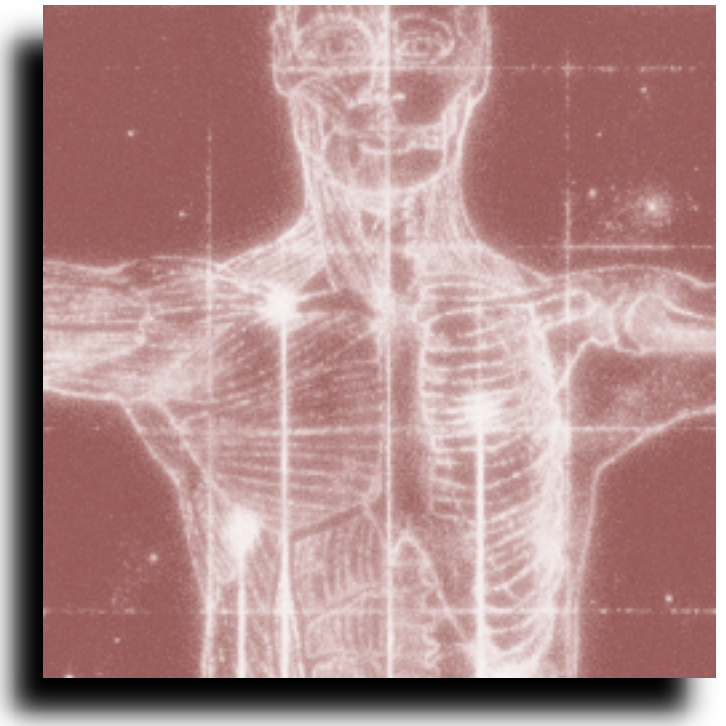
Using Video
to Re-Present the User



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Advocates of user-centered design and participatory design, also referred to as "work practice practitioners'' include computer scientists, systems designers, software engineers, social scientists, industrial and graphic designers, marketing, sales, and service personnel. Working singly or in teams, we have been identifying and combining effective techniques and methods of: gathering data, interacting with user participants, representing activities and observations, and integrating findings with the design and construction of new technologies.

We are engaged in user-centered work practice and code-velopment projects to understand how people work. Our goal is to better inform the development of emerging technologies so that they more closely align with the needs and work practices of the potential users of the technologies. This article describes a few of the approaches we have found useful in developing, evolving and sharing an understanding of user requirements.

The work practice community to which we belong is an outgrowth of efforts pioneered at Xerox PARC by Lucy Suchman and Jeanette Blomberg. We have been evolving a tool kit of methods and techniques for conducting user-centered design work over several projects. We gain understanding about the participants' activities through such traditional ethnographic techniques as: on-site observations of ongoing activities, open-ended interviews, mappings of who is doing what and where, exploration of roles and responsibilities, identification of tasks, goals and chains of accountability, and examination of manuals, job descriptions, direc-

tories, division charts and a myriad of other organizationally related documents. We follow and observe people doing their daily activities, what Pat Sacks calls "shadowing,'' [12] and engage with participants in verifying and correcting our evolving descriptions of their activities. We also develop iterative designs and prototypes of technologies using simulations, mockups, scenarios, and "what-if'' sessions [2].

We take "work practices'' to refer to the study of the interplay of artifacts, activities, interactions, organizational context and technologies that people produce and contend with at actual work sites. In the context our work, "codevelopment'' projects are those in which developers and potential users of a new technology work together to develop the technology. Codevelopment requires establishing an ongoing relationship with potential users of the technology under development. We are trying to understand their existing work activities and technology use. As early versions of the technology become available (in the form of sketches, models and prototypes), the focus of our interaction expands to include the observation of user interactions with developers and the technology. Many perceptions about the requirements need to be refined and changed during the course of a project.

The evolving understanding of requirements necessitates a considerable investment in interviewing and observing users at work, involving members of the product development team in the interactions, and putting user information into sharable forms. Valuable outcomes of such an investment include: descriptions of users' current work practices, user-based definitions of technology requirements, development team comprehension of the users' perspectives, technology impact evaluations, innovative solutions and insights for future product directions.

Although we usually work with only a few sites at a time, the technologies being developed are intended to be used more generally, at a variety of sites. Work practice studies serve as the foundation of a codevelopment effort, but may also be used to explore user work activities even when a particular technology is not involved. The identification of opportunities for new markets based on existing or projected user requirements is one such use.

User-centered work practice investigations can be employed to provide substantive examples of user requirements from user sites. These instances can then be used alone or in conjunction with market research to define and focus the direction of a technology project. Codevelopment methods are especially effective when there are many unknowns about the use and impact of a technology under development.

