FIELD RESEARCH IN PRODUCT DEVELOPMENT

KAREN H. KVAVIK
DANIELLE FAFCHAMPS
SANDRA JONES
SHIFTEH KARIMI

INTRODUCTION

Field research (also "contextual field research, user studies") involves users in product development so that their work experience may be understood by designers and developers. The points of view expressed here were first presented in a well-attended CHI '90 SIG on this user- centered approach. Overall, the notion of "culture" pervades our concerns: The corporate culture, the user's experience with computer tools, and the culture of the work setting. The design and development process within a group reflects a culture. Field research is relatively new to the industry. There is a concern about appropriate methods and techniques. A missionary's role can be a precarious one-- how does the social scientist navigate in a corporate jungle?

The contributors report their personal experiences in using field research in various professional settings. We focus on technology promotion and getting acceptance for user studies, evaluation techniques, and multidisciplinary perspectives, e.g. ethnography and other (social science) techniques. What is striking are the common issues that we face, given diverse work settings and roles. In the following, which encapsulate points made at the SIG, a number of common themes emerge and are reiterated with different emphases by each contributor.

All contributors underscore that field research must encompass the users' whole work situation. Cooperative and participative involvement in product development (users, designers, developers, and others) is essential in successful use of field techniques. The HCI professional, whose work may be new to the engineering environment, must be concerned about his/her role in effecting participation and establishing design practices in such an engineering environment. This includes responsibility for helping to change attitudes regarding user research. The contributions offer ways to promote user-centered practices and to get commitment and acceptance from participants. They include strategies for technology transfer and technology promotion within and across the organizational context. Differing techniques and evaluation approaches are seen as appropriate at different stages of development. Feedback into design and interview analyses are central issues, as all professionals are concerned with time problems and the demand for quick feedback.

Besides these general themes, there are individual notes. Karimi presents diverse ways user studies can be employed in product development and assessment. Jones elaborates the data gathering, analysis, and post-analysis aspects of interviews and discusses both the specific and reusable aspects of users' data. Fafchamps reports on a number of useful strategies in promoting good field research practices and dealing with diverse "cultures". Kvavik discusses getting participation from designers, developers, and other "client groups" involved in development, technology transfer and its spread, and how user studies have effected user "buy in" for new products.

SHIFTEH KARIMI: DIVERSE TYPES OF USER STUDIES IN R&D

The User Studies Team at Apple Computer makes interface design recommendations based on data from users. In collaboration with engineering teams, we design and conduct behavioral studies to address selected interface design issues. Our philosophy is:

- Users should be involved throughout the design process.
- We should use multiple methods of collecting information.
- Users should be observed in their natural contexts, if possible.

We attempt to study entire situations, e.g. the work environment with the product, not particular products in isolation. In practice, we are aware that there is a gap between what we ideally wish to accomplish and what we realistically can do. Conducting user studies is not a precise art. The stage of technology development determines our research methods. Also, different methods generate different levels of information. The following three types of studies exemplify the various ways in which user information can be collected:

Generating Baseline Information about Users

The purpose of gathering this type of information is to influence product design in early stages of development. For example, our group is conducting a study to find out what people do during the course of a day and what tools they use to accomplish their tasks. In analyzing the data, we will focus on those types of activities that can potentially be supported by computers.

Collecting Information Over Time on Users In Their Natural Environment

This next type of study provides more direct feedback to designers. For example, a member of our team is conducting a study on speech work. We are studying a middle school classroom which functions as a real-world laboratory to study speech technologies in education. The teacher is intimately involved in this project and is especially interested in using speech recognition, speech synthesis, and digitized speech to teach English as a Second Language.

Studying Short-term, Real-world Events

This third type of study provides feedback on the usefulness of our technology in real-world settings. For example, I conducted a case study of a successful collaborative effort to publish the book, *15 Seconds: The Great California Earthquake*. Using Apple's current technologies in desktop publishing, the book was published in less than two weeks. During this project, I visited the headquarters, observed the events as they unfolded, and interviewed the core team of journalists and photographers. I was interested in how the team collaborated, how they used the technology/products to accomplish their tasks, and how their experience during this process was different from that of traditional publishing.

Conducting user studies is not free of obstacles. First, time remains a major issue. Research is time-consuming, and engineers often want quick feedback. Second, staff shortages are a major problem. There are few qualified people to undertake the full range of user studies. The third obstacle is a more general one, in that the process of doing user studies is not fully understood in the engineering community. The engineering community likes and values the information from the studies, but they may not appreciate the skills and time it takes to get the information. As usability professionals, we are faced with the responsibility of trying to change people's attitudes in our own working environment.

