Reflections on a Work-Oriented Design Project[*]

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ABSTRACT

This paper reports our experiences in developing a work-oriented design practice. We sketch our general approach to relating work practice studies and design, including our use of case-based prototypes to bridge between the worlds of professional design and the settings in which new technologies will be used. We go on to describe our entry into the work site that was the setting for this project, our encounters with members of the site and with their work, and the development of our design agenda. Along the way we discuss the difficulties of maintaining alignment, the limits of research prototypes, and the politics of representing work practices.

KEYWORDS: work practice studies, case-based prototypes, politics of design.

INTRODUCTION

For some years we have been engaged in research aimed at developing new ways to conceptualize and structure relations between work and technology design. Our efforts have roots in an international network of colleagues in academia and industry. Within our own organization we have developed, through specific relationships and collaborations, into a small, distributed community made up of anthropologists, computer scientists, engineers and product designers. Our current project in work-oriented design was organized at the outset as a collaboration between researchers and product developers. It involved an emergent suite of technologies aimed at bridging between paper and electronic documents, including new approaches to search over electronic documents and machine analysis of marks on paper. A starting premise for the project was that looking in detail at how people work using existing and prototype technologies provides a basis for innovative design and better integrated technologies. A second premise was that individual technologies "add value" only to the extent that they play together in effective combinations, and

that to delineate the space of effective combinations requires applications development within actual end-user environments. On these premises, our research strategy has been to establish relations with specific work settings and to use those as sites for cooperative applications design.

Prevailing models for how studies of work might inform system design involve, at one extreme, handing off the results of field studies of work to design organizations, leaving the task of deriving design implications to the designers and developers, and at the other extreme, using the work site to "test" or evaluate completed designs that are not themselves informed by studies of work. In contrast, the approach to relating work practice studies and design that we have explored in this project involves cycling among studies of work, co-design, and user experience with mock-ups or prototypes of new technologies. We have viewed our work practice studies as embedded within the design activities and our design efforts as contributing to the work analyses.

We have chosen to focus on a single work site and, within that site, to look closely at specific work activities. This choice was motivated by two considerations: our desire to obtain detailed, in-depth views of specific work practices as opposed to more superficial accounts of a wider range of activities, and our commitment to work closely with work site participants. While generalizing beyond our specific case is constrained by these objectives, we believe that some of our findings do apply to other activities and settings. Where warranted, therefore, we point to the more general implications of our work.

In what follows we begin with a sketch of our approach to representing work practices and to cooperative development of prototype applications. We then briefly describe the work site in which our project was located, and the rationale for taking up two design efforts within the site. The remainder of the paper discusses those two efforts, highlighting issues that arose for us in each. These issues include difficulties of maintaining our alignment with the work of others, both within our own organization and in the project site; problems of system integration arising from the use of research prototypes; and encounters with the politics of work and technology development.

REPRESENTATIONS AND PROTOTYPES

A challenge for us in attempting to create a work-oriented design practice is to develop innovative ways of making the insights we gain from work practice studies available to

design.[1] During the course of this project, interested developers accompanied us to the work site and joined in discussions about work practices and about possible technology interventions. However, because not all developers were able to have such first-hand experience of the site, we explored other means of bringing what we learned about the work to the development effort. As part of our own work in the site, we recorded our interviews with members of the organization, instances of their everyday work, and meetings we convened or at which we were present. The full set of materials we accumulated (e.g. documents, field notes and video records) were a resource in our ongoing communications with developers. For example, we used customized video collections in short presentations to fellow researchers and as a resource in meetings with developers.

Along with our efforts to represent existing forms of work practice at the site, we were interested in exploring the use of *case-based prototypes* as a way of reflecting visions of future work practices, augmented with new technologies. While prototypes have long been used as stand-ins for designs-in-progress, they are often employed in structured meetings in which users perform tasks contrived to test particular parts of the system (Gould 1988). In this project we employed prototypes in a different way, more akin to what Bødker and Grønbæk call *cooperative prototyping*.[2] Prototypes were used not (only) as proxies for future products, but as triggers for discussion and mutual learning.[3] Furthermore, we were able to make certain changes to the prototypes in direct response to user feedback during the prototyping session. In this way, our prototypes were co-constructed artifacts that depended in part on participation from work practitioners. We use the term *case-based* to underscore the ways in which our prototypes addressed the work of particular practitioners and reflected our understandings of their work. As with all prototypes, ours constituted partial implementations of envisioned technologies and their interfaces. In addition, they incorporated a significant body of material from the work site (e.g. documents, forms, organizing structures).

THE WORK SITE
We selected a large law firm as the site for this project, motivated in part by the forms of work that we expected to find there and in part by the apparent likelihood of a fit between the work and the technologies that we were interested in developing.[4] Legal practice involves extremely document-intensive forms of work, in environments in the midst of transition from paper-based to increasingly electronic media. Both of these characteristics seemed relevant to our interests.

