Int. J. Engng Ed. Vol. 19, No. 1, pp. 9–15, 2003
Printed in Great Britain.

0949-149X/91 $3.00+0.00

Designing Experience*

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This paper describes the emerging field of 'experience design' and offers an approach to critical examination of engineering design in an effort to improve the experience of both users and those who design for them. Design is described as comprised of three 'threads' (social, symbolic, and material) that can be teased apart for design analysis, opening up assumptions embedded within design practice. The paper suggests how engineering as a profession, and engineers as responsible designers, can develop not only traditional technical skills, but also the critical inquiry skills to improve the experience of design.

INTRODUCTION

AT THE 1999 Mudd Design Workshop, Rolf Faste outlined the need for a profession that recognizes engineering design as a force that shapes users' experiences. According to Faste, 'engineers must understand that when they design products for human use, they are designing behaviors and experiences for users as well as providing functional utility. How can engineers be made aware of the issues involved in designing behavior in addition to hardware?' [1].

Reinforcing the argument that engineers should understand how their 'role has become quite entangled with the form-giving role that traditionally belonged to the industrial designer,' [1] a new field of study and practice called 'Experience Design' has emerged. Experience Design draws on the skills associated with a wide range of professions, including system architects, hardware engineers, information designers, business strategists, database specialists, usability researchers, game designers, media planners, anthropologists, and software designers [2]. According to the editors of GAIN, the American Institute of Graphic Arts journal of Design for the Network Economy, 'the experience designer must combine the rigors of engineering with the inspiration of high art. He or she must become adept at the traditional skills of design, and engage in dialogue with the virtuosos in the world of social science, economics, architecture, theater and the narrative arts.' [2]

Working within a discipline at Sapient called 'experience modeling,' I participate in this multidisciplinary design experiment with business strategists, graphic designers, site developers, engineers, project managers, content strategists, information architects, brand strategists, product designers, anthropologists, and others. I am reticent, however, to claim that what we do is actually design people's experiences. After all, people have experiences. We design for them. If we design well, we support positive experiences. But the emerging emphasis on 'experience' is well placed. How well have designers understood the experience of those who will use the systems they implement? Furthermore, how well do they understand their own experience of design?

During my undergraduate education, design problems were typically focused on technical challenges. The most fascinating problem I engaged during my senior year demanded no understanding of users: I worked with a team to emulate the architecture of a PDP-11. The only time I was asked to consider user experience was in a class on the psychology of human computer interaction. We tracked how many seconds it would take to complete particular user tasks and prescribed the 'optimum' configuration of graphical displays. After graduating with a degree in computer engineering, I designed machine control and data acquisition systems for manufacturing plants. As an application engineer visiting plant floors, control rooms, and research laboratories, I was continually immersed in the use context, but the social implications of my work were invisible to me. I did not have the training or the analytical tools to inspect how my work translated into the social world.

Since working as an engineer, I started a process of inquiry into the social context of technological practice. I began to see how choices made in the design of industrial automation machines and systems shaped how work would be carried out. When seeing a graphical operator interface terminal on a manufacturing floor, I have not only evaluated how well the process flow is represented, but I have noted that security profiles on operator displays are configured differently depending on organizational role. When working on a supply-chain problem, I have tracked not only what information customer service representatives

* Accepted 2 August 2002.

need, but also that they refer to paper notes taped to their display monitors. When studying a material conveyance system, I have listened not only to engineers who narrate their redesign of workstations to house more efficient computers, but also to users who describe how the new workspace hinders offline work.

I have developed a habit of thinking about technology that helps me open up to critical examination assumptions that are embedded in technology design. I tend to focus on how social and symbolic resources are mobilized in design practice as well as how material resources (artifacts, tools, and machines) function. Symbolic resources include advertisements in the trade press, stories engineers tell to persuade, product specifications, and design guidelines. Social resources include organizational structures that sustain design activity and procedures that support collaboration. If engineers understand how design as a practice combines material, social and symbolic resources, they may be more effective in designing for users' experience.

