. However, the experience must be shared with other team members, and therefore needs to be documented and rationalized. Box 9.3 provides an example ethnographic account in the form of a description of an ethnographic study of a new media company. In this case, the intention was not explicitly concerned with designing an interactive product, but was a business-oriented ethnography. The style and content of the piece, however, are typical of ethnographies.

Studying the context of work and watching work being done reveals information that might be missed by other methods that concentrate on asking about work away from its natural setting. For example, it can shed light on how people do the "real" work as opposed to the formal procedures that you'd find in documentation;

BOX 9.3 An Example Ethnography
(printed with the permission of Fiona Hovenden, the ethnographer)

Background I was asked to design a retreat for a new media company. They were about to shift from working in a very open, unstructured way to formalizing their working processes. The main reason for this was that they had signed a deal with a large organization that was going to act as a financial patron in return for first options on the new media company's ideas and designs.

This proposed shift was causing some tension and anxiety within the company, with people feeling that their current working practices worked very well and that imposing structure would stifle the creativity on which their work depended.

Method Over a four-day period, I had a desk in the office and observed the rhythm of work and the working practices. I spent two days just observing, and then I conducted one-to-one face-to-face interviews with every member of the company, and one-to-one email interviews with the three people from the patron organization who were coming to join the company.

The account (excerpted here) is my notes, built up over the four-day period. The structure, and the content are built up iteratively. For example, on the surface the company appeared very collectivist—everyone in the company treated everyone else as a peer, people invited other people to work with them on projects, nobody seemed to tell anyone else what to do. But during the interviews it became clear that everyone waited for the opinion of the leader before doing anything. In fact, on the surface it looked as though there were three joint partners, but the entire company implicitly and explicitly deferred to one of them. So, although in the account the surface appearance is what I first noted, the interviews indicated that there was no attempt at consensus.

Brief Characterization of User Community This is an apparently loose aggregation of artists, artist-technicians, information designers, producers, and a small, nontraditional operations team. There is a commitment to an open, collectivist way of working that seems to translate as anyone can say anything or ask for anything, and they will be given a hearing. However, the way things actually get done does not seem to be by consensus. There are obvious and accepted loci of power associated with particular individuals. It is these individuals who bestow a hearing.

The commitment to collectivism is currently undergoing a shift, as a new patron relationship requires a more formal business structure. A business focus will also be a more explicit part of the new community life. There is a shifting power structure, in which [current leader] will be joined by [X] and [Y] from the patron organization at a more formal managerial level. They will become the gateway through which all project ideas will have to pass, and will also control the financing of projects. They will therefore have a great deal of power, while the power available to the collective will be the power to persuade/seduce.

Community Practices and Productions This community creates new media products. The nature of this work means that there is a strong visual bias and a highly developed visual sophistication.

One of the original motives for the formation of the company was to explore non-traditional narratives. The lead information designer has also described the work the company does as "story telling." Both in the ongoing championing of the exploration of narrative and in the actual client work done, the community is practiced at the visual presentation and production of stories. This (dominant) aspect of work could be described as translating speech to visuals.

Client projects seem primarily visual, sound is not the focus. In terms of workspace noise, sound bleeds in from the surrounding environment. Public music is played sporadically, and usually by [designer], who has brought in a CD player that sits on his desk. However, many community members wear headphones for significant periods of their time at work.

Many of the working practices seem informal and fluidly structured. This is according to the accounts given by community members in interviews, and the specific request from [leader] to make formalizing working practices a major part

of the retreat. More information on working practices is not covered by the available data. However, there is one community practice I would like to briefly mention here. I attended one Tuesday morning production meeting. This seems to be the one set time in the week when everyone in the community comes together to create a community-wide status report. However, not everyone showed up. Meetings are possibly the most significant rituals of modern business practice, and seem to work best when the form and function of the ritual is known, understood, and felt to be relevant by everyone involved. The most startling aspect of the production meeting to me was that individuals seemed to decide when the meeting was over and left the room accordingly, without marking the fact in any other way, say by announcing their departure. The effect (to me) was of the meeting dribbling away, which seemed to lessen its importance.

the nature and purposes of collaboration, awareness of other's work, and implicit goals that may not even be recognized by the workers themselves. For example, Heath et al. (1993) have been exploring the implications of ethnographic studies of real-world settings for the design of cooperative systems. We described their underground control room study in Chapter 4, but they have also studied medical centers, architects' practices, and TV and radio studios.

In one of their studies Heath et al. (1993) looked at how dealers in a stock exchange work together. A main motivation was to see whether proposed technological support for market trading was indeed suitable for that particular setting. One of the tasks examined in detail was the process of writing tickets to record deals. It had been commented upon earlier by others that this process of deal capture, using "old-fashioned" paper and pencil technology, was currently time-consuming and prone to error. Based on this finding, it had been further suggested that the existing way of making deals could be improved by introducing new technologies, including touch screens to input the details of transactions, and headphones to eliminate distracting external noise.

However, when Heath et al. began observing the deal capture in practice, they quickly discovered that these proposals were misguided. In particular, they warned that these new technologies would destroy the very means by which the traders currently communicate and keep informed of what others are up to. The touch screens would reduce the availability of information to others on how deals were progressing, while headphones would impede the dealers' ability to inadvertently monitor one another's conversations. They pointed out how this kind of peripheral monitoring of other dealers' actions was central to the way deals are done. Moreover, if any dealers failed to keep up with what the other dealers were doing by continuously monitoring them, it was likely to affect their position in the market, which ultimately could prove very costly to the bank they were working for.

Hence, the ethnographic study proved to be very useful in warning against attempts to integrate new technologies into a workplace without thinking through the implications for the work practice. As an alternative, Heath et al. suggested pen-based mobile systems with gestural recognition that could allow deals to be made efficiently while also allowing the other dealers to continue to monitor one another unobtrusively.

Hughes et al (1993) state that "doing" ethnography is about being reasonable, courteous and unthreatening, and interested in what's happening. This is particularly important when trying to perform studies in people's homes, such as those described in Box 9.4. There is, of course, more to it than this. Training and practice are required to produce good ethnographies.

BOX 9.4 Ethnographies of the Home

Home use of technology such as the personal computer, wireless telephones, cell phones, remote controls, and so on has grown over the last decade. Although consumer surveys and similar questionnaires may be able to gather some information about this market, ethnographic studies have been used to gain that extra insight that ensures that products do not just perform needed functions but are also pleasurable and easy to use.

Dray and Mrazek (1996) report on an international study of families' use of technology in which they visited 20 families in America, Germany and France. They spent at least four hours in each of the homes, talking with all members of the family, including children of all ages, about their use of computer technology. They give no details of the data collected, but assert that the study was extremely useful, that "there is no substitute for contextual studies," and that the results have influenced many design decisions and specifications for new products. One aspect of the study they emphasize is the need to develop a rapport with the family. They focused their attention on building a strong positive rapport in the first few minutes of the visit. In all cases, they used food as an icebreaker, by either bringing dinner with them for themselves and the family, or by ordering food to be delivered. This provided a mundane topic of conversation that allowed a natural conversation to be held.

After dinner, they moved to the location of the computer and began by asking the children about their use of the technology. Each family member was engaged in conversation about the technology, and printed samples of work were gathered by the researchers. A protocol designed by the marketing and engineering departments of the company was used to guide the conduct of this part of the study, but after all of the protocol had been covered, families were encouraged to discuss topics they were interested in. Immediately after a visit, the team held a formal debriefing session during which all photos, videotapes, products, and notes were reviewed and a summary debriefing questionnaire was completed. A thank-you letter was later sent to the families.

From this description you can see that a huge amount of preparation was required in order to ensure that the study resulted in getting the right data, i.e., in collecting data that was going to answer the relevant questions.

Mateas et al. (1996) report on a pilot ethnographic study that was also aimed at informing the design and development of domestic computing systems. They visited ten families and also emphasize the importance of making families feel comfortable with them. In their study, this was partly achieved by bringing a pizza dinner for everyone. After dinner, the adults and the children were separated. The researchers wanted to get an understanding of a typical day in the home. To do this, each family member was asked to walk through a typical day, using a felt board with a layout of their house, and felt rooms, products, activities, and people that could be moved around on the felt house.

From their work they derived a model of space, time, and social communication that differed from the model implied by the standard PC. For example, the standard PC is designed to be used in one location by one user for long periods of uninterrupted time. The studies revealed that on the other hand, family activity is distributed throughout multiple spaces, is rarely conducted alone, and is not partitioned into long periods of uninterrupted use. In addition, the PC does not support communication among co-located members of the family, which is a key element of family life. They conclude that small, integrated computational appliances supporting multiple co-located users are more appropriate to domestic activity than the single PC.

Collecting ethnographic data is not hard although it may seem a little bewildering to those accustomed to using a frame of reference to focus the data collection rather than letting the frame of reference arise from the available data. You collect what is available, what is "ordinary," what it is that people do, say, how they work. The data collected therefore has many forms: documents, notes of your own, pictures, room layouts. Notebook notes may include snippets of conversation and descriptions of rooms, meetings, what someone did, or how people reacted to a situation. It is opportunistic in that you collect what you can collect and make the most of opportunities presented to you. You don't go in with a firm plan, and so the data you collect is not specifiable in advance. You have to do it rather than read about it. What you record can become more focused after being in the field for a while.