SANDRA JONES: USING CONTEXTUAL INQUIRY TO DESIGN SYSTEMS

Contextual inquiry is a field research methodology that was developed at Digital in 1986. It has been used throughout the product development cycle to:

- Study competitive products
- Define system requirements
- Conduct test drives with prototypes and early versions of the software
- Identify changes for successive versions of a product
- Study how people learn a new application
- Collect usability data to measure product success
- Develop usability concepts to guide interface design

The objective of contextual inquiry is to drive system design from a shared understanding of users' work and experience using computers. The success of this approach to system design depends heavily on team work including software engineers, product managers, and documentation designers in data gathering and data interpretation.

Definition of Contextual Inquiry

The key concepts of contextual inquiry are: context, partnership, and focus. Context refers to collecting data in users' work environments during ongoing work. Being present while people are working allows designers to access observations of actual, ongoing experience rather than recalled, abstract experience.

Partnership refers to the relationship that designers establish with users. This relationship is collaborative. By acknowledging users as experts of their work and experience, designers can transcend the role of interviewer and develop a partnership with users. As partners, users and designers have a directed dialogue about users' experience doing work. Together they cointerpret the work experience.

Focus refers to the set of assumptions that determines what designers attend to and what they dismiss during the interview. An underlying premise of contextual inquiry is that

we all operate from an existing set of assumptions that become our entering focus. Our entering focus directs what we pay attention to and what we ignore. As such, focus reveals some phenomena and simultaneously conceals other phenomena. During the interview, the designer seeks to expand the entering focus and shape the focus through dialogue.

Analysis Is Interpretive

The designer is engaged in simultaneous data gathering and analysis with users during the interview. As a result, the designer always has an understanding of users' work from which to design. After the interview, analysis can be performed on handwritten notes or transcripts. We use audio recording during the interview to supplement handwritten notes. After the interview, we transcribe our recordings to produce a written transcript.

During post-interview analysis, the designer continues the inquiry by reading the transcript and asking, "What is going on here?". Interpretations of the text are added to the transcript. We use a coding scheme to differentiate our interpretations from the original text of the transcript. During analysis of the transcripts, we read and reuse users' language, moving back and forth between specific instances and the entire session to build an understanding.

The post-interview analysis process may lead to an interpretation that needs to be validated either with the person who was interviewed or with a new person. Analysis of the transcripts will have the same effect as analysis during the interview: The designer's focus expands and is anchored in the data.

Analysis Results In Specific and General Knowledge

Analysis is inductive; it is a bottom-up process. As we interpret the transcripts, we conceptually group data by asking, "How does this piece of data relate to these other data?" After relating pieces of data, we create labels for the groupings that crystallize our understanding of the groups. This grouping technique is known as "Affinity diagramming"[1].

During analysis, designers inquire into users' work and listen from the position of technological possibilities. As such, the outcome of analysis is a system vision that integrates the power of technology with an understanding of users' work. Concepts about work and usability that emerge from the interview drive system design. These concepts also become the entering focus for subsequent interviews. As designers go from interview to interview and product to product, they bring the understanding that was developed from previous interviews.

Although knowledge that is gained through contextual inquiry is specific to a particular context, it is also reusable. Knowledge is carried across particular domains. For example, designers at Digital who interviewed experienced users of a text editor found that users developed "workarounds" to avoid disruption to their work. The editor disrupted users because it did not automatically format text during editing. When users added text to an existing sentence, text at the end of the line scrolled off the screen making it impossible to read the text while editing. To avoid this problem, users prematurely broke lines by pressing the <Return> key while they were typing and then issued a command to reformat the text when they were finished editing [6].

This instance informed our understanding of the concept of disruption and the relationship between disruption and workarounds. This knowledge then became part of our focus for subsequent interviews with other products.

For example, I later interviewed people learning a desktop publishing system. A person who was trying to put a repeating string of text at the bottom of each page (a running foot) in a document was surprised by the behavior of a Running Foot Paragraph menu item:

> "It is giving me a running foot style of paragraph where I currently am without knowing anything about the page. For things that are oriented to the page, like a running foot, I'm expecting it to do page operations."

This person had a "running foot" concept that did not match the system concept that was expressed in the way a running foot was implemented. I saw from this instance that disruption also occurs when system concepts do not match users' work concepts. As a result, my understanding of disruption was expanded to include a recognition that users have work concepts and that disruption occurs when there is a mismatch between users' work concepts and system concepts. In addition, I saw that learning is precipitated by disruption and involves a modification of users' concepts [7].