In practice these three resources are inherently threaded together such that the social, material, and symbolic permeate each other. So, for example, all threads come together as designers communicate in verbal, visual and written form, work within status and authority structures, apply metrics to evaluate progress and outcomes, and use sticky notes, white boards, push-pins, pens, computer terminals, etc. For the purpose of analysis each thread can be taken apart to respond to the questions raised above about how engineers can become more aware of how their work affects the use context as well as improve their understanding of their own design experience. By outlining three threads of design, I share an approach to thinking about 'experience' in design with the aim of helping engineers improve their ability to answer these questions.

SOCIAL THREAD

The institutions—organizational structures and lines of authority—in which design takes place constrain and enable design processes and outcomes. They determine who is a legitimate participant in design and whose expertise is valued. When meeting with a client, I note who is in the room, where they are located within the organization and whose expertise is represented. By understanding the different stakeholders involved, I am better positioned to anticipate conflicts and to prepare a design process that is more likely to satisfy a larger range of participants in the use context.

Often, engineers have an opportunity to shape not only design processes, but also the structures used to support design. When I worked with the Bakery, Confectionery, Tobacco and Grain Millers International Union, I saw this opportunity in several bakeries. For example, the management of a bakery in New England, challenged by aging machinery and increased competition, called upon an engineering firm to help them redesign their operation. The engineers and managers had several choices about new baking systems to implement. They also considered the structure of design by setting up a joint, labor-management design steering committee that included front-line workers as well as the more traditional supervisory staff. As part of this initiative, the design, selection, customization, and installation of pan and trough storage and dough mixing systems were developed to

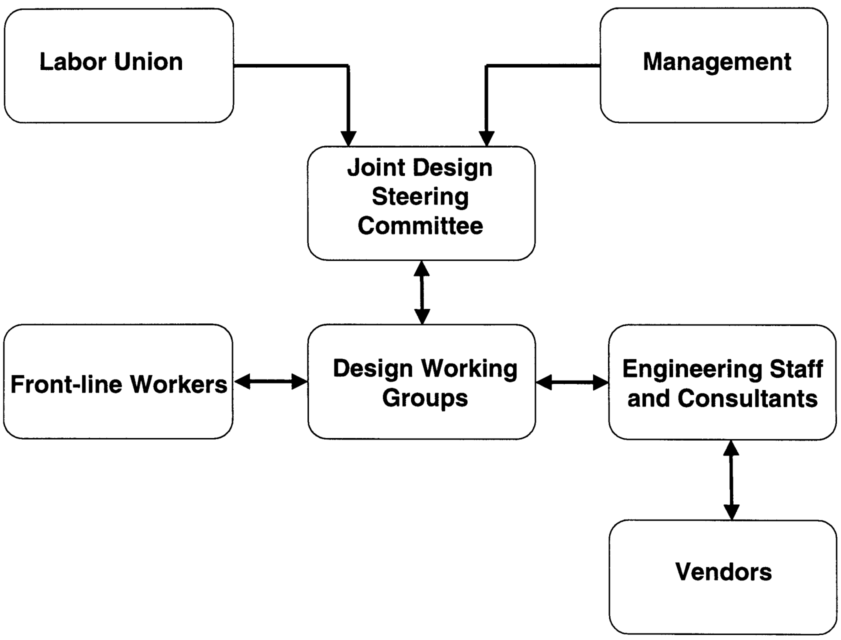

Fig. 1.

support the needs of both labor and management. This structure helps to make explicit where decisions about technology are being made and who is responsible for them. Figure 1 outlines one such structure. It illustrates that engineering expertise is coordinated by a local steering committee comprised of management and worker representatives. Engineers work directly with users in working groups. In addition, the steering committee structure ensures that attention is paid to organizational conflicts as they arise as well as a broad range of design criteria, elicited through participatory decision-making processes.