Our entry into the law firm was through the firm's Director of Technology, who in turn introduced us to the attorneys who sat on the firm's technology advisory committee. Our initial discussions concerning the scope of our project and our early interviews and observations were with members of this committee. Through them we learned that the firm provides its clients with two forms of legal services: corporate law and litigation. These two forms comprise distinct organizations within the firm and involve significantly different document-related work practices. Put simply, the work of corporate law centers on the creation of documents, based in large part on the re-use of existing documents, many of which were generated in-house. Litigation, in contrast, involves locating and accessing crucial documents from out of a very large corpus generated outside of the firm, within the client's organization, and available only in paper form.

Our initial interest in exploring advanced applications for a suite of image processing technologies led us first to focus on the litigation side of the firm's practice, specifically on the work of creating electronic indices to the paper documents used in litigating large cases. Later we turned our attention to the practices of document re-use on the corporate side of the firm, in response to a decision by the developers within our company to include text database retrieval technologies in their next product. We speculated that those technologies could support the identification and retrieval of relevant documents from electronic files. In the end we focussed our work practice studies on both the practice of document retrieval and re-use in corporate law and the database production activity in litigation, exploring the possible applications of text database retrieval and image processing technologies respectively.

CORPORATE LAW
AND THE ELECTRONIC FORM FILE
Through interviewing and observation of the work of two attorneys on the corporate side of the firm we explored the relation between document retrieval and re-use activities, and the text database technologies under development by our company. On several occasions these attorneys expressed to us a central tenet of their practice that effectively states, "If at all possible, avoid drafting anything from scratch." That is, if a "model" or boiler plate document (often referred to as a form document), can be located that is, for example,

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[1]For further discussion of the relations between ethnographic studies of work practice and design see for example Blomberg et al (1993), Blomberg (in press), Forsythe (1992), Hughes et al (1992), Jordan (in press), Simonsen and Kensing (1994), and Shapiro (1994).

[2]For descriptions of the approach and experiences using it, see Bødker & Grønbæk (1991), Grønbæk (1991). For overviews of participatory design, see Muller and Kuhn (1993) and Schuler and Namioka (1993).

[3]For discussions of how case-based prototypes can trigger or "provoke" discussions in work settings, see Trigg et al (1991), Mogensen & Trigg (1992), and Mogensen (1992).

[4]Note that this differs from some early participatory design projects where the system developers / consultants had fewer *a priori* commitments to specific technologies, and could be more freely responsive to the needs of workers. One example was the Utopia project (Kyng 1991) which developed computer systems in cooperation with graphic workers at a Swedish newspaper. For a description of the relations between the project and technology vendors, see Bødker et al (1985).

a buy-sell agreement or a venture capital loan agreement, it should be used as a starting point for the creation of the new document. At times the form document requires only minor modifications, perhaps only the date or names are changed. In other cases the form document provides "language" for a new document that is otherwise unlike the form document. A third possibility is that the form document provides information to help guide composition of a new document.

In response to the challenge of locating relevant form or model documents, attorneys at the firm employ a variety of strategies. These often include retaining documents from previous transactions that might prove useful in the future and "wandering the halls" asking other attorneys if they have ever drafted a particular type of document or one with specific provisions. Attorneys differ in how systematic and diligent they are in keeping and organizing their form documents. Some attorneys are known to others for their dedication to maintaining their form file. They and their form files become resources to others in the firm who do not keep such extensive sets of files themselves. We worked closely with one attorney, M, who keeps a four-drawer lateral file cabinet containing hundreds of documents organized by topic in alphabetically arranged file folders. Another attorney with whom we worked, H, keeps a more ad hoc, distributed (throughout his office, on the floor, desk and in file cabinets) "form file" that while useful for his own work, is less of a resource for others.

The utility of M's file for other attorneys depends on his knowledge of its content and organization, derived in turn from his creation, maintenance, and regular use of the file. Other attorneys rely on M to help determine whether the form file contains documents relevant to the transaction on which they are working, to point them to likely places in the file where relevant documents might be found, and to justify the choice of particular documents (e.g. "This agreement is good for the protection it affords the lender"). During discussions with M about the document for which they are looking, junior attorneys can also learn about other issues relevant to the transaction. M views the effort he expends in maintaining the form file as worthwhile because it provides him with a suitable collection of model documents to work from (reducing the number of times he needs to compose a new document from scratch) and because his overall value to the firm is enhanced by maintaining the form file for use by other attorneys.