In summary, through interviews with users of diverse systems, designers can expand their understanding of disruption and its relationship to usability. Knowledge about users' work and computer usage that is gained through contextual interviews carries across domains. Reusable knowledge, such as knowledge about work concepts and usability concepts, becomes the entering focus for subsequent interviews in other domains. As designers conduct interviews with people doing different kinds of work, they develop a theory of usability that transcends a particular work domain. In this way, contextual inquiry is an effective methodology for designing systems that support and transform users' work [11].

DANIELLE FAFCHAMPS: COOPERATIVE PRACTICES TO FACILITATE THE DESIGN PROCESS

The goal is to describe strategies to help social scientists who plan to conduct field research in industry. Most social scientists who pioneer field research methods in industry have a bumpy start. Discussions with engineers and field researchers suggest that we have not been very successful in identifying early cooperative strategies to communicate our

perspective and work effectively with design engineers. The following are some strategies to facilitate cooperation between field researchers and design engineers:

Encourage Informal Interactions

Field researchers need to broaden their interest beyond the immediate boundary of their current project. Keeping informed about ongoing and planned projects facilitates informal exchanges of multidisciplinary perspectives between field researchers and other members of the technical community. Informal discussions with technical colleagues constitute an excellent opportunity for introducing alternative perspectives to their projects.

Be Sensitive to Organizational Culture

Technical professionals represent the mainstream culture of R&D environments. As potential agents of cultural changes, it is crucial that field researchers develop a good understanding for the dynamics and politics of this mainstream culture. Interactions with this prevalent professional culture should be approached with the same carefulness and sensitivity as we would use to negotiate entry into field research. For example, we should be sensitive to the communication patterns both within our group and within the company. In some companies, it is frowned upon if members of the technical staff explore collaboration with professionals from other company entities. In other companies, such as Hewlett-Packard, hierarchical and organizational boundaries are not an obstacle to communication between individuals.

Use Jargon Judiciously

There are no firm rules for deciding when it is appropriate to use the technical jargon of our discipline and when it obstructs effective communication with design engineers. The use of jargon for the purpose of characterizing aspects of the design process is useful when it helps designers to conceptualize previously unquestioned aspects of their practice. For example, using specific terminology to describe interviewing techniques is appropriate.

Explain, Present, and Teach about Your Perspective

We social scientists should create every opportunity to explain our perspective, methodology, and techniques by volunteering presentations on our work, together with specific examples to illustrate the relevance of our methods and results to system design. Tutorials or seminars for software engineering colleagues are also useful strategies. If presentations and teaching are successful, colleagues will be valuable ambassadors within the technical community.

Develop a Domain Expertise

It is crucial that field researchers develop expertise in at least one domain (e.g. manufacturing, medicine, etc.) which is relevant to their group and to the company. We cannot hope to survive and flourish on the sole strength of being knowledgeable about methods and techniques. Methodological expertise is vacuous to the design engineers who are building a system for a specific domain. If our expertise is domain specific, design engineers will seek our participation. Selecting a domain is in itself a challenging task that requires the careful consideration of the company's plans.

Document Your Contribution

During the design process, engineers have a tendency to rely on group memory rather than on written accounts of their design assumptions and ongoing decisions. Typically, design engineers sketch a vision, sometimes build a demo, and plunge into the work. They usually avoid formal meetings, preferring to make decisions on the fly during informal discussions. The absence of a documentation protocol constitutes one of the major impediments to the assessment, and therefore recognition, of field research's ongoing contribution to the design of the artifact. Engineers' ideas quickly concretize into lines of code and artifacts. Field researchers contribute knowledge about the work practice the artifact seeks to capture. We need to devise design-specific means to document our results and their contribution to the design.

These suggestions and strategies are, by no means, exhaustive or sufficient to ensure productive and satisfying cooperative practices between field researchers and design engineers. We are trained in the analysis of human interactions, and we are relatively new to the design field. It is our responsibility to experiment with and promote interactions that will allow field researchers and design engineers to work successfully together.

KAREN H. KVAVIK: EFFECTING BUY-IN FROM PARTICIPANTS-- TECHNOLOGY TRANSFER AND ITS SPREAD

In UCON Engineering at Unisys we build software configuration tools for hardware and software products for correct and complete entry of orders. From field research we have seen benefits not only for design and improved usability, but for gaining user interest and commitment to the new tools. The "real world" approach presents usability issues in a tangible fashion to developers and involves users in the development of their own tools. This section discusses the effects of field research for user "buy in" of the new products, and effecting participation from designers, developers, and others involved in product development.