User-Centered Design: Methodological Orientation

The scope of the efforts to be informed by user-centered and participatory design practices varies widely. We find that we need to be prepared to engage with users operating in very disparate settings. They may be part of a computationally sophisticated modeling organization; they may be storing and retrieving original documents manually from hundreds of filing cabinets. Our goal may range from basic research to the design of a computer system or tool for a particular user community or the construction of an entire line of machines or system applications intended to support work across a range of different environments.

In order to gain an understanding of the users' work, we try to appeal to the very resources upon which the participants draw to achieve their own understanding of their work. These resources include: occupational and organizational knowledge of prescribed—and non-prescribed but still proper—tasks, responsibilities, procedures and the unique ways of referring to them [4]. These evolve distinctly in all communities of practice, be they occupational, educational, recreational, political, etc. Knowledge of many of these aspects can only be gained from experienced coworkers. Further resources include the material artifacts in use, and the situational and interactional context in which the activities of work are conducted.

In any project, a diversity of products, user communities, and perspectives may be conjoined. We have sought to create a tool kit of techniques and methods, rather than a strict set of protocols, which may be drawn upon and configured in different combinations to address different situations [7]. These techniques yield different views of organizational and technical features. From these views, we build a detailed understanding of the organization of work, the intertwining of understanding, action, and artifact, within a particular user group.

We try to gather and refine requirements in a way that will: accurately and adequately reflect users' current needs, lead to system and technology implementations that capitalize on current practices, and maximize the benefits of new innovations. We strive to anticipate the immediate disruptions that changes in technology and procedures engender. We also try to envision how current innovations will interact with projected future technological advances.

Throughout this process, one of our main objectives is to represent users in a way users view as accurate. The term *re-present* characterizes our work, emphasizing our goal to provide a view of a user site that closely aligns with the actual events. In this effort we have found two approaches to be particularly effective. One is the use of videotapes of user sites and activities; the other is the development of ways to graphically represent our observations of the