ACTIVITY 9.2 Look up from reading this book and observe your surroundings. Wherever you are, the chances are that you can see and hear lots of things, and probably other people too. Start to make a list of what you observe, and when things change or people move, write down what has happened and how it happened. For example, if someone spoke, what did his voice sound like? Angry, calm, whispering, happy? Spend just a few minutes observing what you can see.

Now think about the same observations but begin to interpret them: imagine that you have to place the main items or people that you can see into categories. For example, on a train you might consider who might be getting off at which station, in a bedroom you might think about how to tidy up the items lying around.

How easy is it to go from the detailed description to the more abstracted one?

Comment

As I am writing this, 1 am in a room on my own. I therefore don't have people to observe, but my desk is covered with things: a pen, a boarding pass from a recent trip abroad, a rosette from a parcel wrapping, and many books, papers, disks etc. If I look around then 1 can see the wallpaper and the curtains, clothes hanging and in piles on the bed. In the background I can hear cars moving along the road, and the television downstairs. To spend any length of time really describing any one of the things 1 observe would take up a lot of words, and that's a lot of data.

If I now consider how to file the things I can see, then I would start to think of categories such as which are books, which are research papers, what can be thrown away, and so on. It becomes easier to feel like I'm making progress. The other thing to notice is that some things 1 can observe are blocked out of my sphere of interest, such as the cars outside.

In some ways, the goals of design and the goals of ethnography are at opposite ends of a spectrum. Design is concerned with abstraction and rationalization. Ethnography, on the other hand, is about detail. **An** ethnographer's account will be concerned with the minutiae of observation, while a designer is looking for useful abstractions that can be used to inform design. One of the difficulties faced by those wishing to use this very powerful technique is how to harness the data gathered in a form that can be used in design.

Below, we introduce one framework that has been developed specifically to help structure the presentation of ethnographies in a way that enables designers to use them (other frameworks to help orient observers and how to organize this kind

DILEMMA What To Lose When You Abstract?

In Chapter 7, we discussed the need for data interpretation and analysis. This involves structuring and abstracting from the data, so that important aspects of a situation can be reasoned about at a higher level of generalisation without getting bogged down in details. It is inevitable that when moving from a more detailed description to a more abstract one, information will be lost. But what is important and what is irrelevant? This is a key question to answer if ethnographic data is to be used to inform design.

of study are described in Chapter 12). This framework has three main dimensions (Hughes et al, 1997):

1. The ***distributed co-ordination*** dimension focuses on the distributed nature of the tasks and activities, and the means and mechanisms by which they are co-ordinated. This has implications for the kind of automated support required.
2. The ***plans and procedures*** dimension focuses on the organizational support for the work, such as workflow models and organizational charts, and how these are used to support the work. Understanding this aspect impacts on how the system is designed to utilize this kind of support.
3. The ***awareness of work*** dimension focuses on how people keep themselves aware of others' work. No-one works in isolation, and it has been shown that being aware of others' actions and work activities can be a crucial element of doing a good job. In the stock market example described above, this was one aspect that ethnographers identified. Implications here relate to the sharing of information.

Rather than taking data from ethnographers and interpreting this in design, an alternative approach is to train developers to collect ethnographic data themselves. This has the advantage of giving the designers first-hand experience of the situation. Telling someone how to perform a task, or explaining what an experience is like, is very different from showing them or even gaining the experience themselves. Finding people with the skills of ethnographers and interaction designers may be difficult, but it is possible to provide notational and procedural mechanisms to allow designers to gain some of the insights first-hand. The two methods described below provide such support.

9.4.1 Coherence

The Coherence method (Viller and Sommerville, 1999) combines experiences of using ethnography to inform design with developments in requirements engineering. Specifically, it is intended to integrate social analysis with object-oriented analysis from software engineering (which includes producing use cases as described in Chapter 7). Coherence does not prescribe how to move from the social analysis to use cases, but claims that presenting the data from an ethnographic study based around a set of "viewpoints" and "concerns" facilitates the identification of the product's most important use cases.

Viewpoints and concerns

Coherence builds upon the framework introduced above and provides a set of focus questions for each of the three dimensions, here called "viewpoints". The focus questions (see Figure 9.1) are intended to guide the observer to particular aspects of the workplace. They can be used as a starting point to which other questions may be added as experience in the domain and the method increases.

In addition to viewpoints, Coherence has a set of concerns and associated questions. Concerns are a kind of goal, and they represent criteria that guide the requirements activity. These concerns are addressed within each appropriate viewpoint. One of the first tasks is to determine whether the concern is indeed relevant to the viewpoint. If it is relevant, then a set of elaboration questions is used to explore the concern further. The concerns, which have arisen from experience of using ethnography in systems design, are:

1. ***Paperwork and computer work.*** These are embodiments of plans and procedures, and at the same time are a mechanism for developing and sharing an awareness of work.
2. ***Skill and the use of local knowledge.*** This refers to the "workarounds" that are developed in organizations and are at the heart of how the real work gets done.

Distributed coordination

- How is the division of labor manifest through the work of individuals and its coordination with others?
- How clear are the boundaries between one person's responsibilities and another's?
- What appreciation do people have of the work/tasks/roles of others?
  How is the work of individuals oriented towards the others?

Plans and procedures

How do plans and procedures function in the workplace?

- Do they always work?
- How do they fail?
  What happens when they fail?
- How, and in what situations, are they circumvented?

Awareness of work

- How does the spatial organization of the workplace facilitate interaction between workers and with the objects they use?
- How do workers organize the space around them? Which artifacts that are kept to hand are likely to be important to the achievement of everyday work?
- What are the notes and lists that the workers regularly refer to?
- What are the location(s) of objects, who uses them, how often?

Figure 9.1 Focus questions for the three viewpoints.

Paperwork and computer work

- How do forms and other artifacts on paper or screen act as embodiments of the process?
- To what extent do the paper and computer work make it clear to others what stage people are at in their work?
- How flexible is the technology at supporting the work process—is a particular process enforced, or are alternatives permitted?

Skill and the use of local knowledge

- What are the everyday skills employed by individuals and teams in order to get the work done?
- How is local knowledge used and made available, e.g., through the use of personalized checklists, asking experts, etc.?
- To what extent have standard procedures been adapted to take local factors into account?

Spatial and temporal organization

- How does the spatial organization of the workplace reflect how the work is performed?
- Which aspects of the work to be supported are time-dependent?
- Does any data have a "use-by-date"?
- How do workers make sure that they make use of the most up-to-date information?

Organizational memory

- How do people learn and remember how to perform their work?
- How well do formal records match the reality of how work is done?

Figure 9.2 Elaboration questions for the four concerns.

3. ***Spatial and temporal organization.*** This concern looks at the physical layout of the workplace and areas where time is important.
4. ***Organizational memory.*** Formal documents are not the only way in which things are remembered within an organization. Individuals may keep their own records, or there may be local gurus.

The elaboration questions associated with these concerns are listed in Figure 9.2 and a sample social concern from the air traffic control domain, together with resultant requirements, is shown in Figure 9.3.

9.4.2 Contextual Design

Contextual Design is another technique that was developed to handle the collection and interpretation of data from fieldwork with the intention of building a software-based product. It provides a structured approach to gathering and representing information from fieldwork such as ethnography, with the purpose

Paperwork and computer work

Flight strips embody the process of an aircraft's progress through the sector of airspace controlled by a suite. As an aircraft approaches the sector, its strip is moved progressively to the bottom of the rack until it becomes the current strip for the controller to deal with. The work of the controller can therefore be viewed in terms of dealing with the flow of strips as aircraft enter, traverse, and leave the controller's sector.

The collection of strips in various racks in a suite provide an 'at a glance' means of determining the current and future workload of a particular controller. The practice of 'cocking out' strips, i.e., raising them slightly in the racks, informs the controller that there is something non-standard about the flight concerned. This may be done by the assistant controller when inserting the strip, or by the controller as a reminder. Glancing at the strips provides a controller with an indication of their current and future workload, in the same way as it allows other controllers to see the relative loading on other sectors. This feature of the organization of the strips is used in particular at change over of shifts, where the incoming controller will spend up to 10 minutes looking over the shoulder of the out-going controller in order to 'get the picture' of the current state of the sector.

Flight strips provide incredibly flexible support for the work of controllers. Different practices exist regarding whether strips are placed into the racks in a top to bottom sequence or vice versa. All instructions given by controllers to pilots, and the pilots' acknowledgements, are recorded onto the relevant flight strip. These annotations are made using a standard set of symbols, and different coloured pens according to the annotator's role within the controlling team. In this way, flight strips constitute a record of a flight's progress through a sector.

Requirement 1. The system shall support controllers 'getting the picture' by providing the ability to determine current and future load for a sector 'at a glance'

Requirement 2. The system shall provide a facility to mark exceptional or non-standard flights requiring special attention

Requirement 3. Annotations to flight records shall be recorded and presented in such a way that they identify the person who made them.

Figure 9.3 Elaboration of paperwork and computer work.

of feeding it into design. It has been used on a number of projects, e.g., see Box 9.5.

Contextual Design has seven parts: Contextual Inquiry, Work Modeling, Consolidation, Work Redesign, User Environment Design, Mockup and Test with Customers, and Putting It into Practice. In this chapter we are focusing on understanding users' work, and so shall discuss only the first three steps. Step 4 involves changing work practices, which is outside our scope here. Step 5 produces a prototype that is used with customers, and the final step concerns the practicality of the working system. The activities involved in these last two steps have been discussed in general terms in Section 8.2.