Defining and developing a prototype

Our application development effort on the corporate side of the firm was informed by our general understanding of the centrality of document re-use in the practice of corporate law, while being focused specifically on supporting the maintenance and use of M's form file. Our decision to work with M was based on the highly developed organization and use of his form file, his willingness to allow us access to a subset of the documents (for scanning), and his interest in working with us. H continued to contribute to the application design effort by reflecting on the overall value of making form documents available electronically and by evaluating the usefulness of particular design features.

We worked with M to develop an application incorporating text database retrieval technologies and supporting his document retrieval and re-use work. We were interested in understanding better M's current use of his paper form file. We asked him to describe the organization of the documents in his form file and we observed a few occasions when he referred to the file either to assist in document composition or in response to requests from colleagues. However, because his use of the form file was occasional and unpredictable, we decided to leave a video camera in M's office so that he could record his use of the file. We asked him to record himself when using the file either for his own purposes or in response to colleagues' requests.

Informed by these observations and in collaboration with M, we decided to build a prototype that would give M electronic access to a sizable fraction of the documents in his form file. We began by borrowing, copying and quickly returning approximately a quarter of the documents (a total of 862) in the cabinet. Over the next month, we scanned the documents doing optical character recognition (OCR) whenever possible. By scanning and OCRing the documents ourselves we allowed our design effort to focus on issues of searching and browsing the corpus rather than the problems of inputting new documents.

A reliable product platform on which we could build our application did not become available in the course of our project due to organizational and technical problems that emerged in the development organizations with which we worked. Instead, we made use of a research platform being developed at Xerox PARC to support "retrieval-centric" applications (Rao et al, 1994). This research platform provided an interface to text database technologies and supported browsing of document page images.

The prototype we created was based on this platform, reflected particular aspects of M's work practice, and included the images and text from his document corpus (Figure 1). We left the prototype in his office for over two weeks, again requesting that he record himself using the prototype or discussing and demonstrating it for visitors (Figure 2). In addition to providing us with a record of his attempts to use the prototype as occasions arose, we unexpectedly found that the camera became a communication channel from M to us during the time the prototype was in his office. M's comments to the camera included requests for new features, complaints about the speed of the system, general observations as to its utility, and a few humorous asides. For some of M's requests and complaints, we were able to respond with "patches" to the prototype and new documentation intended to clear up possible confusion.
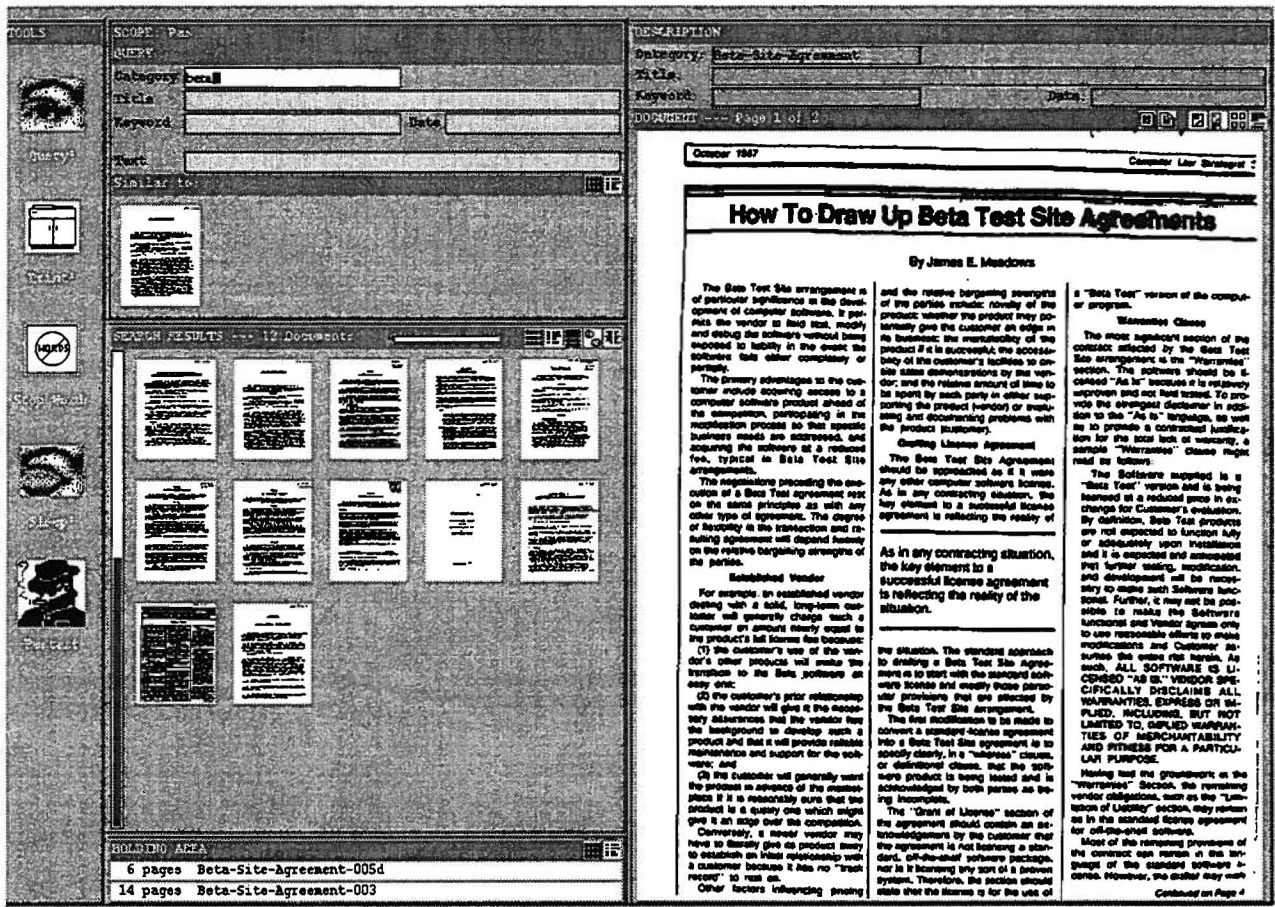
Figure 1: Electronic file cabinet prototype: The left side of the window contains reduced "thumbnail" images of the documents returned from a search. The right side shows a "full size" image of one of a chosen document's pages. Other options include displaying the OCR'd text for a document and laying out intermediate-size images of its pages. See (Rao et al, 1994) for a full description of the prototype.