Users vs. Client Groups

The targeted users are company-internal marketing and sales world-wide. Configuration for correct orders has been a difficult and costly problem. The configuration process requires capabilities for tracking many dependencies, insuring correct style numbers and prices, the ability to add on to an existing system, phased proposal facilities, various types of reports, graphs, and rapid scenarios. We have to under-

stand our users' culture and needs. The new tools must not only be accurate, but also fit their particular work situation while configuring varying hardware and software products, and require no training. We must win user trust and acceptance for adoption of the new configuration tools.

While targeted users are marketing support and sales people, we also have other "client groups" whose input into the development process is important and whose participation must be co-opted. These are program management, engineering, customer service engineers, and information providers, individuals who play roles across the company in the development of the very products for which we are making the configuration tools.

Our Approach

The software is prototyped on a LISP machine, and then ported to a PC for delivery. We use field research to evaluate 1) design and development, and 2) pre- and post- release configurators for ongoing improvements. At the earlier development stages, the field work provides us with insights into design and development directions.

Our approach is ethnographic. People have a story to tell, with opinions and values to impart. We use think-aloud techniques, recorded and supplemented by interviewer notes, with structured probing when we have particular questions regarding a design. It is important for the designer/developer and evaluator to have an understanding of goals to be accomplished in a particular interview. We always do a wrap-up at the end of every session to ensure that our understanding of the users' opinions is correct. When possible, we try to do the evaluations at their work site (their own or their group's work area). We are fortunate in being located where we have many users literally within a few steps. In essence, we are part of the users' work site. Users may supplement their appraisals by showing insightful personal tools (e.g. spreadsheets, databases, illustrations), created to aid their own configurations and personal styles. If they are marketing support, they may give us concrete insights about sales people they work with and their customers. Conversely, sales people tell us how they interact with their customers and their marketing support.

Effecting Technology Transfer, Change, Spread, and Acceptance

As in any technology change and spread, adoption of field research and usability practices do not occur uniformly. Among developers some are outwardly resistant; some profess to usability research, but are passively resistant when studies need to be done; others may jump in wholeheartedly, with varying degrees of success because of lack of know-how. Within our development group, a teamwork and "hands-on" approach has helped in acceptance of a field research approach. However, the user evaluation data themselves are seen as very helpful and an effective way to "sell" the approach.

Because of time pressures (and possible excuses that there is not time to do evaluations), it is important to plan with developers when software can be taken to users and then be persistent in achieving those plans so that time does not "slip by". It is important to return evaluations to developers quickly. It is not always clear when early prototypes are ready for user evaluation of some sort, e.g. enough functionality or too rudimentary an interface. With software interface screen slide demos, the demo has to be complete "enough" to give an illusion of the software "flow" for user reactions. Otherwise, it is hard to judge whether the underlying model is poor, or if some omissions are causing the confusion. Software "ownership" by developers and fear of criticism may prevent early evaluations. Part of our field work emphasis has tried to refocus the developers' own user interactions away from giving a demo. With field interviews, only the user and interviewer are involved.

Technology transfer is effected by informal explanations and "hands-on" approaches for developers, and explanation of rationale to users. The latter are pleased to be consulted. An example of a more formal approach is a training session given to an ancillary group (client group). The training not only has furthered understanding about our targeted users, but provided us with other users and co-opted "clients". When put in the place of an end user, a "client" understood some of the problems developers had with information sources and that the company documentation he was in charge of needed changing. With this understanding of real user and developer problems, the client promised more support for our work. Another result of participation is that a client may also find that the configurator tool can be used in some way to benefit his/her own work.

Acceptance of field research as a part of the development effort and technology transfer have led to co-optation and cooperation: "buy in" for our products from users, help from information providers, and adoption on the part of designers, developers, and also management and other "clients". This is a circular process, because getting participants to "buy in" produces more and more cooperation. Sales and marketing support are pleased to be consulted and to see their contributions in the software; they become "owners" and tell colleagues about the configurators. They talk about the configurators to their own customers and show them examples. Trust and adoption for the new tools are increased. (In fact, we see "trust" as one of the most salient "higher order" concepts for the software [9, p. 813]. This is not just the software's computational accuracy, but that price book information is present, and all recent dependencies are accounted for. Some users will go to imaginative ways to try to "fool" the software, to make sure that it is working properly.)

To summarize, field research has led to user and client involvement (and evolvement), which lead to further ideas for the software tools, including applications and tie-in with other software tools used in the sales process. It has aided "buy-in" from developers and information providers. Involving a "client" in field research serves as an illustrative

way for him or her to understand a user's point of view. As a consequence, management has become more committed to usability efforts.

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