Contextual inquiry

Contextual inquiry is an approach to ethnographic study used for design that follows an apprenticeship model: the designer works as an apprentice to the user. The

BOX 9.5 Using Contextual Design for Office Products

Page (1996) reports on the use of Contextual Design in customer research for a new version of the word processor WordPerfect. The company already had some experience of field research, since the initial version of WordPerfect had been based on informal user observation and user testing, although it wasn't seen as such at the time.

The scope of this study was quite wide, with the team wanting to learn about "the making of documents": how they were conceived, created, reviewed, approved, and distributed. To cover this scope, the team was multidisciplinary, involving expertise in word-processor development, human factors, documentation, marketing, and usability. Contextual Design was chosen because it leads the team systematically through the data-gathering and interpretation activities to product design.

The team undertook three weeks of training, organized as one week of training, four weeks of work, one week of training, four weeks of work, etc. Users were chosen carefully so as to reflect different types, including those who use the existing version of the product and those who don't use computers at all, and to be sure that they were representative of the company's main client base. The set of users was refined as data collection progressed and it became obvious where gaps were, and what kinds of user were needed to fill them.

Even though the intentions of the researchers had been communicated to the collaborators, they often arrived at sites to find that a focus group had been arranged rather than an opportunity for observation. Also, some people thought that the researchers were there to help solve their software problems and expected them to spend time on this rather than on data collection. Observing people at higher levels of management proved difficult at times, despite arranging visits well in advance. The result of this was that they collected more data about support roles, such as administrators and secretaries, than about others.

All team members took part in observation, and interviews were conducted in the worker's workplace, as laid down in the Contextual Design method. Generally, the interviews were taped, although if the data was interpreted within 24 to 48 hours there was no need to listen to the tape again.

Data was interpreted with the entire team. The observer would review her notes while other team members asked questions to draw out information. One team member was charged with writing down each important factor identified by the team, and others were responsible for drawing the workflow, sequence, physical, and context models. It was felt, however, that the contextual model did not represent the cultural influences in any useful way, and so it was not used. To structure the data, they used the affinity model, consolidated models, redesigned work models, user environment model, and user interface designs. A portion of the affinity diagram is shown in Figure 9.4.

When producing the redesigned work model, the goal was to streamline processes and eliminate breakdowns. Any emerging technologies that might help in this were identified and studied. For the user interface designs, paper prototypes were developed early on and tested with users, and as concepts became more certain, running prototypes were created in ToolBook and Delphi.

The researchers knew they might have problems in selling the idea to the implementors. To overcome this, they started having open days for the rest of the company as soon as they had their first affinity diagram and consolidated models. In some cases, members of the development teams were on the Contextual Design teams; where developers were not on the teams, they were invited to contribute to the design ideas before products were in their final form. This involvement helped to increase the developers' sense of ownership.

Page (1996) gives two examples of actual features that were a result of their fieldwork: "Make It Fit" and "QuickTasks." Make It Fit is a feature in WordPerfect 6.1 for Windows that takes the text and makes it fit into the available space, either by expanding it to fill blank space or by shrinking it. QuickTasks is a feature of PerfectOffice 3.0 that automates a series of steps across multiple applications, prompting users for information as it is needed.

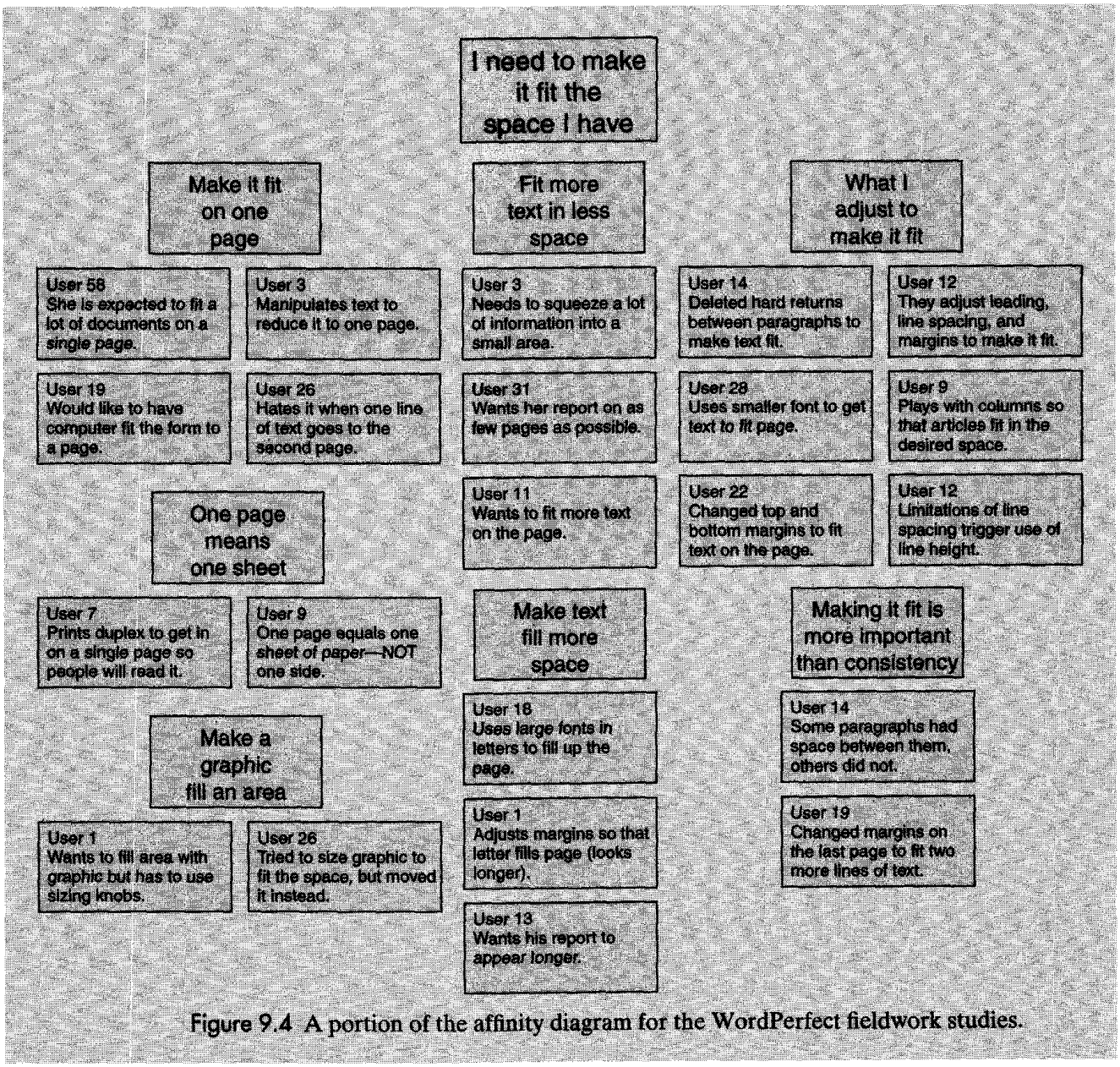


Figure 9.4 A portion of the affinity diagram for the WordPerfect fieldwork studies.

most typical format for contextual inquiry is a contextual interview, which is a combination of observatfbn, discussion, and reconstruction of past events. Contextual inquiry rests on four main principles: context, partnership, interpretation and focus.

The context principle emphasizes the importance of going to the workplace and seeing what happens. The partnership principle states that the developer and the user should collaborate in understanding the work; in a traditional interviewing or workshop situation, the interviewer or workshop leader is in control, but in contextual inquiry the spirit of partnership means that the understanding is developed through cooperation.

The interpretation principle says that the observations must be interpreted in order to be used in design, and this interpretation should also be developed in cooperation between the user and the developer. For example, I have a set of paper cards stuck on my screen at work. They are covered in notes; some list telephone numbers and some list commands for the software I use. Someone coming into my office might interpret these facts in a number of ways: that I don't have access to a telephone directory; that I don't have a user manual for my software; that I use the software infrequently; that the commands are particularly difficult to remember. The best way to interpret these facts is to discuss them with me. In fact, I do have a telephone directory, but I keep the numbers on a note to save me the trouble of looking them up in the directory. I also have a telephone with a memory, but it isn't clear to me how to put the numbers in memory, so I use the notes instead. The commands are there because I often forget them and waste time searching through menu structures.

The fourth principle, the focus principle, was touched upon above in our discussion of ethnography and was also addressed in Coherence: how do you know what to look for? In contextual inquiry, it is important that the discussion remains pertinent for the design being developed. To this end, a project focus is established to guide the interviewer, which will then be augmented by the individual's own focus that arises from their perspective and background. The contextual inquiry interview differs from ethnographic studies in a number of ways:

1. It is much shorter than a typical ethnographic study. A contextual inquiry interview lasts about two or three hours, while an ethnographic study tends to be longer, probably weeks or months.
2. The interview is much more intense and focused than an ethnographic study, which takes in a wide view of the environment.
3. In the interview, the designer is not taking on a role of participant observer, but is inquiring about the work. The designer is observing, and is questioning behavior, but is not participating.
4. In the interview, the intention is to design a new system, but when conducting an ethnography, there is no particular agenda to be followed.