Bringing the case to developers

On several occasions, we used a variety of project materials (including video recordings of work at the firm) in discussions with product developers who did not visit the site. For example, we met with programmers and quality assurance engineers charged with developing a product aimed at work activities similar to those we encountered at the firm. The meeting consisted of a series of topical discussions, each triggered by a short video segment from our collection. Our initial suggestions of technical questions raised by each segment were followed by free-ranging discussions of relevant implementation issues. During the discussions, we answered questions and volunteered information about the setting and our understanding of the attorneys' work practices. As a result of these discussions, several features were added or modified on the developers' "to do" list for the current product plan.

In this meeting we showed a video clip of H critiquing the words used to classify search clusters. The prototype we built for M incorporated a wide range of advanced retrieval algorithms. Many of these algorithms rely on what is called a "stop-word list" to eliminate certain common words from the text before building indices. Normally the stop-word list is taken to be standard across applications (assuming only that the text is in English). In our discussions with M and H, however, we found that additional stop words were required; words like "corporation" and "agreement" are as non-distinguishing at the law firm as "and" and "the." It was immediately apparent to the developers (as it had also been to us) that the attorneys would need the ability to edit their own stop word lists. In discussing the problem of re-indexing the corpus when stop words change, a developer made the concrete proposal for their document management product that stop word lists should be assigned on a per-corpus basis. This requirement came from seeing the need for customizability and from recognizing that stop word lists might not be identical for all attorneys in the firm.

Another design topic that came up involved the role of on-screen page images in search and browsing. The software platform on which our prototype is built combines document page images with OCR'd text. Support for corpus-
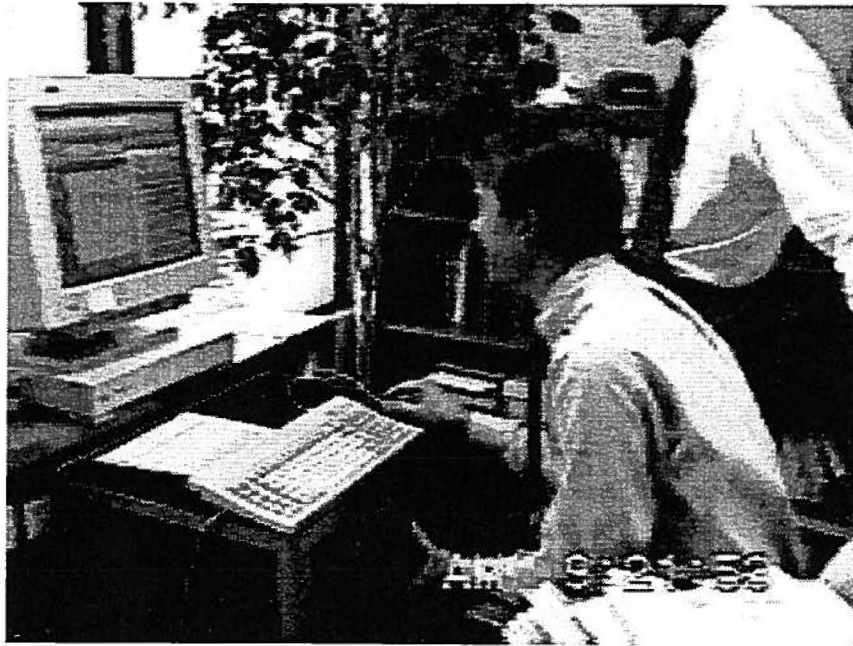
Figure 2: M using/demoing the prototype with a visitor.