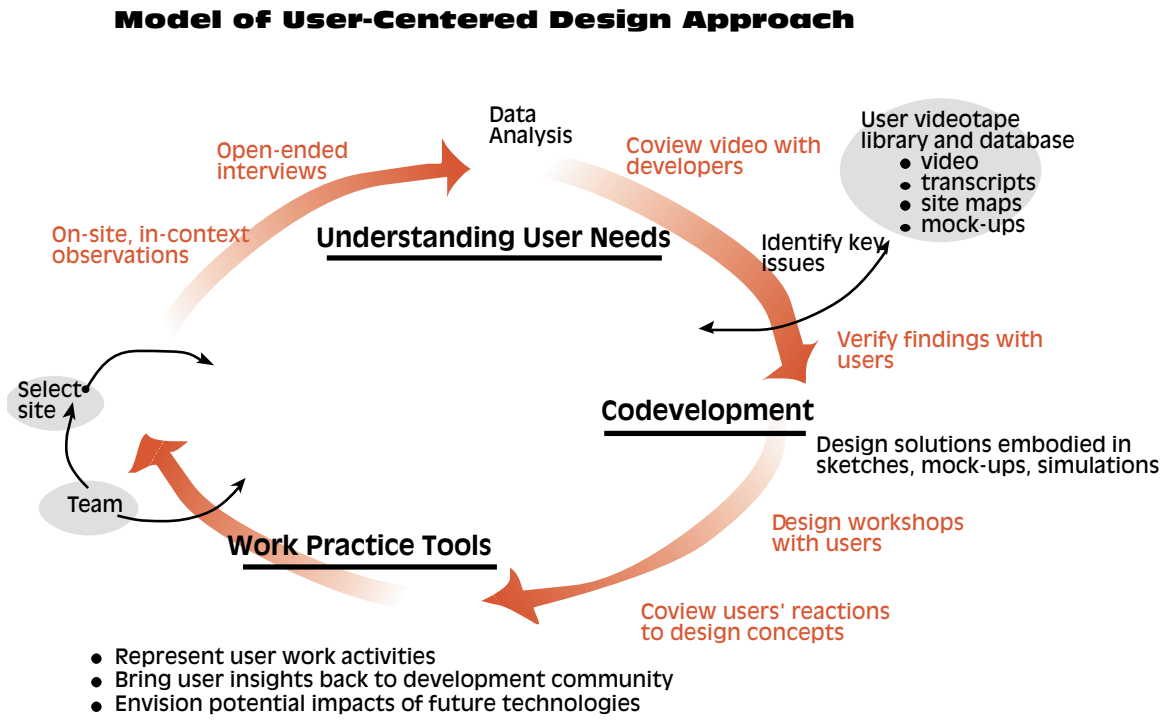


Figure 1. Our model of a user-centered design approach. A project starts with a team and based on project objectives selects appropriate customer sites. Initial focus is on understanding user needs, accomplished through on-site interviews and observations. Codevelopment emphasizes the iterative design of product concepts or prototypes with users. Development of work practice tools facilitates data analysis and communication of findings among developers and study participants. Videotape records of interactions with users and with developers provide a rich set of resources from which to understand user requirements and provide appropriate design solutions to meet those requirements. Steps usually videotaped appear in red text.

users' work. Though we find both approaches to be mutually intertwined, in this article we will focus primarily on aspects of the use of video. (See [16] for a detailed treatment of graphical representations.) Figure 1 illustrates our model for conducting user-centered design projects, highlighting the steps where video is used.

The Role of Video in a User-Centered Design Project

Video is uniquely suited to support a user-centered design methodology. Figure 2 illustrates many of these uses, which are further detailed in this section.

Whenever possible and with the participants' knowledge and consent, we obtain video recordings of people going about their everyday activities as well as our interviews and other interactions (e.g., workshops and "what-if" sessions). One of the most important accomplishments of videotaping is capturing and demonstrating user-relevant methods of addressing, categorizing, and resolving work-related activities [3]. This mitigates against our imposing our own attitudes and expectations on the activities we observe, and enables the users to speak—and be heard—in their own terms using their own naturally occurring categorizations.

Contrary to common expectations, user participants are usually willing to be videotaped. This is especially the case after we explain what the tapes will be used for, and who will see them. Participants generally become even more comfortable with the videotaping when we pay return visits and use video segments or graphical representations to verify that our descriptions accurately convey their own understandings of their work activities. Displaying video materials at the field site is easily accomplished using portable 8mm video equipment. (For example, the Sony Video Walkman is smaller than most shoe boxes and can operate from batteries.) We may show participants video clips to elicit confirmations. Or we may point specifically to features on clips that we do not understand. In our experience, participants generally respond to our solicitations by readily furnishing more detailed accounts about