ACTIVITY 9.3 How does the contextual inquiry interview compare with the interviews introduced in Chapter 7?

Comment We introduced structured, unstructured, and semi-structured interviews in Chapter 7. Contextual inquiry could be viewed as an unstructured interview, but is more wide-ranging than this. The interviewer does not have a set list of questions to ask, and can be guided by the interviewee. Contextual inquiry, however, is to be conducted at the interviewee's place of work, while normal work continues. It incorporates other data-gathering techniques such as observation although other interviews too may be used in conjunction with other techniques.

Normally, each team member conducts at least one contextual inquiry session. Data is collected in the form of notes and perhaps audio and video recording, but a lot of information is in the observer's head. It is important to review the experience

and to start documenting the findings as soon as possible after the session. Contextual Design includes an interpretation session in which a number of models are generated (see below). Figures 9.5 to 9.8 show flow, sequence, cultural, and physical models focused around the system manager of an organization (Holtzblatt and Beyer, 1996).

Work Modeling

For customer-centered design, the first task of a design team is to shift focus from the system that the team is chartered to build and redirect it to the work of potential customers. Work, and understanding work becomes the primary consideration. But "work" is a slippery concept. What is work? (Beyer and Holtzblatt, 1998, p. 81)

Contextual design identifies five aspects to modeling "work," each of which guides the team to take a different perspective on what they have observed:

- The ***workflowmodel*** (Figure *9.5)* represents the people involved in the work and the communication and coordination that takes place among them in order to achieve the work.

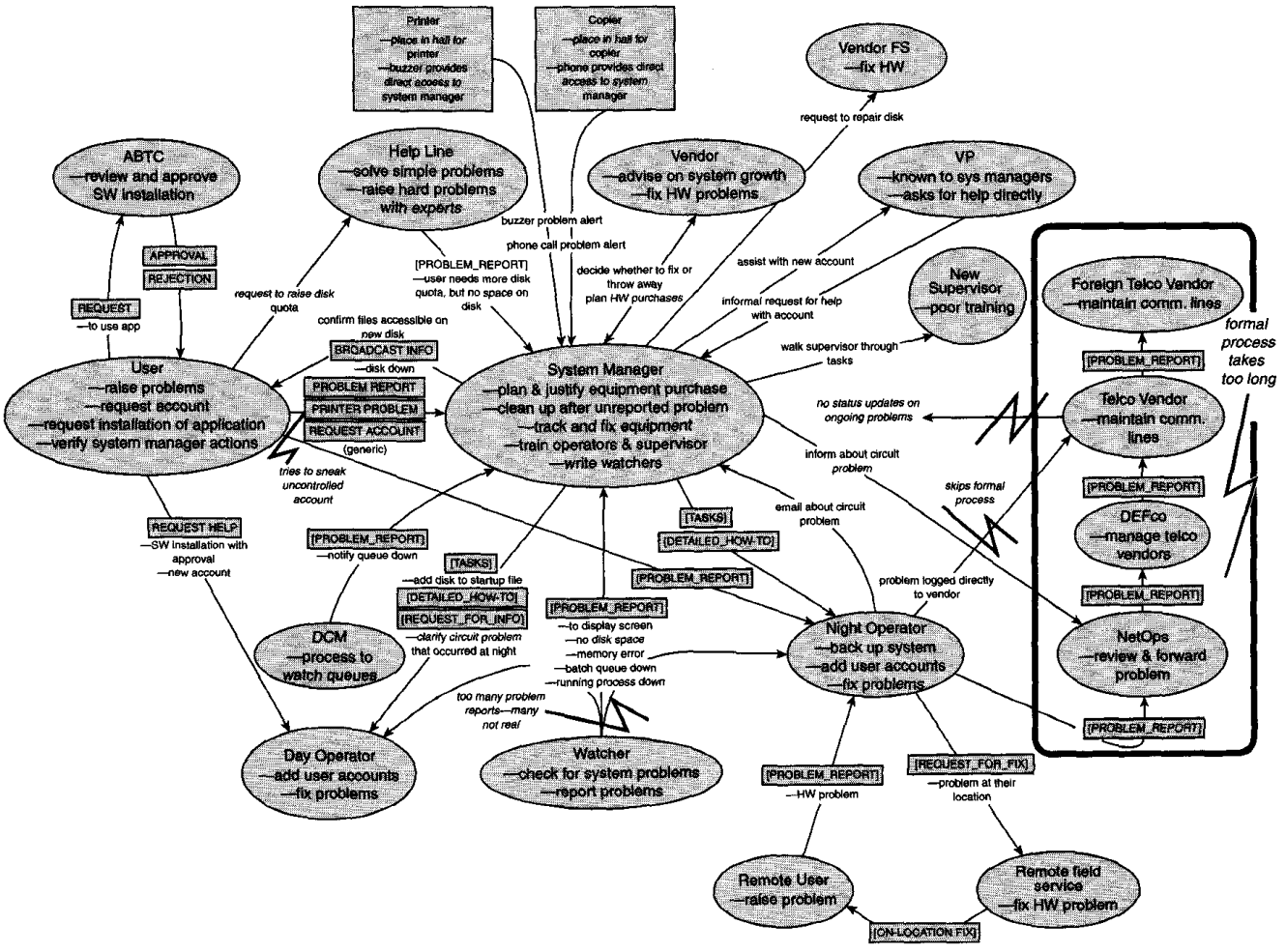


Figure 9.5 An example work flow model.

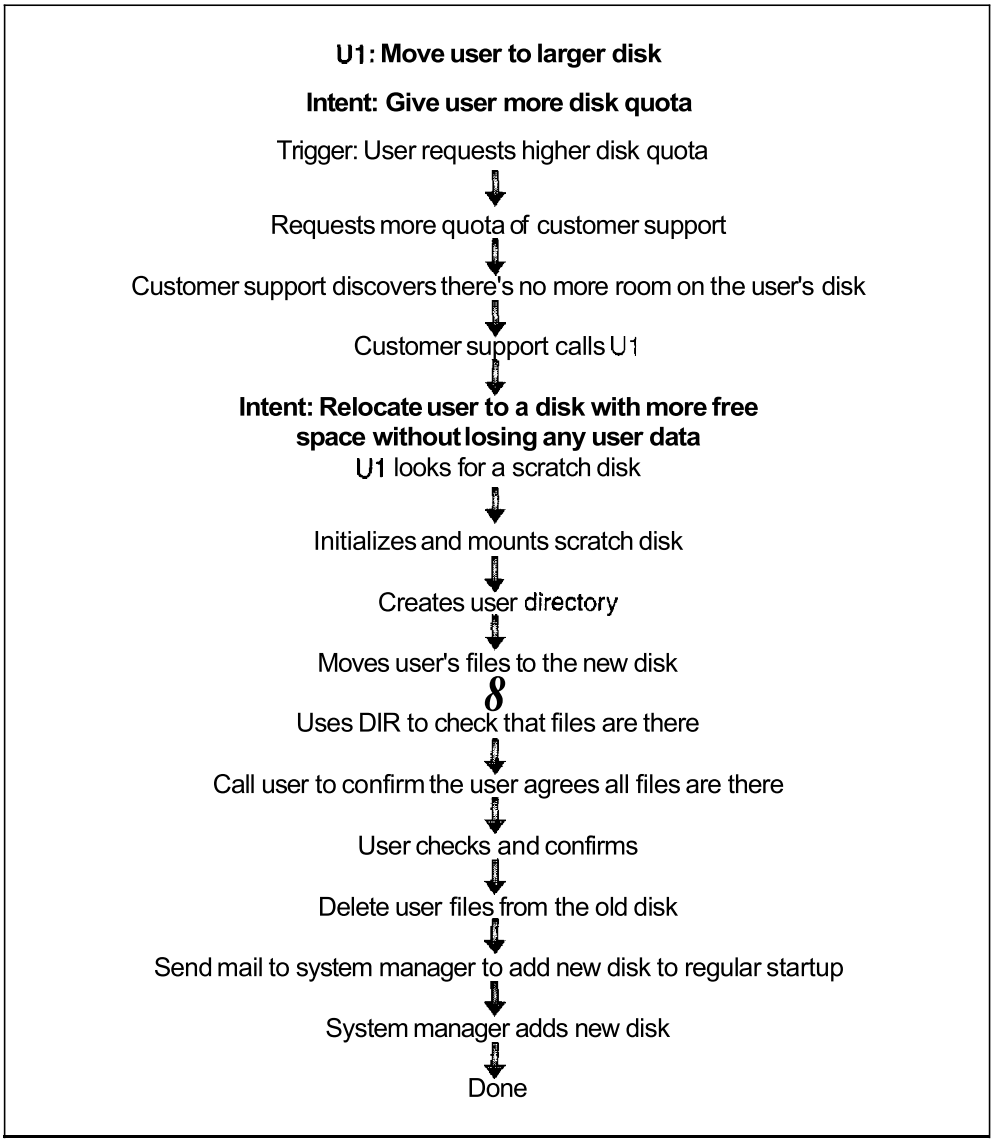


Figure 9.6 An example sequence model.