wide searches is based on the text, while browsing through smaller collections of documents and document pages is facilitated using reduced page images arrayed on the screen. Our discussions of this topic with the developers revolved around several video clips showing M searching for documents, browsing using small scale "thumbnail" reductions of the documents' first pages, and browsing within the document using intermediate-sized page images laid out in rows and columns. We noted the attorneys' ability to identify quickly the genre or style of a document (e.g. memo, letterhead, financial statement, etc.) from a vastly reduced image of its first page and their need for quick access to larger images of specific document pages. We also pointed out that attorneys found intermediate image sizes useful for browsing quickly through the pages of single documents and for jumping to larger images of particular pages.[5] In viewing these video clips the developers were interested in the degree to which M and H relied on cues about the form and structure of the document. These cues could be gleaned from reduced page images, but were lost in ascii text renderings. Also of particular interest to them (but not originally to us) was the precise point at which M shifted from refining a search by, say, adding new keywords, to using what one of the developers called "pictorial browsing," that is, browsing using scaled page images.

Problems of integrating the prototype

Because we based our prototype on a research platform rather than on an early version of a product, we experienced two problems of integration. First, we were left with the question of how to integrate what we were learning into the product development process. Second, the UNIX workstation on which the research platform was built was incompatible with the PC-based computing environment at the law firm. This meant that we could not investigate areas of potential interest. These included inputting new documents into the system (by scanning or online production), reuse of text taken from documents found in the corpus, and sharing the form file with M's colleagues. The developers with whom we worked asked, for example, about "access rights" for documents in an electronic form file; that is, under what conditions would M's colleagues independently be allowed to look for, read and modify the contents of his form file? Based on our fieldwork, we could offer observations on M's and his colleagues' current use of the file.[6] But because our prototype was electronically isolated from the firm's computing environment, we were unable to explore fully the security issues that would arise for a networked form file.

Partially as a way of addressing the integration shortcomings of our prototype, we began discussions with

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[5]In the last version of our prototype, four page image reduction sizes were supported, all of which M used and appreciated. For more on changes made to the prototype based on M's use of an early version, see Rao et al (1994).

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[6]For example, we have discussed whether some of the value of the file to others might be lost if M is no longer the sole "interface" to the corpus. It may be that the form file is valuable because of M's involvement in its creation and use. As one of the attorneys remarked to M about our prototype application, "Oh man, I love it! I need one of these babies. But I need it with your files in it."

a product program developing a document management product which was PC-based and which could incorporate online documents created using the firm's favorite word processing software. We hoped that the document corpus we had created for M could be integrated into the pre-release version of this product and used in a new round of "alpha testing" with M. This time, the platform and interface would fit better into the law firm's computer environment, even if certain features from our original prototype were lacking. Both M and the developers liked the idea and all agreed on the importance of incorporating documents from M's own corpus. Unfortunately, the pressures to meet product development deadlines meant that the resources needed to port the corpus (i.e. to build a customized alpha version of the product) were unavailable.

Having concentrated for some years on strategies for documenting work practices and co-developing applications, our aim in this project was to bring our efforts more directly in line with product design and development within our organization. While the electronic form file application extended our understanding of work and our concrete experience of cooperative prototyping, the alignment with product development proved even more difficult than we had anticipated (Poltrock & Grudin, 1994). Delays in early product development meant that our commitment to the work site to develop a prototype in a timely way could not be met without recourse to an alternative research platform. As a consequence, we found ourselves limited in the possibilities for integration with the existing technology environment and work practices of the law firm. Later on, product schedules precluded the development organization from working with us to provide M with an early version of a product that incorporated many of the same search capabilities as the electronic file cabinet application. All this meant that we had to resort again to more indirect strategies for relating our research findings to product development.

THE WORK OF LITIGATION

Litigation work within the firm comprises defense of corporate clients against suits brought by other corporations or by shareholders. The material grounds for these disputes take the form of documents, in some cases numbering in the hundreds of thousands, gathered from the client's files. Every case includes a legally binding process known as "document production" in which documents taken by the firm from the client's files are turned over to the opposing side. This same corpus provides the basis for the firm's preparation of its own case.

