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Transforming society by transforming technology: the science and politics of participatory design☆

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Abstract

This article attempts to shed historical light on some of the social, political, and ethical issues that have arisen from two disparate perspectives on technology which have both come to integrate an explicit consideration of social factors into systems design. It presents two distinct historical traditions which have contributed to the current field of participatory design methodologies—*Joint Application Design* (JAD®), and the British "socio-technical systems" and Scandinavian "collective resources" approaches—and which in practice integrated the end-users in different ways consequent upon their differing perspectives on workers, professional relationships to technology, and stated goals. One interest in examining the independent development of methodologies from these two perspectives is that, despite their differences, the approaches ultimately converged on a set of shared concerns and very similar practices.

The paper also examines the relation of these traditions to transformations in the theorization of business organization and trends of corporate restructuring which helped to secure a place for variants of related methodologies in major US and multinational corporations. It concludes with an examination of some broader issues in the relationship between technology and society and the prospects for the critical study of technology. I argue that participatory design and its related methodologies are best understood as a model for involving users, designers *and the technology itself* in a process of technological development. Rather than seeing participatory design as merely the insertion of public dialog within technological design practices, as several observers have done, we should see it as a model for the critical practice of developing technological designs.

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> Everywhere we remain unfree and chained to technology, whether we passionately affirm or deny it. But we are delivered over to it in the worst possible way when we regard it as something neutral; for this conception of it, to which today we particularly like to do homage, makes us utterly blind to the essence of technology. (Martin Heidegger from *The question concerning technology*)

1. Introduction

While technological "progress" is not without many vocal and compelling critics, the fact that technology permeates our society is undeniable. The insight into the deep connection between the form of technology and the form of human life, so eloquently expressed by Heidegger in the quote above, has led to some very interesting work in the design of socio-technical systems. This article attempts to come to terms with some of the social, political, and ethical issues that arise from this work in a single, though broad, domain of socio-technological development—information systems design. I have chosen this particular domain because of an interesting convergence which has occurred in the practices which involve users in systems design.

There are almost as many different ways to design information systems as there are information systems, but there are also identifiable commonalities among groups in the various approaches to design. A good history and examination of the philosophical assumptions of different approaches to the design process is presented by Hirschheim, Klein and Lyytinen (1995). Their historical account focuses on the design process itself, while this article will be concerned with the development towards user participation in design. What is interesting in the latter historical development is how systems designers and worker participation initiatives bumped into one another and ultimately came to align themselves into a more or less symbiotic relationship. As Hirschheim and colleagues make abundantly clear, the various approaches to systems design have very different sorts of metaphysical, epistemological and normative assumptions behind them and objectives ahead of them. Yet despite their ideological differences, their practices and responses to problems bear many similarities worth reflecting on.

This article will be more concerned with the journey toward this convergence than with the final destination. I will simply use the idea of a convergence of approaches to guide the narrative of the history leading up to a body of participatory design methodologies that all seem to share a value in explicitly "representing" users in the design of information systems. The various methodologies these approaches have arrived at fall under the broad description of "participatory design" and share this description by virtue of the fact that they each seek to integrate the end-users of an

information system into the process by which that system is designed. A comparison of methodologies will also invite contrasts: in who the "user" is, in what part of "design" the user becomes involved in, in what goal "participation" is hoped to achieve, and in what the crucial aspects of that participation are. The real claim of this article is that over time, the concepts which originally divided design ideologies have started blending together, that this blending has occurred at the interface between human values and technological development, and that engaging this interface as a social and engineering problem has resulted in several common sorts of difficulties regardless of ideological perspective.

We will begin the history of this convergence by looking at the approach taken from the perspective of technological rationalization,[1] and which arrives at user participation as necessary for efficient design. We then turn to the socialist and humanist approaches, which arrive at user participation in design as necessary for collective security and individual autonomy. Next we briefly examine the rhetoric of corporate restructuring and how it builds on the concepts of worker empowerment, and utilizes the methods of user participation, to legitimate new political regimes within organizations. Then we consider one of the various brave new hybrids of participatory design which tested the boundaries of political acceptability for changes in engineering reorganization. And finally we compare the representational practices of participatory design to cultural anthropology and draw some conclusions about the lessons to be learned from participatory design in considering a critical theory of technology.