- The ***sequence model*** (Figure 9.6) shows the detailed work steps necessary to achieve a goal. Sequences are collected during the contextual interview, as the user works. However, understanding the steps alone is not sufficient, since although you may be able to streamline the steps themselves, if you do not understand the goals you may create a nonsensical work sequence. The sequence model also states the trigger for the set of steps.
- The ***artifact model*** represents the physical things created to do the work, such as the sticky notes at my desk, described above. The model consists of an annotated picture (or drawing) of each significant physical artifact used in achieving the work.
- The ***cultural model*** (Figure 9.7) represents constraints on the system caused by organizational culture. Organizations have cultures, teams build up their

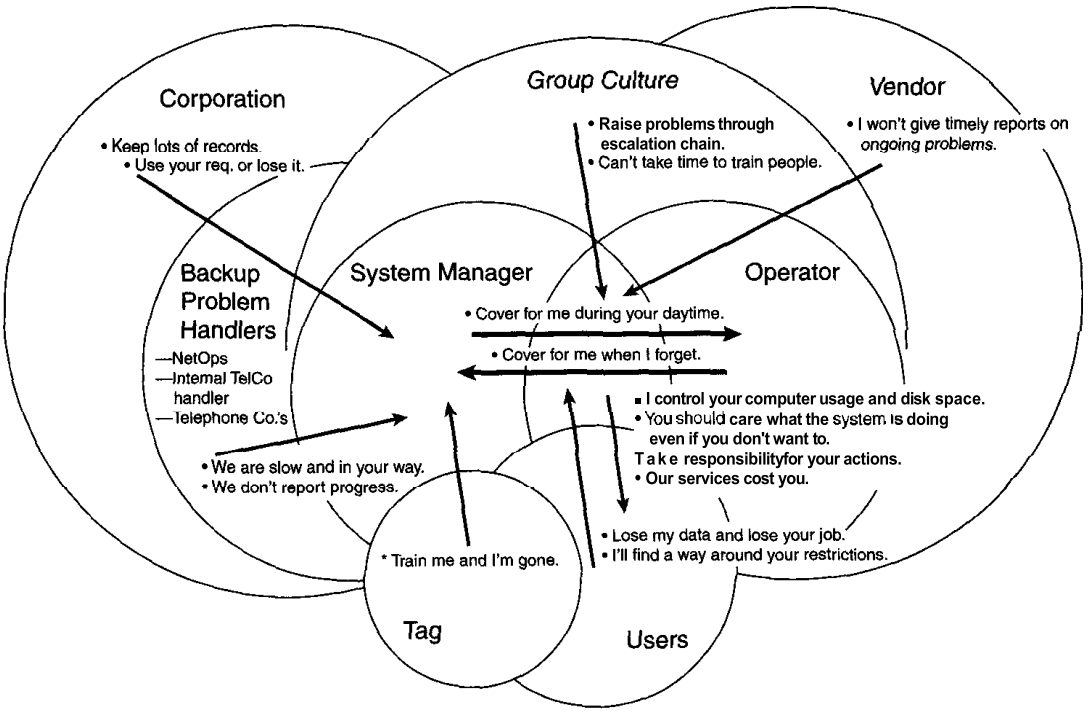


Figure 9.7 An example cultural model.

own culture, and work is performed in a cultural context. Culture influences the values and beliefs held by those taking part in the culture, and it determines rituals, expectations, and behavior. As a simple example, consider the dress codes for different situations in which you may find yourself. If you turn up at a baseball game in a three-piece suit, people will think you're a bit odd. On the other hand, if you turn up at a formal dinner in jeans and T-shirt, you will be refused entry. The cultural model aims to identify the main influencers on work, i.e., people or groups who constrain or affect work in some way.

- The physical model (Figure 9.8) shows the physical structure of the work. It may be a physical plan of the users' work environment, e.g., the office, or it may be a schematic of a communications network showing how components are linked together. The model captures the physical characteristics that constrain work and may make some work patterns infeasible.

The interpretation session

The work models are captured during an interpretation session. The team has to build an agreed view of the customers, their work, and the system to be built. Each developer therefore has to communicate to all the others on the team everything learned from her own interviewing experiences. So, after a contextual inquiry interview has been conducted, the team comes together to produce one consolidated view of the users' work.

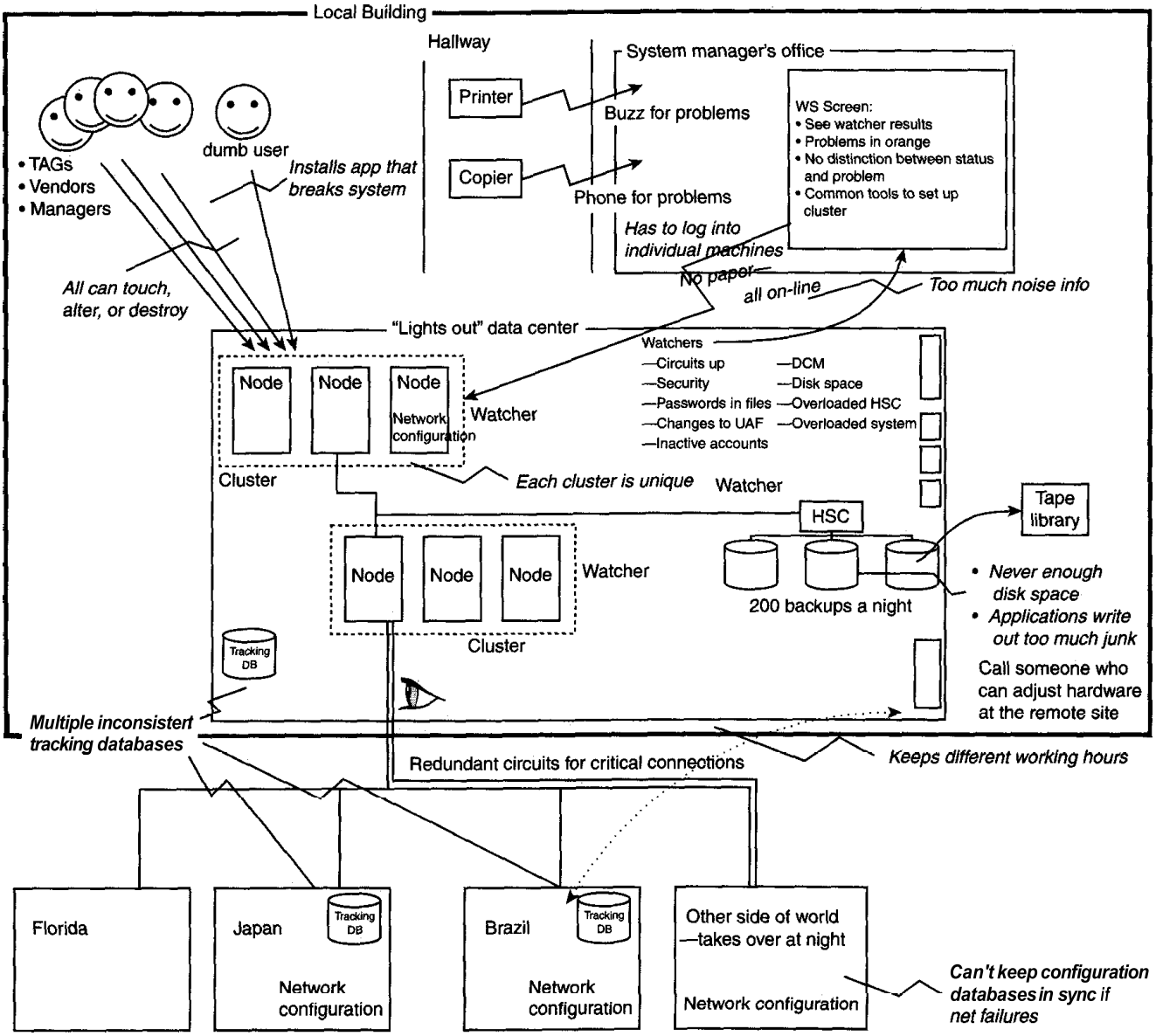


Figure 9.8 An example physical model.

Certain roles need to be adopted by the participants of this session. The interviewer is the person who has conducted the interviews and whose models are being examined. He must describe to the team what happened and in what order. During this recounting, the other members of the team can question the interviewer for clarification and extra information. Work modelers draw the work models as they emerge from the description given by the interviewer. The recorder keeps notes of the interpretation session that provide a sequential record of the meeting. The rest of the team (participants) listen to the description, ask questions, suggest design ideas (which are noted and not discussed at this time), observe, and contribute to the building of the models. The moderator stage-manages the meeting, keeps discussions

focused on the main issue, keeps the pace of the meeting brisk, encourages everyone to take part, and notes where in the story the interviewer was in case of interruptions. The ***rat-hole watcher*** steers the conversation away from any distractions.

The output from this session is a set of models associated with the particular contextual inquiry interview. Each contextual inquiry interview generates its own set of models that is inevitably focused on the interviewee. These sets of models must be consolidated to gain a more general view of the work as described below.

ACTIVITY 9.4 The thick lightning marks in the flow models represent points at which breakdowns in communication or coordination occur. Alongside each lightning bolt is a description of the cause for this breakdown. Study the flow model in Figure 9.5 and identify all the breakdowns and their causes.

Comment There are five breakdowns:

(a) too many problem reports — many not real

(b) the flow "problem logged directly to vendor" skips the formal process.

(c) no status updates on ongoing problems

(d) formal process takes too long

(e) tries to sneak uncontrolled account

Consolidating the models

The affinity diagram (see Figure 9.9) aims to organize the individual notes captured in the interpretation sessions into a hierarchy showing common structures and themes. Notes are grouped together because they are similar in some fashion. The groups are not predefined, but must emerge from the data. The process was originally introduced into the software quality community from Japan, where it is regarded as one of the seven quality processes. The affinity diagram is constructed after a cross-section of users has been interviewed and the corresponding interpretation sessions completed.