No generalized account of the process of document production can adequately represent the overwhelming logistical requirements of actually managing a large document corpus, in relation to the multiplicity of actors involved and the unfolding interests of the case at hand. How documents are taken from client files, photocopied and returned, searched and indexed, in what order, and by whom is only partly rationalizable, due to these practical exigencies. Ideally, however, document production begins with the assignment of a unique identification number to

each page of every document, followed by a rapid sort of the entire document corpus into those documents that are "responsive" to the case – that is, that must be turned over to the opposing side – and those that are not. This sorting is done by "junior" attorneys, relatively new both to the practice and to the firm. The set of responsive documents is then "computerized." This does not mean that all documents are transformed into electronic media, but rather that an online index is created to the paper documents. Creation of this database, done by workers in "litigation support," involves coding each document by representing its type and aspects of its content in a standardized format. That information is entered into a database, and the database can then be queried according to various criteria of interest to attorneys. The results of queries, typically done by paralegals, are presented in a report which is used as a pointer for retrieval of the paper documents.

Litigation Support

Having developed an initial sense for the document-related work practices of paralegals and attorneys, we decided to look directly at the work of coding documents and creating the database index. From what we had heard, we had reason to believe that the relations of paper and electronically-based media involved in this practice were particularly well-suited to our design agenda. Through inquiries, we located the firm's litigation support operation. There we found a former paralegal, with extensive experience in the maintenance and use of computerized databases, supervising an office of temporary workers, many with bachelors degrees. These "document analysts," as their supervisor called them, were engaged in carefully examining and representing the thousands of documents for a given case with the goal, vigorously instilled by their supervisor, of creating a valid and useful database.

At the time we began to look at the work of litigation support, coders were recording information about each document on a form, which was then handed to co-workers who entered the information into the database (Figure 3). It became clear to us that representing the documents involved coders in an interweaving of tedious activity with mindful judgment. What interested us was the possibility of embedding bits of automation into the coding practice in a way that would relieve the tedium, while maintaining interactive control required for the exercise of necessary judgments. The image processing technologies that we were interested in exploring supported machine "interpretation" of certain classes of marks on paper, for example, constrained handprinted characters, checked boxes, and circled text. We decided to work with the supervisor of litigation support and her staff to mock-up a redesigned document coding practice, incorporating some of our technologies. Our aim was to develop a design that combined automatic recognition of document codings where possible, with an interface that provided image views of documents and editable text fields to support the coders'

Figure 3: A document coder at work.

review, correction and enhancement of entries into the database (Figure 4).[7]

Maintaining alignment between our design efforts and the work practices of litigation support during this time was a significant challenge for us. The litigation support staff were continually experimenting with alternative strategies for coding documents. One lesson we (re)learned was the degree to which workers themselves are engaged in reflecting on and redesigning their own practice.[8] Our design proposals had to stay attuned to these ongoing changes in work practices.

The politics of invisible work

The place of the "routine/knowledge work" distinction in divisions of labor and its implications for technology development came to life for us in our work with the law firm. A powerful construct in the representation of divisions of labor within organizations is the distinction between so-called "routine" and "knowledge" work. The standard organizational icon of the pyramid, for example, is stratified according to the attribution of progressively more knowledge as one moves from bottom to top. The bottom layers on this view are made up of relatively large numbers of workers with relatively few skills, engaged in appropriately routine tasks. The top layers comprise smaller numbers of workers with greater knowledge and

skills, engaged in correspondingly more "knowledge-intensive" forms of work. With respect to technology development this image argues that efforts to replace labor by capital investment should begin with displacement of routine work by automation or outsourcing. As this logic is brought to bear on increasingly more powerful organizational actors, more effective forms of resistance appear. Technology is reconstructed from a replacement for one's labor to one's "intelligent assistant."

In the case of the work of litigation support, we were presented with two very different views of the work. On the one hand, our initial contact with the firm was through a senior attorney who described the process of document coding as made up of two types; what he termed "subjective," or issues coding, done by attorneys, and "objective" coding which he described as follows:

> You have, you know, 300 cartons of documents and you tear through them and say, I'm going to put post-its on the ones we have to turn over [to the other side.] And then, ideally, you hire chimpanzees to type in *From, To, Date*. And then, ideally, you then have lawyers go through it again and read each document, with their brain turned on.

This characterization was repeated on several occasions in which the attorney recapitulated for us how the document production process is organized. At the same time, at no point during the period in which we talked with and recorded the work of attorneys did we encounter the work of objective coding directly. That work was, literally as well as figuratively, invisible from the attorneys' point of view. On the other hand, once we began to observe and engage

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[7] For more on the work of document coding and our design proposal see Suchman (1994).