The historical presentation traces two major traditions which have only recently converged into the rather heterogeneous field of practices that constitute participatory design. The first tradition I will examine is the development of the user-involving design methods which originated in large US corporations producing office technologies, and take IBM as my principle example. IBM's design practices represent a continuous tradition and practical methodology which began systematically involving users in a methodology first developed by systems designers in 1977. Called *Joint Application Design* (JAD®),[2] it was derived as an extension of an existing IBM design methodology, *Business Systems Planning* (Carmel, Whitaker & George, 1993, p. 41). I begin the historical narrative with IBM because it represents a fairly linear extension of older rationalist and functionalist design methodologies. While not often recognized as a major contributor to participatory design, Joint Application Design not only addresses the integration of users into systems design, it also provides insight into the corporate culture which would later adopt variants of the participatory design methods originating in Europe.

The other, and better recognized, tradition which contributed to the current field of participatory design had its roots in the post-war work of social scientists at the Tavistock Institute of Human Relations in London, but really began its historical development in 1960 with a series of four labor organization experiments called the

[1] Hirschheim et al. (1995) call this the "Functionalist Paradigm".

[2] *Joint Application Design* and JAD are registered trademarks of IBM Corporation. I use the term "Joint Application Design" herein to refer not only to the IBM doctrine which is considered in detail, but also to its many variations and imitators where considered as a style or trend in design.

Norwegian Industrial Democracy Project. That project led to two different research programs: one in Britain, the "socio-technical systems" approach; and one in Scandinavia, the "collective resources" approach. These strains subsequently grew back together in the early 1980s but only recently found a broad influence in North America.[3] The literature commonly refers to this tradition as the "Scandinavian approach," or simply Participatory Design,[4] although it consists of many diverse techniques and methods developed by British as well as Scandinavian researchers.

One interest in examining the independent development of methodologies from these two perspectives is that, despite their differences, the approaches ultimately converged on a set of shared concerns and very similar practices. From a closer practical perspective, each design tradition recognized a set of problems surrounding the position of the "user" in systems design. Yet the articulation and resolution of these problems took very different turns and expressed different values. From a broader cultural and political vantage, the two traditions have very different origins and maintain very different values, and it is thus surprising that they should find as much common ground as they do. There are, of course, critical issues which arise as the two traditions grow closer together, and the details of their historical development become crucial to any critical understanding of it.

After recounting the history of European Participatory Design, I will return to the transformations which occurred in American business and which further altered system design methodologies in the late-1980s. These transformations included the widespread adoption of participatory design principles and practices by North American corporations. This occurred first through the singular, though high-profile, work at Xerox Corporation, which was strongly influenced by the European researchers in the early 1980s, but continued to spread, and much more quickly, in the late-1980s. This pattern of growth coincided with the more general movement of corporate restructuring. From among many similarly relevant projects during this later period, I examine a single project to illustrate the impact of the changing conceptions of corporate organization on design methodology.

The methodology, called Engineering Codevelopment (EC), evolved through an experimental project sponsored by the Commission on Preservation and Access (a private, non-profit organization) begun in 1989. Called the "Class project," it was a joint venture between Xerox and the Cornell University libraries to develop proprietary digital-image technologies for the preservation of, and on-line access to, delicate rare books in the libraries' collections. Unlike the two principal traditions we will investigate, Joint Application Design and Participatory Design, it is not really

[3] As we will see later, the networks of interaction between these methodologies and their objectives is made even more complex by their relationship to the broader Quality of Working Life movement, which also grew out of the Norwegian project and which influenced North American system design indirectly via its impact on enlightened Human Resource Management and later on Total Quality Management and eventually on Business Process Reengineering.