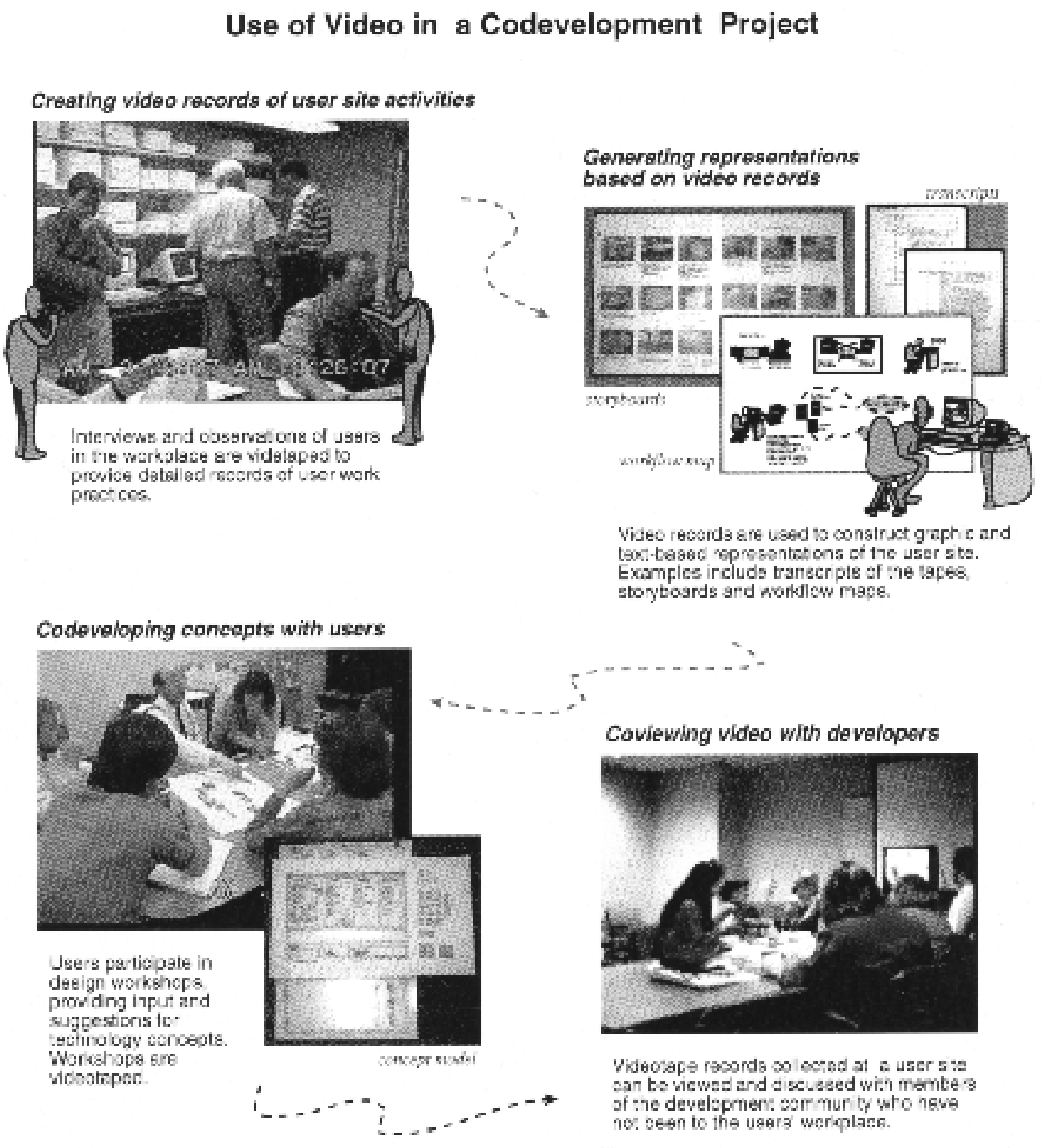


Figure 2. How video is used throughout the course of a codevelopment project. Video is used to create detailed records of user work practices, generate sharable representations of these work practices, codevelop design concepts with users and share recorded interactions at the user site with members of the development community.

activities under examination. They often express pleased surprise that we are intrigued by what seems so commonplace to them.

When we return from site visits we review tapes and create logs of the videos. We write broad textual descriptions of recorded occurrences, and indicate their placement on the tape with time stamps. This makes it easier to locate particular clips. Segments that appear to be particularly relevant, as well as those that are difficult to understand, are more fully transcribed. These transcripts make it easier for viewers to retain details from a rich but fast-moving flow of information. Viewers of these video materials need not be limited to the participant or codevelopment populations. People from a variety of divisions in the organization can benefit from the information the video recordings contain.

Our general understanding of user activities and processes are often achieved only after consideration of the full complement of data we have gathered from interviews, mappings of the artifacts in use at the site, collections of manuals and routinely-used documents, etc. These are often too unwieldy to assemble and display in one place at one time and are impossible to carry around to relevant interested parties dispersed throughout an organization.

An overview that reflects this diversity of features is needed. We are developing graphical representations which identify and highlight critical constituents. In this way, we can use paper documents[1] to show some of the documents, activities and technologies in question as well as some of their temporal, organizational, and functional features. These representations have the advantage of being portable, free of computational platform complications (for the viewers at least) and yet can still evoke a sense of the customer or user site from which the components were originally drawn. The rich details serve as reminders that the source of this information is a real work site, not just a hypothetical construct.

At the same time, the very techniques employed to create such graphical representations are extremely useful in creating lively "envisionments'' and imagined workplace scenarios. We have found that these documents are a useful way to bring our evolving ideas back to users in the field, for them to verify and modify our descriptions and understandings. These representations can be used to display prototypes, and elicit reactions to candidate solutions and innovations, both in the field and within the development community. Instances of such graphical representations can be seen in Figures 2 and Figure 3.

[1]Graphical representations need not be limited to paper documents. In fact, we are developing multimedia, computational-based interactive ones that we find very exciting. For purposes of this article, however, we are limiting our discussion to paper documents.

Codevelopment and Coviewing

Codevelopment involves the collaboration of members of a product development team (software and/or hardware engineering, marketing, planning, etc.) and potential users of the product. It implies the actual construction of a working prototype. In an effort to facilitate codevelopment, we make our field site interactions and observations available to members of the development community.

This is done through coviewing, which consists of reviewing relevant video segments obtained at the user site with others in the development community. The goal is to help the development community gain insights to the users' perspective and work practices. Coviewing sessions often result in the identification of issues and potential technology solutions to these issues.

Building Shared Understandings. We strive to build a shared understanding of the users' viewpoints (about their work practices, the impacts of existing technologies, imagined impacts of future technologies) and to facilitate the analysis and communication of this understanding with developers and users. Our experience suggests that using video documentation provides a unique form of data and is a source of special insights. Video, used in concert with other elements in our tool kit, is a valuable link to users and representations of their work.