Another example of an organizational structure that supports collaborative design between engineers and users comes from the automotive industry where workers are taken out of their jobs for a period to work in a different part of the organization. Ford Motor Company's Wayne Integrated Stamping and Assembly Plant and the United Auto Workers developed an organizational change process that shaped both plant management as well as technology design. Before the change process was initiated [3]:

> hourly employees were not involved in the selection of new equipment. . . When new machines were brought into the plant, they often did not work as promised. Skilled trades workers had to fix problems immediately, before they received any training on the new equipment. . . For the next model changeover, however, the union has appointed a group of hourly workers to be involved in the purchase of new equipment. Their insights are being used to make design improvements in advance of the equipment reaching the production floor. One manager described it this way: 'They've asked production people to get more involved, so we've taken some production [workers] . . . off the floor and they work 100 percent of the time on the new car line. So that what they're doing is setting up the jobs. They're going to the vendor shops and reviewing the tools and making sure that it's ergonomically good, it's set up right for the operators. And we're getting a lot of good feedback from that.'

The lessons of attending to diverse stakeholders when structuring design processes have been repeated elsewhere. From design for manufacturing to integrated process and product development to participatory and human-centered information system design, organizational theorists, management scholars, and interdisciplinary design studies researchers recognize that effective manufacturing and service-based solutions require an understanding of social, cultural, and institutional factors underlying technologies of production [4–8].

As design processes incorporate a wide range of participants not traditionally included in the design team, tensions between participants may rise. Conflicts may emerge as a result of diverse cultural norms, social status, organizational relationships, and language patterns. These conflicts are not necessarily limiting. Conflicts can be productive if they are not pushed aside or ignored. Neglected conflicts still exist, only to reappear later as problems in use. Engineers that examine the social thread of design may find it useful to identify approaches that can tap the potential of diverse perspectives. The field of participatory design provides many such approaches. Participatory design provides a framework for individual designers to deal with issues raised during collaboration in design, including how to negotiate conflicting constraints and values, make visible diverse stakeholders' interests and knowledge, and assess design success along a variety of metrics. Computer Professionals for Social Responsibility provides the institutional home for participatory design efforts in North America. The field provides an enormous set of resources for investigating the social thread of design, including organizational structures and collaborative tools [8–14]. See also Judith Gregory's paper, 'Scandinavian Approaches to Participatory Design' in this volume.

SYMBOLIC THREAD

The symbolic thread in design encompasses representations in and of design, including how design problems are formulated, how design outcomes are evaluated, and the narratives told in between. At Sapient, we expend a considerable amount of design effort considering and creating representations that accurately and convincingly reflect desired users' experiences within the context of a client's business problem. One of the key tasks of 'experience modeling' at Sapient is to help formulate the right design problem. To do this, experience modelers work with business strategists as well as graphic designers, information architects, and engineers. Technical constraints play a key role in shaping the problem the team sets out to solve, but so does business strategy and user experience. In formulating a design problem, several important questions arise;

- For whom will the design serve?
- What is the scope of the design project?
- Who will work on the design problem?
- Within what environments will the design solution need to exist?

Without investigating these questions at the beginning of the design process, the wrong problem may be pursued—resulting in a brilliantly designed (in terms of, for example, technical efficiency or aesthetic quality), but failed outcome (either from the client's or user's perspective).

In a recent project, a client asked Sapient to redesign their website—which receives over 25 million visits per day—to provide both an easy-to-use experience for their customers and business value to them. The client, ShipCo, had been asking for several years, 'Who is the priority audience for the site?' They have a huge research department with a lot of quantitative data about ShipCo customers. They also have call-center data and demographic information. Their representations of customer data, however, could not readily inform design. The data was not prepared in a form that could define which customers were of the most value to their business. Nor could the data tell them what their customers value—what their information needs are, what messages appeal to them, what tools they most like to access, etc. One of the first phases of our design effort was to clearly understand and articulate the various user types and represent the priority user types to our client. The resulting representation is the result of combined work between business strategists, content strategists, information architects, and experience modelers. (See Fig. 2.) Together we were able to define nine user types, and identify how these user types fit into ShipCo's market segments in terms of revenue generation for ShipCo. The user types were prioritized on the basis of market segment, products used (e.g. premium versus traditional services), the type of content they were interested in (transactional versus informational), and what the user most valued as part of the shipping process (e.g. low cost, excellent customer service, etc.)