The affinity diagram is built by a process of induction. One note is put up first, and then the team searches for other notes that are related in some way.

The models produced during the interpretation session need to be consolidated so as to get a more general model of the work, one that is valid across individuals. The primary aim in consolidating flow models is to identify key roles. Any one individual may take on more than one role, and so it is necessary to identify and compare roles across and among individuals. For example, two different people may take on the role of quality assessor in different departments, and one of these may also be a production manager. To do this, the individuals' responsibilities are listed and a group of them that all lead towards one goal is identified. This goal and its set of responsibilities represents one role. Like the affinity diagram, this activity is concerned with grouping elements together along theme lines. Sometimes individuals use different names for the same role. The artifacts and communications among people need to be consolidated, too, in terms of flows between roles.

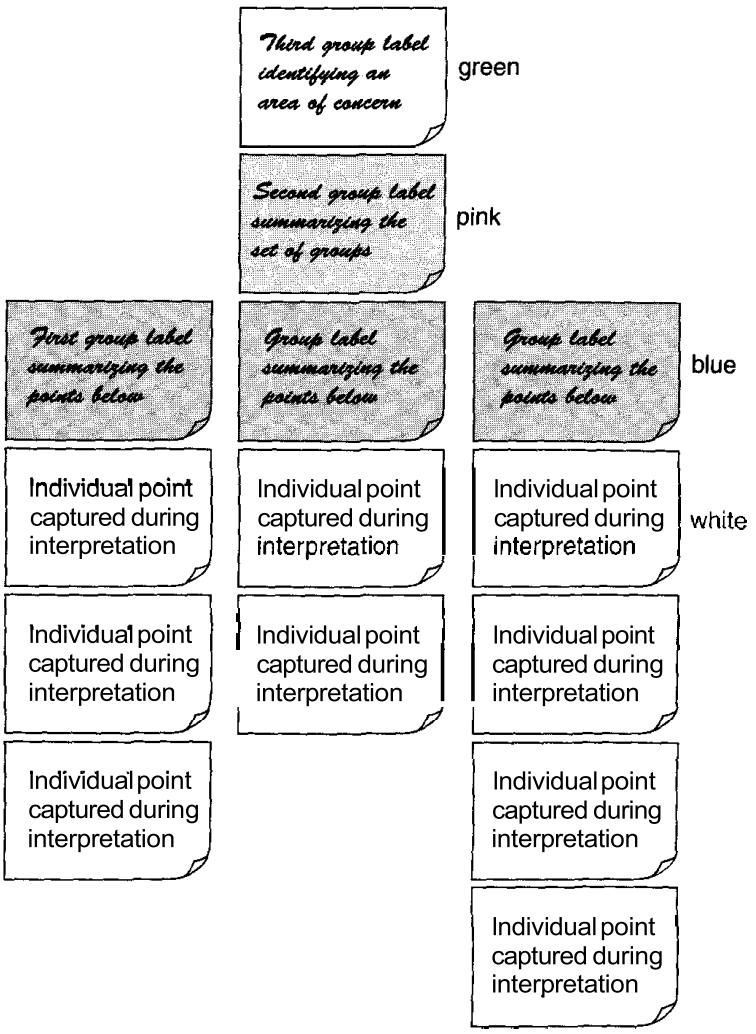


Figure 9.9 The structure of an affinity diagram.

Consolidated sequence models show the structure of a task and common strategies. The consolidated sequence model allows the team to identify what really needs to happen to accomplish the work, and hence what needs to be supported.

Artifact models show how people organize and structure their work, so a consolidated model shows common approaches to this across different people. The sequence models show the steps in the task, while the artifact model shows what is manipulated in order to achieve the task.

Physical space also has commonalities. For example, most companies have an entrance lobby with a receptionist or security guard, then beyond that personal offices and meeting rooms. Within one organization, even if it is distributed across different buildings, there is commonality of physical structure and hence constraints under which the work must be accomplished.

The cultural models help in identifying what matters to people who are doing the work. The cultural model identifies the influencers, so a consolidated model shows the set of common influencers within the organization.

All together, the consolidated models help designers to understand the users' intent, strategy to achieve that intent, structures to support the strategy, concepts to help manage and think about work, and the users' mind set.

The Design Room

An important element of Contextual Design is the design room, where all the work models are kept, pinned to the wall. The room is an environment that contains everything the team knows about the customer and their work. Design discussions held in the room can refer to data collected at the beginning of the project, and this can be used to support design ideas and decisions. This physical space in which the team is surrounded by the data is a key element of Contextual Design.

Contextual Design has been used successfully in a variety of situations from cell phone design (see Chapter 15) to office products (see Box 9.5). Its strength lies in the fact that it provides a clear route from observing users through to interpreting and structuring the data, prototyping and feeding the results into product development. This systematic approach means that, with suitable training, interaction designers can perform the observations and subsequent interpretation themselves, thus avoiding some of the misunderstandings that can happen if observations are conducted by others. Contextual Design is discussed further in the interview with Karen Holtzblatt at the end of this chapter.

9.5 Involving users in design: Participatory Design

Another approach to involving users is ***Participatory Design.*** In contrast to Contextual Design, users are actively involved in development. The intention is that they become an equal partner in the design team, and they design the product in cooperation with the designers.

The idea of participatory design emerged in Scandinavia in the late 1960s and early 1970s. There were two influences on this early work: the desire to be able to communicate information about complex systems, and the labor union movement pushing for workers to have democratic control over changes in their work. In the 1970s, new laws gave workers the right to have a say in how their working environment was changed, and such laws are still in force today. A fuller history of the movement is given in Ehn (1989) and Nygaard (1990).

Several projects at this time attempted to involve users in design and tried to focus on work rather than on simply producing a product. One of the most discussed is the UTOPIA project, a cooperative effort between the Nordic Graphics Workers Union and research institutions in Denmark and Sweden to design computer-based tools for text and image processing.

Involving users in design decisions is not simple, however. Cultural differences can become acute when users and designers are asked to work together to produce a specification for a system. Bødker et al. (1991) recount the following scene from the UTOPIA project:

> ***Late one afternoon, when the designers were almost through with a long presentation of a proposal for the user interface of an integrated text and image processing system, one of the typographers commented on the lack of information about typographical code-***

Figure 9.10 A newspaper cutting showing a parcel-sorting machine mockup.

structure. He didn't think that it was a big error (he was a polite person), but he just wanted to point out that the computer scientists who had prepared the proposal had forgotten to specify how the codes were to be presented on the screen. Would it read "<bf/" or perhaps just "\b" when the text that followed was to be printed in boldface?

In fact, the system being described by the designers was a WYSIWYG (what you see is what you get) system, and so text that needed to be in bold typeface would appear as bold (although most typographic systems at that time did require such codes). The typographer was unable to link his knowledge and experience with what he was being told. In response to this kind of problem, the project started using mockups (introduced in Chapter 8). Simulating the working situation helped workers to draw on their experience and tacit knowledge, and designers to get a better understanding of the actual work typographers needed to do. An example mockup for a computer-controlled parcel-sorting system, from another project, is shown in Figure 9.10 (Ehn and Kyng, 1991). The headline of this newspaper clipping reads, "We did not understand the blueprints, so we made our own mockups".

Mockups are one way to make effective use of the users' experience and knowledge. Other paper-based prototyping techniques that have been developed for participatory design are PICTIVE (Muller, 1991) and CARD (Tudor, 1993).

9.5.1 PICTIVE

PICTIVE (Plastic Interface for Collaborative Technology Initiatives through Video Exploration) uses low-fidelity office items, such as sticky notes and pens, and a collection of design objects to investigate specific screen and window layouts for a system. The motives for developing the techniques were to:

- empower users to act as full participants in the design process
- improve knowledge acquisition for design

A PICTIVE session may involve one-on-one collaboration or it may involve a small group. To perform a PICTIVE session you need video recording equipment, simple office supplies such as pens, pencils, paper, sticky notes, cards, etc., and some design components prepared by the design team such as dialog boxes, menu bars, and icons. These plastic design components may be generic or they may be specific to the system being developed, based on the development so far. The shared design surface is where the design will be created, jointly between the designers and the users, by manipulating and changing the design components and using the office supplies to create new elements. The video equipment records what happens on the shared design surface. Sample design objects and the layout for a PICTIVE session are shown in Figure **9.11** (Muller, **1991).**

Before a session, each participant is asked to prepare a "homework assignment." Typically, users are asked to generate scenarios of use for the system, illustrating what they would like the system to do for them (along the lines of the scenarios we discussed in Chapter 7). Developers are asked to develop a set of system components that they think may be relevant to the system. These may be generic elements that will be used in many design exercises, they may be specifically for the system under discussion, or a combination of these.

The design session itself is divided roughly into four parts (Muller et al., **1995).** First of all, the stakeholders all introduce themselves, specifically describing their personal and/or organizational stake in the project. Then there may be some brief tutorials about the different domains represented at the meeting. The third part of the meeting concentrates on brainstorming the designs, using the design objects and the homework assignments. The design objects are manipulated during the session to produce a synthesis of each participant's view. The scenarios developed by the users may help provide concrete detail about the work flow of the design. The final session is a walkthrough of the design and the decisions discussed. The role of the video recording is mainly that of record-keeper, so that there is a complete and informal record of the design decisions made and how they were made.