All the people who may be interested in fieldwork-derived findings cannot participate in either the performance of the fieldwork or in analysis of data gathered there. Both fieldwork and analysis require special skills and training which may not be within their experience. The techniques used, especially audio- and videotaping, produce a great amount of field data that must be reviewed and studied, which is a time-consuming effort. Also, in order to minimize disruption at the field site, it is not recommended that hordes of people descend upon the user community. Hence, one issue that arises is how can we bring the "field'' home.

Bringing the "field'' home. Coviewings are an extremely productive way to bring findings from the field home and to make them available to others. These findings may have import for people involved throughout the entire production cycle, from the concept stage through development, implementation, marketing, release, sales, installation, and support.

The coviewing process enables a diversity of perspectives (e.g., software engineering, marketing, sales, interface design) to be brought to bear on the materials. Implications of certain features not apparent to the work practice team may be detected by others, and a greater variety of alternative suggestions for remedies or future enhancements may

be generated. Though not all suggestions lead to mutually agreed-upon courses of action, they promote energetic and informative exchanges. They can, moreover, lead to valuable and time-saving early identification of possible sources of misunderstandings among people responsible for various aspects of a product's development.

Capturing and Conveying User-relevant Methods of Addressing, Categorizing and Resolving Work-related Activities. For viewers who have not visited with actual users some of these methods can come as quite a surprise and be quite instructive. A favorite example comes from a session where software engineers were watching an "expert'' user use an automatic feeder to scan pages into a tool designed to produce "on-demand'' printing of custom textbooks. While doing an online preview of the final product before printing, he noticed that one of the pages was upside down. He lifted the entire stack of pages, repositioned the offending page, returned the stack to the feeder and set the tool to rescan the entire stack. When asked by a fieldworker why he chose to do this rather than use a feature of the tool's system which would enable him to correct the error electronically, he said that it took less time to rescan the entire stack than it would to find the page and reposition it from within the system.

One of the coviewing engineers pointed out that fixing the error from within the tool would take less them than it took for the rescanning of the entire stack. And in 'absolute' time this was the case. But the user's sense of time was based on the work he could accomplish within that time period. He said that during the time the stack was being automatically rescanned he was free to perform other activities, but that fixing the problem within the system would absorb all his attention so that he would accomplish less. This sort of unanticipated usage had implications for the amount of paper handling the feeder would have to do, and for the amount of scanning the product would be required to perform, an amount not necessarily tied to the actual number of custom book packets created. There were also implications for the design of the service that allowed users to manipulate images electronically.

Coviewers Bring Different Perspectives to Bear on the Data. When used to augment work practice findings and analysis, coviewing enables us to present to others instances of the data on which we base particular findings or recommendations. Coviewers-viewers often bring a variety of interests and skills that are involved in different aspects, and at different stages, of the design, production, and sale of a technology. They may use the same words in different ways [8]. Coviewing sessions provide them with opportunities to not only look at video data but to have some experience of examining it in the same way we do, to review it, slow it down, evolve implications, and even challenge our conclusions using the same materials we have used.

Video provides a stable reference that can be shared, reviewed and discussed by viewers having different backgrounds. And in certain instances, rather than disagree about what a particular action or event "should'' be called, people can simply point to the relevant portion of tape and say, "There! See that, whatever we call that, a loading problem or a feeder problem, it needs to be fixed.''

We were pleasantly surprised during the course of one study to be approached by members of the training and sales organizations to conduct a workshop on our findings about a new product and its impact on customer sites. Because the product was quite different than previous ones, the members of these organizations were eager to understand as much as possible about the technology in use. Coviewing provides an opportunity for people to inform and alert others to those issues that may have been neglected. It also provides an opportunity to raise questions that have not been addressed, or to offer different interpretations of actions than those drawn by the work practice practitioners. This results in everyone gaining a richer understanding of the activities or issues being explored by viewers using a number of perspectives.

Advantages and Disadvantages of the Use of Video

The use of video has been instrumental in facilitating our understanding of user work practices. Some of the advantages and disadvantages we've realized by incorporating video into our work follow.

Supporting the generation of new product concepts. For the development community video records and analysis enhance the ability to generate new, unanticipated product concepts. The customer benefits from the early identification of new capabilities. The following example from our work with the bookstore of a large university, which was developing a system for producing custom textbooks, illustrates how both product developers and users benefited. (See [1].)