With respect to user participation in design, representations of design—whether marketing announcements, computer aided design models, design reviews, or diagnostic messages to operators—can be presented in language that prevents collaboration of non-technical people, or they can be presented in lay terms so that users can understand the implications of design choices. In the workplace, when engineers develop collaborative languages with workers, all team members can more easily identify how their work experience is

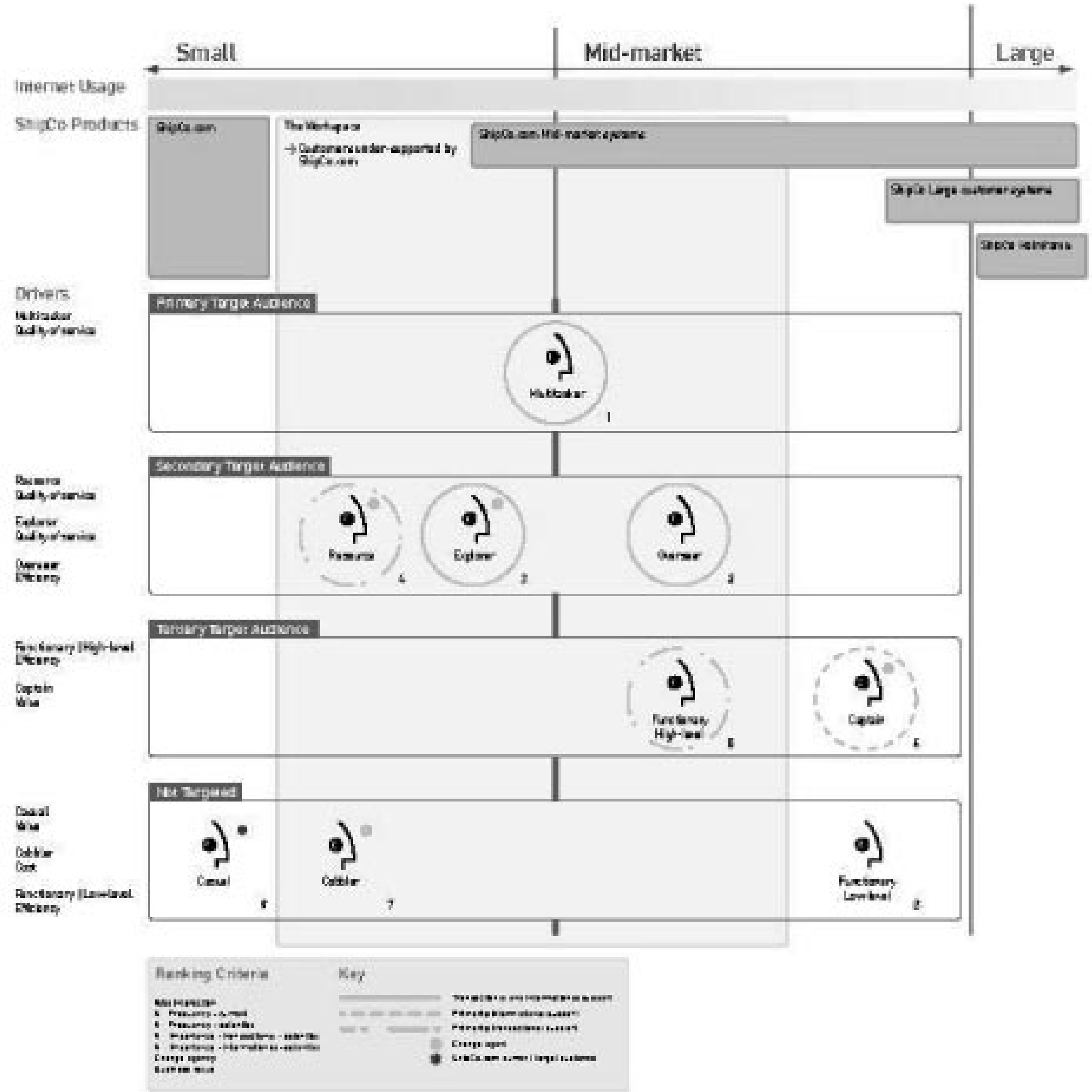

Fig. 2.