[4] I will refer to this specific tradition as "European Participatory Design" or "Participatory Design" to distinguish it from the more general participatory design (no capitalization) which is intended to refer to all the various approaches to integrating users in the design process.

a tradition so much as an exemplar of an interesting design perspective which lies somewhere in the field of convergence between these traditions. Xerox's design methodologies have been numerous and varied, arising out of more academically and experimentally oriented research than was typical of most American companies, focusing in the early 1980s on cognitive ergonomics and human–computer interaction at its Palo Alto Research Center (PARC), and by the late-1980s on systems design organization with its newly created Work Practice and Codevelopment Group. I examine only one of these methodologies in detail because it represents an interesting point of intersection between the Joint Application Design and European Participatory Design traditions—researchers there were influenced by both approaches. It thus serves as a useful illustration in understanding how participatory design reshapes design practices and, because it represents many of the features sought by management theorists in their discourse on Business Process Reengineering, it also provides an illustration of one way in which participatory design methods were able to align with this field of discourse. I choose to examine Xerox's Class project, despite Xerox's consideration of this project as a failure, because it provides insights into the complex social factors involved in technological design, and the ways in which these factors influence design practice.

The two main methodological approaches of Joint Application Design and European Participatory Design began with very different perspectives on technology and the role of technology in the workplace. This led to very different ways of conceiving of the "problem" of integrating technologies into the workplace. Moreover, each perspective and set of problems developed in very different contexts; these arose in different kinds of organizations—public, trade-union, commercial—and in situations which placed designers and users in very different relationships. There are two interesting phenomena which resulted from this and which I wish to emphasize. The first is that at some point, each of these traditions decided that systematically involving users in the design of technological systems was central to achieving their objectives. The second is that despite seeing the users' participation in the design process as an essential local objective, how each tradition conceived of the users' role in that process was shaped by their global objectives. This configuration turns out to bear a striking resemblance to that confronted by colonial anthropology, and its researchers came to address many of the same critical issues as those reflecting on participatory design. Finally, we will consider the role which technology should be recognized as playing in political discourse. With these issues in mind, I turn now to the background of these different approaches to user participation in systems development.

2. Technological rationalization: early 1970s to mid-1980s

2.1. Background

Before describing in detail the methods of participatory design, it may be helpful to review the basic methods of system design which these approaches sought to

reform or replace. Arguably, information systems began with the first written records, probably Babylonian cuneiform impressions on clay tablets. But the profession of information systems design did not emerge until the 1950s, when computers first began to be applied to organizational information problems. Hirschheim et al. (1995) describe this early period as the "pre-methodological" era which was characterized by the "seat-of-the-pants approaches" to systems design (p. 29). There were no precedents to reflect on, and new methodologies grew in response to new challenges. Concerned primarily with programming and the management of physical data storage (e.g. which stack of punch-cards goes with this program), systems design was largely driven by technological considerations. From the beginning, large information systems projects were subjected to management techniques in a manner similar to other engineering organizations.[5] Eventually, programmers, systems designers and management information systems analysts emerged as professional groups with recognized roles in systems development.

By the mid-1960s, some standardized methodologies had developed from these early approaches. They are best characterized as the "life-cycle" methodologies. The basic idea of these methodologies is that systems development ought to consist of a series of stages, which begins with defining a system's requirements, progresses to defining the data structures and algorithms necessary to realize the requirements, and then manages the actual programming and testing of the system. If the system's future users needed to be consulted during this process, this was done unsystematically through informal interviews, a process called "requirements gathering," which was done only in the initial, pre-planning stage of design, or in an evaluation of the finished system after it had been implemented.