Custom course packs are a growing trend in university settings, where professors will collect several relevant articles and excerpts from books to be used in the classroom either in conjunction with or in place of standard textbooks. Xerox was combining existing technologies (printers, scanners, digital storage devices) with expanded capabilities and applications support. From our work with the bookstore we became aware that the potential market that custom publishing presented extended far beyond the educational custom textbook arena. Developers identified a need and potential solution

Conventional Description of the Sales Bulletin Request Process

1 Sales rep fills request order form, sends to Industrial Manufacturer
2 Dee receives request form
3 Dee lists requested items in inventory/log books
(there are 2 books: one for sales rep's territory, one by item requested)
4 Dee addresses UPS label and shipping notice
5 Dee collects requested materials from storage
6 Shipping notice is filled out, ordered materials left in mail room to be shipped
7 Materials shipped via UPS to sales rep.

Details of Work Practice Revealed by Video

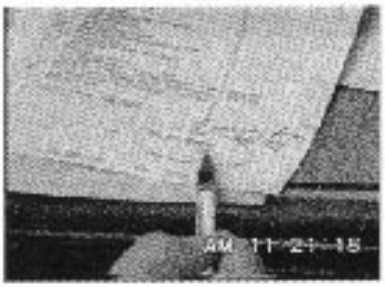
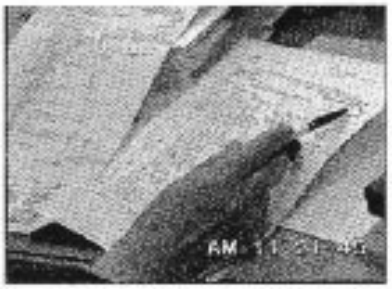
Video clips from field	Participant's description	Viewer's comments
	Here's one supply order form I got in from one of our reps... He's leaving me a note.... other than these things he needs this. Well he doesn't read his literature that we send him because that happens to be an Eden product and its on the Eden list. Okay, so I in turn... I am sending a copy when I send his literature, that this is an Eden product. From the future to get it from Eden. But in the meantime I have faxed this to Eden and asked it to send it to him so that we're not delaying his order for that product.	• Doc receives a request from a sales rep for materials describing products and supplies. • Requests usually come in by mail and fax. Those received by mail come in on blue forms. This particular form has handwritten annotations from the requesting rep. • Relevant for distributed work & multi layered documents. print- fax- copy- write • Articulating meaning of forms, highlighting processes, use of color • One document connects & carries instructions for 3 people. (Redundancy. Past and future history).
	And this product, he didn't see this on the order form. Well he didn't see it on the order form because he's using the old order form. So if he looked at the new order form he'd find it there. So I am telling him this also. In the meantime he will get a copy of this highlighted with the information.	• Date info on rep request document allows diagnostic on reason for problem. • Doc gives remedial instruction. *Circles* 'old date' to point to problem. • Gestures on paper (circles, arrows) possible retrieval method highlighting distinguishing features of different handwritings
	So in the meantime, I will take a copy of this (marked up order)), this is going to the Clearwater rep	• Highlighted 'copy' is going to go to Eden if highlighting function is to be preserved the document will be sent by mail or delivered. • At this point the Company does not have a highlighting copier, nor a color fax. • Document duplication records transactions among three interactants. • Cycle: printed form, handwriting, fax, highlighting, handwriting, copy Then fax & mail

Figure 3. How video helps reveal easily overlooked features of the work. The conventional description of the sales bulletin request process is very straightforward and linear. Based on the review of a small portion of the video, it becomes apparent that the task is much more involved than initially described.

for managing the process of obtaining and tracking copyrights from publishers for the contents of the custom course packs before bookstore staff even became aware of the need. The bookstore management benefited from early identification of services they could provide to previously unanticipated future markets.

Evaluations of existing technologies. We have also previously evaluated existing product effectiveness by recording instances of technologies in use in actual work contexts. Members of our team were involved in a study to look at the work practices of customer sites before and after the installation of a new printing technology. They discovered several mismatches between the engineering model of customer work practices and the actual work practices at the customer sites. Reviewing these materials helped to identify current problems and revealed opportunities for enhancements and upgrades.

Video records not only provide a different level of information about users' work practices and requirements and richer, more detailed data about users' work practices and requirements, but preserve features of the situated context of use, which helps maintain a lively user presence throughout our analysis. Complaints and requests seen and heard directly from users attempting to do some piece of work have much greater authority, far greater effect, and are more difficult to dismiss, than any summary reports fieldworkers produce, no matter how accurate the latter may be.