relevant to the design process. At one extreme, engineers may not be sensitive to how technical decisions affect work organization. Their means of communicating design options to others may take the form of sophisticated terms and technical language, complicated graphs, and dense metrics, thus discouraging input from others less technically literate or inclined. At the other extreme, engineers may be oversensitive about their technical expertise, holding back any discussion of new technology trends in work groups fearing that their jargon and specialized knowledge will intimidate front-line workers. In this case, workers have no sense of future work conditions and cannot provide valuable insight from current work practice.

These two problems—prioritizing the audience for a website and ensuring that workers have a voice in the design of their work—emphasize different social aspects of design. One stresses instrumental value; the other political change. Both problems, however, are intimately tied up in the symbolic thread of design. The extent to which solutions to either problem are perceived as successful is a result, in part, of what metrics are used to evaluate the design outcome. In for-profit contexts, return on investment (ROI) is a key metric. A significant challenge for advocates of user experience in design in these contexts is to identify how to represent the value of enhanced user experience. Survey research, log file analysis, data mining, and usability software provide some measures of user experience. Other techniques, less amenable to quantitative analysis, are on-site prototype testing and in-context evaluations. Each of these metrics emphasizes different aspects of the user experience. Log files and usability tests track tasks completed. In-context evaluations provide insight into users' motivations. As at the beginning of the design process, representations of design play an important role at the conclusion. By ensuring that design problems are formulated with users in mind and by ensuring metrics evaluate what is important to people in the use context, engineers can steer design practice towards solutions that improve users' experience.

MATERIAL THREAD

As designers create tools, products, built environments and other material objects, they leave them in users' hands and the spaces they occupy. By their obduracy, placement, form, and composition these material artifacts and architectures physically shape social relationships and symbolically express social meanings. In many companies, social status is demarcated by boundaries between carpeted and tiled floors, offices with doors and those without, proximity to windows, and access to restricted laboratories. Analyzing how material resources are configured in the use context (to identify what social practices they facilitate and constrain) helps track design values and assumptions as they become embodied in tools, machines, systems, and spaces.

Computers and the applications they house are particularly relevant tools for anyone interested in understanding how engineering shapes people's experiences in contemporary life. More easily than users who lack technical expertise, engineers can understand how computer architecture maps to the architecture of social experience. They have special knowledge about how computer hardware and software work—how they are connected together as well as how they are laid out within social spaces. In manufacturing organizations, for example, engineers can identify—more easily than front-line workers— where 'intelligent' sensors are located, what information is collected from them on the plant floor, and where this information is routed.

Engineers have a great opportunity to match their technical expertise with knowledge of the use context to make design useful. As the field of usability becomes increasingly influential, internet websites and other computer software is becoming easier to use. This is because usability experts carry out research with representative users and have developed heuristics from this research that guide design. In addition to a focus on computer usability, designers can improve users' experience by making products useful. Usefulness—as contrasted with usability—comes from a deep understanding of people's experience. Experience modeling, as it is carried out at Sapient, aims to represent how people perform their job in the context of their work and how they actually use products and services. A goal is to understand not only instrumental processes, but also people's expectations, motivations and concerns. For example, customer service representatives use sticky notes to remind themselves of hard-to-remember computer codes and to track inventory schedules. Finding out why and how they use these ad hoc tools can help a designer create online features that support everyday tasks. Whether for work or play, useful products are created by designers who understand users' offline behavior and social context.