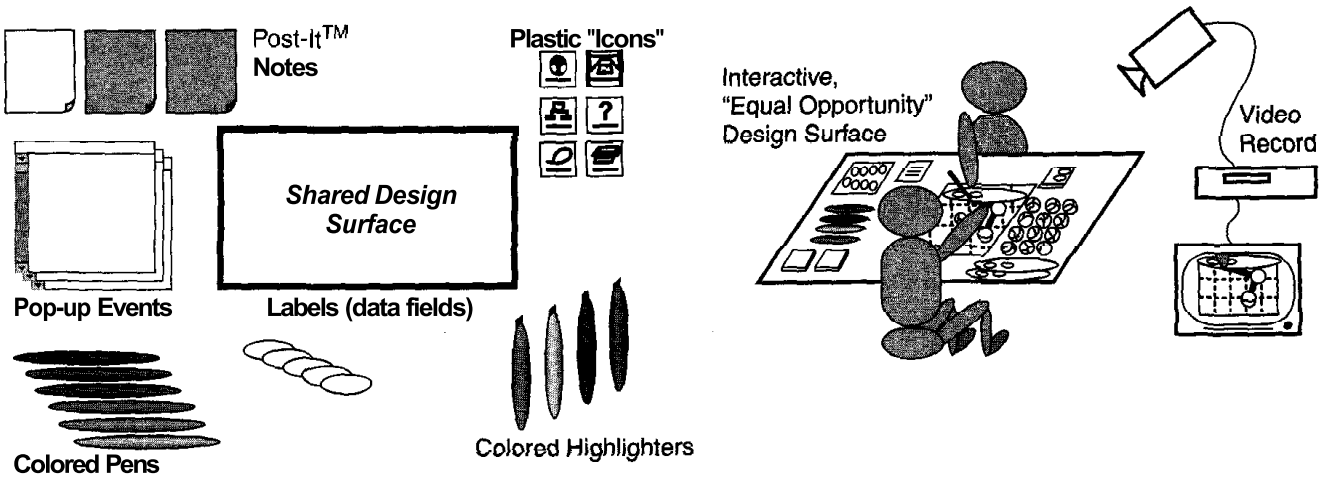


Figure 9.11 PICTIVE design objects **and PICTIVE** setting.

ACTIVITY 9.5 Describe a set of design components you would develop for a PICTIVE session for the shared calendar application discussed in Chapter 8.

Comment From our earlier design activities, we know that having dialog boxes and icons for arranging a meeting would be appropriate. Also, different mechanisms for specifying the people to attend the meeting and for choosing dates, e.g., drop-down lists, free text entry, or planner-style date display. These components could be based on our preliminary designs. We will also need a menu bar and associated menu lists, calendar page display, and function button components. It would also be important to have some blank components that could be completed during the brainstorming session.

9.5.2 CARD

CARD (Collaborative Analysis of Requirements and Design) is similar to PICTIVE, but uses playing cards with pictures of computers and screen dumps on them to explore workflow options (see Figure 9.12 for an example set of cards

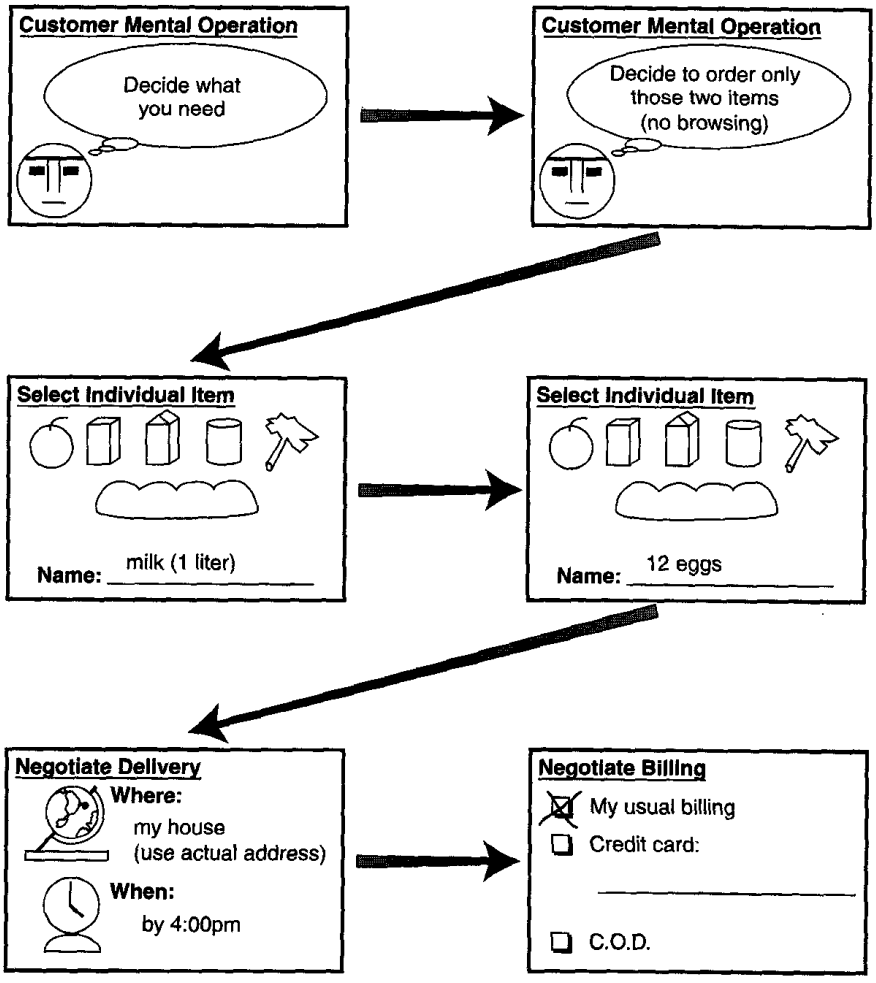


Figure 9.12 Example of CARD.

(Muller et al., 1995)). Whereas PICTIVE concentrates on detailed aspects of the system, CARD takes a more macroscopic view of the task flow. CARD is a form of storyboarding (see Chapter 8).

A CARD session could have the same format as that described for PICTIVE. During the design brainstorming part of the session, the playing cards are manipulated by the participants in order to show the work flow between computer screens or task decision points. The example in Figure 9.12 shows how the task of buying groceries through a computer screen such as via the Internet can be represented by

Table 9.1 A comparison of techniques introduced in this chapter

	Ethnography	Coherence	Contextual Design	Participatory Design[2]
Active user involvement	Low level	Low level	Medium to low level	Equal partners, users can be very influential
Role of designer1 researcher	Uncover findings about work	Collect and present ethnographic data according to the viewpoints and concerns	Steer discussion Interpret findings	Equal partners with users
Length of study	Typically continuous and extensive.	N/A	A series of 2-hour interviews	A series of 2-hour design sessions
Benefits	Yields a good understanding of the work	Overcomes the problem of representing ethnographic data for design	Systematic Is designed to feed into the design process	Users' sense of ownership is increased User contact is beneficial for designers
Drawbacks	Requires expertise Difficulties translating findings into design Requires a long lead-in time	Coverage limited to presenting ethnographic data Limited support currently for progressing to design	Involves many diagrams and notations May be complicated for users to understand the output	Users' thinking can be constrained by what they know If users are involved too much they get bored and it becomes counter-productive
When to use	Most settings where there is sufficient time and expertise	If an ethnographic study for interaction design is to be conducted (by ethnographer or designer)	When a user-centered focus is required Particularly useful for innovative product design	Whenever users are available and willing to become actively involved in design

[2]The main difference between CARD and PICTIVE lies in the level of detail at which design takes place. For the purpose of this comparison, they can be considered under the common title of Participatory Design.

playing cards. Note that the cards can be used to represent users' goals or intentions as well as specific computer screens or task elements. Participants can easily create new cards during the session as deemed appropriate.

CARD can be used to complement PICTIVE as it provides a different granularity of focus. Muller et al. (1995) characterized this as a bifocal view, CARD giving a macroscopic view, and PICTIVE the microscopic.

At the beginning of this chapter, we explained that there are different levels of user involvement, from newsletters and workshops through to full-time membership of the design team. Each project will need to decide on the level of user involvement required. To support this involvement, a project may also choose to use one or a combination of the techniques introduced in Sections 9.4 and 9.5. For example, Contextual Design could be used even if one of the users is a member of the design team; an ethnographic study might be running alongside a series of user workshops. These techniques expand the level of user involvement. However, each approach has advantages and disadvantages, and Table 9.1 provides a brief comparison between the main techniques introduced in this chapter.

Assignment

This assignment asks you to apply some elements of Coherence and Contextual Design to your own work or home circumstances.

(a) Using the questions for elaborating the viewpoints and concerns in Coherence, study the environment of your workplace, university library or somewhere similar that you know. Begin by deciding which concerns are relevant to each viewpoint, e.g., ask, "Are there paper artifacts used in the workplace?" or "Is local knowledge used?" Then answer the questions of elaboration for the three viewpoints and the four concerns.

Study your answers to the questions and see if you can identify priorities or constraints within the organization that you were not aware of before.