Use of video recording technology also permits the gathering of data without investigators being present during the taping. We have found that occasionally we can leave videocameras with users so they can continue to provide us with information they think is pertinent. At one site, over a two-day period, cameras were set up for the participants to record events they found interesting about a newly-introduced technology. We discovered that they had left messages for particular members of the development team on the tape. Not only could they describe their concerns, they could show us what they were talking about. They recorded instances of problems occurring during the course of their ongoing work activities and explicitly pointed to examples of things they wished they could do.

Reuse of video data and user sites. Other advantages of video recordings, ones we did not anticipate when we began using videotaping techniques, are the ways the recordings can be reused. Sometimes material on the tapes turns out to be relevant to members of product programs within the corporation who are not otherwise working with, or perhaps not normally even on contact with, one another.

Video data can also be reused by compiling tapes into an archive for future use. For example, in one study we had been primarily interested in the storage, duplication, and upgrading of documents at two sites: an internationally based industrial manufacturer and a national market research firm. Months later, a colleague working in a different division of the corporation was exploring facsimile usage among customers. It turned out that some of the videos from our first site contained material showing faxes in use. We were able to give her examples of fax usage and provide her with material from additional sites other than the ones she had visited.

After viewing the tapes, she decided that the industrial manufacturing and market research sites were suitable for an in-depth fax development project. Because we had maintained a good ongoing relationship with the customer, she was able to step in without having to go through lengthy introductions and mutual trust building. Much time was saved because she had access to information already gathered about technological and organizational features of the companies. She, in turn, shared her findings regarding fax usage at the companies with us and our overall picture was enriched and updated.

We have used different departments within a single site to participate in three different development projects. This greatly reduced the amount of time necessary to find appropriate sites, negotiate a working agreement, and conduct a study. Also, if a site participates in multiple studies, new team members have access to pre-existing materials about the site. In addition to videotapes these resources include written reports, analyses, as well as people who had previous connections with the site and who could elaborate on the materials.

Capturing elusive details. Activities in the field may occur so quickly that observers may miss details and implicit components of the work. It is not always possible to query working participants as often as one might like. Videotaped materials not only allow repeated viewing of recorded activities but can be frozen, allowing their possible implications to be examined in a more thorough manner, and to be reexamined in the light of new information. Video is what Don Norman calls an "experiential'' artifact, one that allows us to experience events as if we were there and get information about things that might otherwise be inaccessible [11].

Videos of customers' real workplaces offer embodied glimpses of actual users, not abstract or idealized constructs. This can make it difficult to discount the displayed details of the intelligence, knowledge, and resources they apply to even the most routine features of their work, which have been so often trivialized, if not completely overlooked. For example: Dee works in an industrial manufacturing site for a company with

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offices worldwide. Among many other things, Dee receives and fills requests from field representatives for brochures listing product items. Figure 3 represents a conventional "work process'' characterization of Dee's work process, in contrast with the complexity of features revealed in a minute of video.

In the moment of activity shown in Figure 3, the seamless but intricate intermixing of artifacts and actions, of paper, pencils, faxes, copiers, of inscribing, gesturing, annotating, and highlighting that are brought to bear on the field representative's order form is vividly displayed. More importantly, clearly in evidence is the diagnostic and remedial work that Dee performs to fill the request in a way that is both timely and informs and instructs all the affected parties of what is happening. The range of resources on which she draws is enormous, from a detailed familiarity with sources of product within the company to exploiting ways in which handwriting styles allows for differentiating writers' identities. That people do these things, and how they do them, might be valuable to know if you wanted to build a tool to support their work.

Disadvantages

Though we are enthusiastic advocates of video recording and analysis, we would be remiss in excluding discussion of at least some of the difficulties or drawbacks of the techniques and methodology in the context of requirements gathering for corporate product development. The following should be addressed when considering the use of video:

- Time requirements and level of detail may be too extensive. For a given purpose, there may not be enough time to permit the use of video, nor may the sort of detailed data it provides be required. Learning what is on the tapes and locating needed segments are time-consuming enterprises. Making logs and transcripts, finding examples and making collections of relevant activities or features, culling bits and pieces from a range of site materials as well as from videotape in order to be able to formulate general understandings and then representing those understandings in ways that render them accessible to others are all extremely time- and labor-intensive activities.
- Need to develop a skill base to conduct field work with users. Though it is not our purpose to provide a "how to'' manual, we have in general found it difficult to describe our data gathering, analysis, and representation techniques. The particular assignment, organization, and participating customer or user site, all affect the ways in which one proceeds. We have noted a tendency to underestimate the skill such work requires. Finding a site, gaining access, asking questions, collecting materials and videotaping, maintaining a productive customer/user relationship with the work team, the testing of in-development technologies and analyzing the received data—this does not appear too difficult outwardly. But this is not the case. There is a growing body of materials, case study reports and workshop proceedings [3, 6, 9, 10, 14]. These must be reviewed and particular techniques extracted for suitable circumstances.