Before working in a technology and strategy firm, I held a research and consulting position at a non-profit organization that helped companies develop 'high performance work systems'. High performance work systems stress continuous learning, a long-term orientation, and an increased reliance on workers' discretion and judgment as compared to work systems that overlook the experience of front-line workers in redesign efforts—what can be called 'technocentric' design. In technocentric design, managers and engineers understand technology design primarily as a means to increase efficiency and control over the modern production system. Those most closely affiliated with the design and development of machinery—engineers and managers—make all decisions about work organization, plant and

Table 1. Configuration of machine control technology

Technology	Examples	Configuration
Data collectors Device Controllers	Sensors Switches Digital and analog I/O devices	What devices are used at each step of the process? What information is being collected? What information should be collected? What is the information used for? Where is it stored/sent? To what are these devices connected?
Displays	Discrete, pilot lights Simple, 1–2- line character CRT-based graphics Flat panel graphics	What information (collected by the above devices) is available to the operator? Is information being 'passed through' the operator to another location in the company? Does the display only provide information that the operator reacts to? Does the display allow for input from the operator? Are there passwords that allow operators to modify information or programs (recipes)? What parts of the process can the operator view? Does the display require operators to 'log in' by entering their name?
Computers	Programmable logic controllers Personal computer technology	What does the computer do? Does it simply control the operator interface? Does it analyze data? How are the computers programmed? How are the programs/recipes modified? Is there an external computer needed to change the program/recipe? Do operators have access to this computer? How is the PC or PLC connected to other machines?

organizational layout, and workers' activity. This orientation to design solves technical problems by focusing on technological capabilities and applying specialized expertise.

The editorial content of industrial automation vendors' product brochures reveals this technocentric focus. Articles emphasize centralized, hierarchical control where operators are the source of inefficiency. For example, Emtrol, Inc., a manufacturer of automated pan and trough storage, software systems, and other industrial automation products for the baking industry advertises the benefits of 'immediate personnel reductions' and 'the power to manage your process or your entire business from your desktop PC.' Visual Expert, an expert system for industrial automation applications, underestimates the value of front-line operators. Its brochures claim that 'by applying engineering expertise to process deviations and alarms, corrections can be made quicker, thus increasing plant efficiency. Engineers can be free to tackle the real productivity enhancement problems.'

While some application stories in trade magazines reinforce the technocentric design goal to 'run the entire plant from a single control room', [15] other articles describe the utility of day-to-day intervention by people who are working right at the machines. These articles project technological trends that can support front-line operators or limit their role. Two of these trends are the increasing use of personal computer technology (which is more flexible and powerful at the plant-floor level than previous control technologies) and intelligent sensors (which generate and act on data directly at the point of control obviating the need for continual communication with remote computers). For example, see [16–18].

As some trade press application stories illustrate, machine control technologies can be configured to support design that undercuts or relies on operators' knowledge. Decisions about ostensibly inevitable technology trends and neutral technical artifacts—including sensors, displays, programmable logic controllers and information systems—are decisions about work organization. For example, some questions that operators might ask about particular machine control technologies are listed in Table 1.

Choices about how artifacts, tools, and machines are configured affect when operators need to report to a supervisor and the extent to which they control their work. Decisions about what information is displayed on the graphical user interface affect the actions of operators as they monitor or control the moisture and color of cookies and snacks. As noted above in the section on the social thread in design, the configuration of these technologies is, in turn, shaped by who is participating in design decisions and how information is dispersed throughout the organization (whether by informal conversations during a shift change, formal training programs or redesign meetings, or through a joint labor-management steering committee and working groups).

CONCLUSION

Design is a social activity with social outcomes. As Faste argues, the engineering profession has a responsibility to recognize how its work shapes not only functional outcomes, but also people's experiences. With this understanding, designers need a whole host of skills—technical, social, and analytical—to design effectively, that is to enhance their experience of design as well as the experience of users for whom they are designing. The message for students who will eventually work as designers is that they need to know not only that engineering is a social activity (and that they must have 'social' skills to get along in design), but they must know how to analyze design practice. Critical inquiry skills about design as a social practice enable designers to mobilize resources effectively. My response to the concern that engineers be made more aware of how design shapes users' experience has been to provide them with a heuristic for examining design practice. Engineers who actively inspect the social, symbolic, and material threads of designers' and users' experience will generate discussion and debate about who participates in design, how design problems are formulated, and how artifacts, tools, and machines enable and constrain particular design practices and outcomes. They will be better equipped to improve users' and their own design experiences.

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