2.2. The user as functional input: joint application design

The development of Joint Application Design (JAD) is itself indicative of the difficulties encountered by rationalistic system design methods. The conventional wisdom of systems design was embodied in Business Systems Planning, IBM's development methodology during the 1970s. A classic problem for any form of centralized planning in a hierarchical organization, where those doing the planning are removed from the activities of those the plans are being made for, is poor communication. In IBM's case, systems designers were finding it difficult to formulate system requirements from their labs while users were being frustrated by systems that failed to suit the needs of their office. Informed by insights from group dynamics and social psychology, Joint Application Design was developed in 1977 by IBM employees Chuck Morris and Tony Crawford as an extension of the existing design methodology. The intended objective of the methodology was to reduce the time required for the System Development Life Cycle (SDLC) while simultaneously increasing

[5] For an interesting history of the imposition of the division of labor on computer programming, see Greenbaum (1979).

quality and reducing overall costs. The impetus for this methodology was thus only minimally theoretical and overwhelmingly technical.

To achieve these goals, the methodology sought to integrate structured meetings with users into the SDLC; it is these meetings which stand as the essential defining characteristic of Joint Application Design. The meetings are arranged so as to occur several times during the earlier stages of the SDLC, where meetings in the earliest stages focus on high-level user concerns and objectives while meetings in the later phases of design demand increasingly detailed information from users, with the ultimate goal of creating a single Design Document. The Joint Application Design Document is intended to provide the system's requirements and consists of a list of user requirements approved by everyone attending the meetings, thus constituting both an object of group consensus and a technical resource for design.

A universal feature of Joint Application Design meetings is that they are highly structured by a concern for maintaining social control in situations which might otherwise call into question the relationships between experts, managers, and workers, or digress into an unproductive chaos:

> The Joint Application Design methodology emphasizes structure and agenda. This is evident in the JAD literature that reads somewhat like cookbooks. Everything is explained in great detail: "to do" lists are included, as are masters of useful forms. There are four necessary building blocks for a well-run JAD meeting:
>
> 1. *Facilitation*. A designated leader (or leaders) manages the meeting. Some JAD practitioners consider the meeting leader to be key to process success, even more so than the act of gathering the users in one place, the essence of JAD.
> 2. *Agenda setting/structure*. The meeting must have a plan of action.
> 3. *Documentation*. One or more designated scribes carefully document everything in the meeting. Various lists are rigorously maintained.
> 4. *Group dynamics*. Group dynamics techniques are used for inspiring creativity (e.g. brainstorming), resolving disagreements (e.g. airing facts, documenting them as "issues," taking notes), and handling speaking protocols (e.g. enforcing "only one conversation at a time").
>
> (Carmel et al., 1993, p. 41)

In addition to the facilitator and scribe, the key individuals involved in these meetings are users and designers. It is important to note that the "users" in these meetings are supposed to consist of managers and veteran workers with detailed knowledge of the work process. The implication is that "user satisfaction" consists in not only satisfying the requirements of the work process but in satisfying those in charge of overseeing and managing those processes. As Carmel et al. (1993) report:

> we have observed numerous North American JAD meetings in which operational employees are overlooked as participants. This results in a meeting room filled with middle managers and supervisors unable to specify details of day-to-day

> operations (e.g. what 17 fields are needed to fill out form A345). This organizational failure stems in part from an unjustified lack of confidence that "front-line" workers can meaningfully contribute to the design process. (p. 46)

This raises many issues regarding the implications of information technology in organizational control and workplace politics which will be addressed more carefully in the final section.

Besides limiting the voice of the worker as a "user" through the explicitly management-dominated organization of meetings, Joint Application Design also serves to protect and promote the authority of technical experts. Indeed, the ostensive objectives of the designers are embodied in the meetings' structured nature by its simultaneously satisfying two functions: (1) the extraction of knowledge, beliefs, impressions, and desires from users in a controlled fashion through designer-established agendas, and (2) the rationalization or "selling" of the system to users by design engineers. Function 2 is achieved in part through the use of elaborate visual aids which seek to enable design experts to, among other things, describe their system to users and justify technical constraints[6] and in part because everyone in attendance at the Joint Application Design sessions is considered to have "signed off" on the Design Document those sessions produced. The literature seeking to improve on the Joint Application Design methodology generally focuses on slight alterations in the presentation aids, forms, or the overall organization of the meetings themselves. The dual function of the Joint Application Design meeting allows the technical experts to represent users' needs as objective data in the technical design phase by using the information contained in the Joint Application Design document. Thus the technical design process may largely retain its rationalistic procedures while the users' influence on design is conveniently reduced to a well-structured functional input to the design process, a process which always remains in the control of the expert designers. It is precisely this highly structured nature of the process which is touted by how-to books on Joint Application Design (Wood & Silver, 1989; August, 1991; Crawford, 1994). So while Joint Application Design does seek to integrate users into the design process, it is unwilling to call into question or transform the fundamental technical rationality, practices, and political organization of that process.