Further Considerations

We have been asked how it is possible from examination of a few sites to generalize findings for a product expected to be used in thousands of different work settings. We agree with Suchman's assessment that it is most important to recognize "the irremediable incompleteness of any designed artifact, in the sense that functionality isn't inherent in the device but relies for its realization on the situated activities of use'' [15].

There are a number of requirements-gathering techniques that claim to provide at least a statistically significant view of substantial populations. The sort of in-depth, detailed study we have been describing provides concrete, empirically verifiable information about one, or a few, real work environments, what Haraway terms a "view from somewhere'' [5]. The two orientations need not be mutually exclusive. Indeed, they may be mutually complementary.

As well, the sites we select—large industrial manufacturers, college bookstores, market research firms, law firms, print shops—do not exist in isolation. They make products, have suppliers and customers with whom they trade, they function within the broader business community. When we engage with a customer we are necessarily exposed to features of their interaction with the outside world, from regulatory agencies to telecommunications mechanisms, from our customers' suppliers to our customers' customers. Though at any given time we may be embedded in one site we are interwoven in the web of its interrelationships. Each study adds to our understanding of the collective.

What Do Customers Have to Gain?

Agreeing to participate in a work practice or codevelopment project includes a considerable invest-

ment on the part of participants in terms of time and resources. A work practice study may involve two or three site visits a week, sometimes over the course of two to six months. A codevelopment activity requires the same amount of time at the onset of a project, and often several days of interaction with the participants as early versions of a technology are introduced to the site. Codevelopment projects may range from six months to a few years. What can customers expect from such an investment? Since we do not always guarantee that a viable technology will be available at the end of a codevelopment activity, it is important to ensure that customer expectations are realistic.

Representations serve as documentation the participants can use for their own purposes. For example, users and their management have used representations to display their work to others in their workplace. In one case, we characterized some unique skills and working styles within a group that was about to merge with another department. The characterizations were used in the merger discussions so that the teamwork and work practices exhibited by the group would be preserved after the merger. In some situations, our representations of the workplace provide a voice to workers who, though they may be experts at the work they do, may not be very articulate about it. Representations of work make explicit some aspects of work that may have become transparent to the workers and their management.

Matching user requirements with existing technologies. If during the course of a study, user needs can be matched with existing technology offerings, availability of appropriate technologies can be discussed with the study participants. In some instances, we have uncovered a need for a technology that is already available. In these cases, we may be able to put the site in touch with appropriate account representatives.

Balancing the inconveniences of a new technology with its potential benefits. As with all technology development efforts, early releases and prototypes represent the opportunity for developers to incorporate necessary modifications and improvements. In anticipation of potential improvements to current work practice issues, eager users have to survive and rise above the challenges the emerging technology brings with it. During one codevelopment project, the users participating in the study referred to the codevelopment experience as living on the "bleeding edge'' of technology. They were eager to incorporate the capability the technology would bring them, but surviving the transition to incorporate it into their workplace took substantial effort.

Envisioning future opportunities and markets. As users' requirements are accommodated by emerging technology, its users begin to experience the improvements in their current work. They often come to another level of awareness about their role in their areas of expertise and what the requirements for new technologies would be to support that role. In one example, users at a site began projecting new market opportunities for their services (custom publishing) and new features they would need from their technologies to support their work.

Conclusion

We have described some of the substantial contributions work practice methods and techniques can provide toward understanding user requirements, involving users in the development and iteration of innovative technologies and sharing understandings gained about requirements and their implications for product development. Of the available tools in our tool kit, we think video excels in presenting users' activities, their work environment, and concerns. In conjunction with graphical representations, video-based data-gathering techniques enable participants to observe materials on which understandings about them are being based and provide feedback on those understandings.

Coviewings are an effective technique for "bringing the 'field' home" and reviewing materials in such a way that multiple perspectives can be shared over time and across diverse communities involved in the creation of technologies. As an unanticipated bonus we find that we can express our appreciation to user participants for their involvement by providing them with videos and representations of their work that they can use for their own purposes. This reciprocity helps secure mutually satisfying long-term relationships with users at customer sites.

Acknowledgments.
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