[8] Andrew Clement among others has argued eloquently for the place of worker's active and *independent* involvement in work and technology design (Clement, 1994).
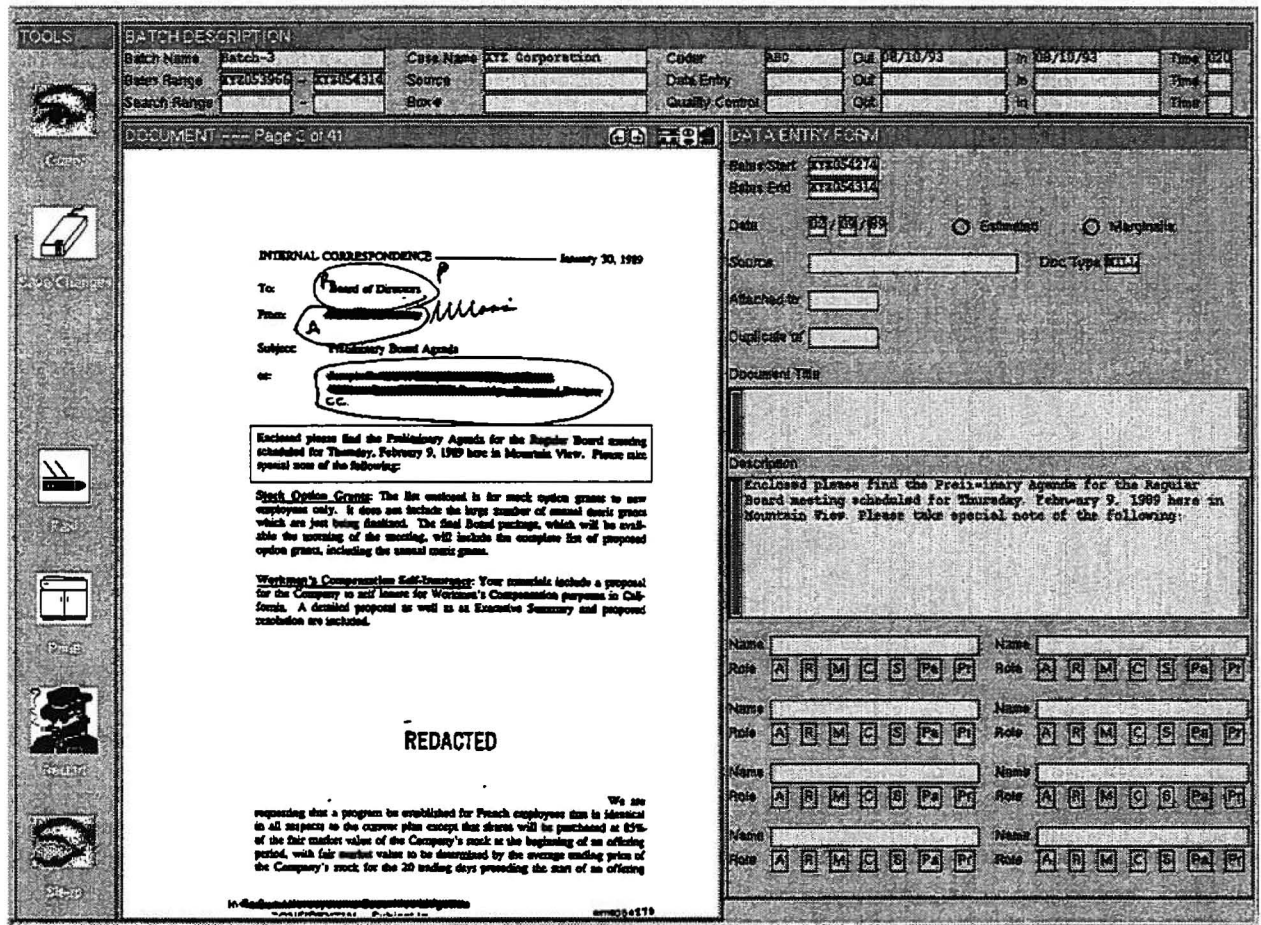
Figure 4: Prototype for document coding and data entry: The left side of the window shows a document page image. The document analyst has circled and labeled various names of interest on the original hardcopy. The right side shows an electronic data entry "form" some of whose fields have automatically been filled in. A region containing text has been specified in the page image, automatically OCR'd, and pasted into the Description field in the data entry form.

with the work of litigation support, the supervisor of that operation expressed to us her belief that, given the coders' familiarity with the document corpus, they could be responsible for certain other aspects of the document production process, now handled by junior attorneys (for example, the assignment of "subjective" codes). She also expressed her view that the attorneys underutilized the database, due to their ignorance of its capabilities and how to exploit them.