3. Technologies of socialism and humanism: mid-1960s to mid-1980s

3.1. Background

European Participatory Design has its roots in a very different socio-political sensibility. The Norwegian Industrial Democracy Program consisted of four experiments

[6] These visualization aids have themselves become a hot commercial product. One Joint Application Design consulting firm offers a US$400 briefcase filled with magnetic color-coded presentation symbols, while an entirely new programming application domain has developed for this purpose called CASE (computer-aided software engineering) tools (Carmel et al., 1993, p. 42). There are, of course, other important uses for CASE tools, including rapid proto-typing and developing elegant interface designs.

carried out by researchers from the Tavistock and the Norwegian Work Research Institute between 1964 and 1967 (Emery & Thorsrud, 1976). These studies investigated how social groups formed around production technologies and sought to reform job distribution and wage systems for workers. After these four experiments, two research programs developed along different trajectories: Scandinavian researchers focused on union empowerment through "collective resources" and British researchers focused on autonomy in work group organization through "socio-technical systems design." Each felt that they had chosen the most promising set of objectives for what they saw as being feasible for the democratic reform of workplace technology and hence each saw the objectives of the other as tangential to the central issue. The British saw the union-centered approach as only being viable in the political environment of Scandinavia and as failing to theorize the organization of labor on a fundamental level, while the Scandinavians saw group dynamics as being ineffectual because it failed to consider the predominating power struggles of class and capital. Both approaches, however, were motivated by a shared concern for workplace democracy and the humanization of work and both contributed to the broader Quality of Working Life movement then beginning to take shape.[7]

3.2. Empowering the working class: collective resources

The Scandinavian collective resource approach originated when the Norwegian Computer Centre (NCC) began working with the Norwegian Iron and Metal Workers Union in 1970 to educate union officials on how technology affects working conditions and might be made to serve union interests. The expressed goal was to assist unions in devising technological control activities and policies. The basic methodology was to set up union mechanisms to gather and analyze information about specific technologies and their effects on workers. The belief was that by doing this the unions could offset the employers' natural advantage in technological knowledge and make it possible for the unions to put technological issues on the bargaining table. Research revolved around an elaborate "negotiation model" which sought to depict the bureaucratic process of introducing new technologies on the shop-floor in a way which would allow trade unions to intervene in response to management's technological proposals (Ehn & Kyng, 1987, p. 42). The "collective" here indicates that the intention was the empowerment not of individuals in their workplace but of the trade union collective in bargaining situations, while "resources" indicates the value placed in information resource gathering on the part of trade unions. The initial projects did not seek to integrate the workers directly into technological design processes, nor did they recognize design processes as a particularly significant locus of interest. In fact, worker participation (in the process of information gathering) was seen as problematic in that (1) the workers involved might become experts and join management thereby threatening union solidarity, (2) such a process could give man-

[7] For an enlightening genealogy of the Quality of Working Life movement and its spread out of Norway, see Miller & Rose (1995).

agement undue access to "shop floor information," (3) it could prevent effective trade union participation, or (4) that it could even become a managerial strategy for worker manipulation (Ehn & Kyng, 1987, p. 40). Here the concern was not in the democratization of the technological design process, but of the bureaucratic decision process through which a company would seek to introduce a new technology on to the shop floor.