(b) Again using your workplace or similar location, attempt to draw the five Contextual Design work models introduced in Section **9.4.3.**

First of all, identify a key player in the workplace. This may be one of the librarians, a clerk or secretary, or a manager. If possible, run a contextual inquiry interview by sitting with her while working and asking her to tell you about one major aspect of work. **If** this is not possible, then identify one of the main tasks that is visible to you, such as the librarian issuing books, and sit and watch how the task is performed.

Draw the models from the information you have collected. If you find that you need more data, go back and collect more. Once you feel that the models are complete, take them back to the person you interviewed (if possible) and ask for comments.

Summary

This chapter has elaborated on some issues surrounding the involvement of users in the design process. We have also introduced the method of ethnography as a useful source of information for a user-centered design process. One of the main disadvantages to using ethnography is finding a way to represent the output of the study so that it can be fed into

the design process. We have described two approaches to design (Coherence and Contextual Design) that were derived from ethnography and other approaches, to address this problem.

Users may be involved passively or they may be more actively involved in making design decisions. Participatory design is an approach in which users are co-designers. We have described two techniques (PICTIVE and CARD) that have helped users' input to be more effective.

Key Points

- Involving users in the design process helps with expectation management and feelings of ownership, but how and when to involve users is a matter of dispute.
- Putting a user-centered approach into practice requires much information about the users to be gathered and interpreted.
- Ethnography is a good method for studying users in their natural surroundings.
- Representing the information gleaned from an ethnographic study so that it can be used in design has been problematic.
- The goals of ethnography are to study the details, while the goals of system design are to produce abstractions; hence they are not immediately compatible.
- Coherence is **a** method that provides focus questions to help guide the ethnographer towards issues that have proved to be important in systems development.
- Contextual Design is a method that provides models and techniques for gathering contextual data and representing it in a form suitable for practical design.
- PICTIVE and CARD are both participatory design techniques that empower users to take an active part in design decisions.

Further reading

GREENBAUM, JOAN, AND KYNG, MORTEN (eds.) (1991) ***Design at Work: Co-operative Design of Computer Systems.*** Hillsdale, NJ: Lawrence Erlbaum. This book is a good collection of papers about the co-design of software systems: both why it is worthwhile and experience of how to do it.

BEYER, HUGH AND HOLTZBLATT, KAREN (1998) *Contextual Design: Defining Customer-Centered Systems.* San Francisco: Morgan Kaufmann. This book will tell you more about contextual design and the rationale behind the steps and the models.

CUSUMANO, M.A., AND SELBY, R. W. (1995) *Microsoft Secrets.* London: Harper-Collins Business. This is a fascinating book based on a two-and-a-half-year study of Microsoft and how they build software. The book details findings about strategies to manage an innovative organization competing in a rapidly changing world, to develop and ship products that appeal to mass markets, and to continually build on and improve market position.

WIXON, DENNIS, AND RAMEY, JUDITH (eds.) (1996) ***Field Methods Casebook for Software Design.*** New York: John Wiley & Sons, Inc. This book is a collection of papers about practical use of field research methods in software design, some of which are directly mentioned in the present chapter. The three main approaches that these papers cover are ethnography, participative design, and contextual design. There are 14 chapters describing case studies and three chapters giving an overview of the main methods. For anyone interested in the practical use of these methods in software development, it's a fascinating read!

INTERVIEW with Karen Holtzblatt

Karen Holtzblatt is the originator of Contextual Inquiry, a process for gathering detailed data on product use, which was the precursor to Contextual Design, a complete method for the design of information systems. Together with Hugh Beyer, the codeveloper of Contextual Design, Karen Holtzblatt is cofounder of InContext Enterprises, which specializes in process and product design consulting.

HS: What is Contextual Design?

KH: If you're going to build something that people want, there are basically three large steps that you have to go through. The first question that you ask as a company is, "What in the world matters to the customer such that if we make something, they're likely to buy it?" So the question is "What matters?" Now once you identify what the issues are, every corporation will have the corporate response, or "vision." Then you have to work out the details and structure it into a product. In any design process, whether it's formalized or not, every company must do those things. They have to find out what matters, they have to vision their corporate response, and then they have to structure it into a system.

Contextual Design gives you team and individual activities that bring you through those processes in an orderly fashion so as to bring the cross-functions of an organization together. So you could say that Contextual Design is a set of techniques to be used in a customer-centered design process with design teams. It is also a set of practices that help people engage in creative and productive design thinking with customer data and it helps them co-operate and design together.

HS: What are the steps of Contextual Design?

KH: In the "what matters" piece, we go out into the field, we talk with people about their work as they do it: that's Contextual Inquiry and that's a one-on-one, two to two-and-a-half-hour field interview. Then we interpret that data with a cross-functional team, and we model the work with five work models: communication and coordination, the cultural environment, the physical environment, sequence, and artifact. We also capture individual points on paper notes. After the interviews every person we interviewed has a set of models and a lot of post it notes. Our goal is to see all that data because you don't want to be designing from one person's data from itself, or from any one interview; we need to look at the structure of the practice itself. The consolidation step means that we end up with an affinity diagram and five consolidated models showing the issues *across* the market.

At that point, we have modeled the work practice as it is and we have now six communication devices that the team can dialog with. Each one of them poses a point of view on which to have the conversation "what matters?"

Now the team moves into that second piece, which is "what should our corporate response be?" We have a visioning process that is a very large group story-telling about reinventing work practice given technological possibility and the core competency of the organization. And after that, we develop storyboards driven by the consolidated data and the vision. At this point we have not done a systems design; we want to design the work practice first, seeing the technology as it will appear within the work.

To structure the system we start by rolling the storyboards into a user environment design—the structure of the system itself, independent of the user interface and the object model. The user environment design operates like a software floor plan that structures the movement inside the product. This is used to drive the user interface design, which is mocked up in paper and tested and iterated with the user. When it has stabilized, the User Environment design, the storyboards, and the user interface drive development of the object model.

This is the whole process of Contextual Design, a full front-end design process. Because it is done with a cross-functional team, everyone in the organization knows what they're doing at each point: they know how to select the data, they know how to work in groups to get all these different steps done. So not only do you end up with a set of design thinking techniques that help you to design, you have an organizational process that helps the organization actually do it.

HS: How did the idea of contextual design emerge?

KH: Contextual Design started with the invention of Contextual Inquiry in a post-doctoral internship with John Whiteside at Digital. At the time, usability testing and usability issues had been around maybe eight years or so and he was asking the question, "Usability identifies about 10 to 20% of the fixes at the tail end of the process to make the frosting on the cake look a little better to the user. What would it take to really infuse usability?" Contextual Inquiry was my answer to that question. After that, I took a job with Lou Cohen's Quality group at DEC, where I picked up the affinity diagram idea. Also at that time, Pelle Ehn and Kim Madsen were talking about Morten Kyng's ideas on paper mock-ups and I added paper prototyping with post-its to check out the design. Hugh and I hooked up 13 years ago. He's a software and object-oriented developer. We started working with teams and we noticed that they didn't know how to go from the data to the design and they didn't know how to structure the system to think about it. So then we invented more of the work models and the user environment design.

So the Contextual Design method came from looking at the practice; we evolved every single step of this process based on what people needed. The whole process was worked out with real people doing real design in real companies. So, where did it come from? It came from dialog with the problem.

HS: What are the main problems that organizations face when putting Contextual Design into practice?

KH: The question is, "What does organizational change look like?" because that's what we're talking about. The problem is that people want to change and they don't want to change. What we communicate to people is that organizational change is piecemeal. In order to own a process you have to say what's wrong with it, you have to change it a little **bit,** you have to say how whoever invented the process is wrong and how the people in the organization want to fix it, you have to make it fit with your organizational culture and issues. Most people will adopt the field-data gathering first and that's all they'll do and they'll tell me that they don't have time for anything else and they don't need anything else, and that's fine. And then they'll wake up one day and they'll say, "We have all this qualitative stuff and nobody's using it ... maybe we should have a debriefing session." So then they have debriefing sessions. Then they wake up later on and they say, "We don't have any way of structuring this information ... models are a good idea." And basically they reconstruct the whole process as they hit the next problem.

Now it's not quite that clean, but my point is that organizational adoption is about people making it their own and taking on the parts, changing them, doing what they can. You have to get somebody to do something and then once they do something it snowballs.

What's nice about the Contextual Design way of doing everything on paper is that it creates a design room, the design room creates a talk event, and the talk event pulls everyone in because they want to know what you're doing. Then if they like the data, **they feel left *out,*** and because they feel left out they want to do a project and they want to have a room for themselves as well.

The biggest complaint about Contextual Design is that it takes too long. Some of that is about time, some of it is about thought. You have people who are used to coding and now have to think about field data. They're not used to that.

HS: What's the future direction of Contextual Design?

KH: Every process can always be tweaked. I think the primary parts of Contextual Design are there. There are interesting directions in which it can go, but there's only so much we can get our audience to buy.

I think that for us there are two key things that we're doing. One is we're starting to talk about design and what design is, so we can talk about the role of design in design thinking. And we are still helping train everyone who wants to learn. But the other thing we're finding is that sometimes the best way to support the client is to do the design work for them. So we have the design wing of the business where we put together the contextual design teams.

We're working with distributed teams, we're working with creativity and invention, we're working with how it impacts with business processes and marketing, we're working with the balance of all those things. But it's only going to be in the context of a