We found ourselves, in other words, in the midst of a contest over conflicting characterizations of the work of "subjective" and "objective" document coding and its requirements. Our observations of the work of the attorneys revealed no small measure of mundane or tedious activities, which when brought into the attorneys' awareness were accepted by them, albeit ruefully, as inevitable accompaniments of their practice. At the same time, the more we looked into the work of document coding

and data entry the more we saw the judgmental and interpretive work that the document coders were required to bring to it. Given our knowledge of previous studies, these observations came as no surprise.[9] Nonetheless, in contrast with the simple characterization provided by the senior attorney, the interpretive demands of something as basic as, for example, finding the "documents" in a box of papers were remarkable. That is to say, document coders

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[9] We are thinking here of previous studies that have revealed, on the one hand, the mundane activity required for the accomplishment of what has come to be called knowledge work, in particular in recent studies of science and technology e.g. Bijker et al (1987), Collins (1985), Fujimura (1987), Knorr-Cetina et al (1983), Lynch and Woolgar (1990), Lynch (1993) and on the other hand, the judgement and reasoning required for the accomplishment of so-called routine work, e.g. Garfinkel (1967), Goodwin and Goodwin (in press), Orr (1990), Suchman (1983), Whalen (1993), and Zimmerman (1969).

were presented with boxes containing hundreds of pieces of paper and asked to establish document boundaries within them.[10] While some pages might be attached together with a paper clip, the coders knew that they could not rely on those physical markers alone; they needed to make sufficient sense of each page so as to assess its association with or independence from those that came before and after. Similarly, deciding on the date of a particular document might involve choosing, given an agreement that was written on one day, signed on another, and faxed on a third, which of those dates would be most useful to an attorney engaged in a search for documents relevant to a particular issue in the case. And so forth.

After working for some time on the design of a litigation support application, we coincidentally received a call from the firm's Director of Technology inquiring as to the progress of our project. On hearing that, among other things, we were developing a proposal with respect to document coding, he responded that we should know that, in the interest of cost-cutting, the senior management of the firm was seriously considering closing down the in-house coding operation altogether and shipping the documents for coding to the Philippines. He explained that the quality of the data, shipped back to the firm on some medium from which it could be downloaded directly into their database, would be "guaranteed," though he did not elaborate on how. He concluded by commenting that the supervisor of litigation support did not yet know the extent of this plan, and that he would appreciate it if we would not tell her.

This conversation placed us in an obvious dilemma, which we attempted to resolve in the following way. We arranged with the Director of Technology to provide him and whomever else he felt was appropriate with an update on our work, including our observations and proposals regarding document coding. We then called the supervisor of litigation support and explained to her, without mentioning the off-shore proposal, that we were planning a progress report for the Director of Technology and others, and that we would like to review with her what we planned to say to be sure that we were not misrepresenting her operation in any way, and to see whether she might have anything to add. In that way we attempted to speak at least in part on her behalf. The Director and a litigation attorney listened to our presentation and, we hope, were at least somewhat influenced by it.

In the meantime, the supervisor of litigation support and her staff have been moving proactively to respond to what they recognize as the potential challenges to their continued operation. First, they have taken their own initiatives to increase the productivity and lower the cost of their services, specifically by coding documents directly into the database rather than in two separate passes for document

coding (on forms) and data entry (from forms into the database), as they had been doing when we arrived. At the same time, they have managed successfully to counter claims by outside sources to be able to do accurate database creation at a significantly cheaper rate. For the moment, their place within the firm seems secure.

Our representations of the work of litigation at the firm involved reconceptualizing the work from activities divided clearly into two types – knowledge and routine – to different orders of practical reasoning and action. The implications of the invisibility of practical reasoning and action are different for differently positioned organization members. For those whose work has been mythologized, making the actual work visible implies a process of demystification. For those whose work has been trivialized, in contrast, making the work visible is about recognizing and acknowledging the skills that are actually involved in doing it. Rather than premising our design proposals on a distinction between mindless labor and knowledge work, we attempted to show that routine activities and the exercise of judgment co-exist at all levels of the organizational hierarchy. While the conditions of our own working practice meant that our design efforts at the firm ended with a research prototype, we hope to have contributed to the standing of litigation support at least by seeing their work and acknowledging what we saw, both in our representations of it and our designing for it.

CONCLUSION

At the time of this writing, our work at the law firm is drawing to a close. However, we are just beginning what will likely be an extended process of communicating what we have learned in the project to other researchers and to product developers. Rather than "delivering" the results of our studies and prototypes to developers, we are committed to find ways to engage them directly in exploring with us the relevance of our work to their ongoing deliberations. Until now, the project has focussed on the relation of our work practice analyses to the design of early research prototypes. It remains to be seen what processes, representations, and artifacts can support our continuing effort to connect our work to product development.

By relating work practices and technologies-in-use, work-oriented design exposes and confronts levels of complexity inherent in attempts to transform work and develop useful new technologies. This project has convinced us of the difficulties of relating research, development and sites of use, of the intimate relationship between representations of work and the design of new technologies, and of the politicized nature of both. It is our view that addressing these difficulties early and throughout the design process, rather than leaving them to emerge during system integration, could result in technologies that contribute to more productive and humane workplaces. Implicit in this agenda, however, is a changed practice for social scientist and designer alike.

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[10] This because "documents," not pages, needed to be entered into the database. A document is entered as a range of page ID numbers; e.g., a given memo might be coded as XYZ000134 through XYZ000138.

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