By the nature of the Norwegian Work Environment Act of 1977, which provided participatory rights to all (not just unionized) workers, issues of workplace democracy were seen as requiring locally specific actions and solutions resulting in several highly specific local projects. And even though the law provided for individuals' rights in workplace co-determination, due to the political relationship which existed between managers, workers and unions, only union-initiated activity was seen as having a viable impact on workplace organization. This was largely a consequence of the theoretical framework which motivated the researchers, who saw themselves as trying to find viable alternatives to the Tayloristic rationalization of work. Inspired by Marxist critiques of technological rationalization from authors such as Braverman, Noble and Winner (see Braverman, 1974; Noble 1977, 1979; Winner, 1977), they believed that unions were the only viable point of resistance to the otherwise inevitable capitalist processes of deskilling and increasingly centralized control through the division of labor, even though they expressed some doubts:

> However, there were also practical and empirical anomalies that could not be explained by these theses. Work was not deskilled in all cases. More collective forms of work organization than the Tayloristic were sometimes proposed by management. It happened that workers gained from the introduction of new technology, etc. But this does not mean that the Marxist approach to understanding changes of the labor process in a capitalist economy has to be rejected. (Ehn & Kyng, 1987, p. 36)

Yet it was precisely this insistence on the Marxist critique which would motivate their rejection of other theoretical approaches until the continuance of their own work necessitated a recognition of the significance of the technological design process. It was the explicit theorization of design processes that the Scandinavian researchers were to later discover in "socio-technical system design" and which would mend the schism between Scandinavian and British researchers after a decade of independent work.

Early collective resource studies targeted the impact of new heavy manufacturing technologies, which in themselves were not particularly flexible, and other areas where the unions had found it difficult to translate workers' interests into negotiable demands. Researchers and union officials sought to analyze workers' feelings about existing technologies (through surveys, union meetings and other methods adapted from psychoanalysis), to require employers to disclose information about technological reorganization proposals (such as the technical specifications and organizational policies involved in introducing numerically controlled machines and computer-based planning systems into the production line), and to produce textbooks and form

classes for the education of union officials and workers (Ehn & Kyng, 1987, p. 28). These methods met with limited success in achieving those goals which could be easily formulated as collective demands, such as requiring the retraining of workers displaced by a new technology, but it was difficult to make any gains on qualitative humanistic concerns through bargaining. The approach failed to spread as a general union movement because most local unions could not spare the necessary time and financial resources required to make it work.[8]

A shift in industrial focus and the conception of design came about with the "second generation" of the Scandinavian approach marked by the Swedish–Danish UTOPIA project in 1981, the first recognizable participatory design development project. Conceived in response to the discouraging results of the earlier trade union projects which had found that existing technologies limited the possibilities of workers to influence workplace organization, UTOPIA targeted technological development as a prospective site for user involvement and influence. According to the Marxist critiques, the technological dehumanization of work through deskilling, intensified division of labor, imposition of rigid and routinized practices, and the shifting of control toward the top of organizations was an inevitable result of the introduction of new technologies which necessarily served the interests of management and owners. Since the existing technologies were presumably all being developed to satisfy the interests of their purchasers, the business owners, and hence to increase productivity, control, and efficiency, the only effective means of empowering workers in competitive industrial markets would be the creation of alternative technologies designed around workers' interests. Thus, the researchers sought to realize the ideals of the Scandinavian Technology Agreements established in the late-1970s, which had empowered workers with control over workplace technology in writing but not in practice, by designing a technological system with their skills and interests in mind (Greenbaum & Kyng, 1991, p. 11).

In cooperation with the Nordic Graphic Workers Union, the UTOPIA (both an acronym and an ideal) project studied a group of newspaper typographers working without computer support in order to develop a state-of-the-art graphics software product for skilled graphics workers. The objective was to create a commercial product which the unions could then demand as an alternative to other deskilling technologies. The commercial product was ultimately unsuccessful due to a small market and the shortcomings of the company which owned and marketed it. The completion of this project in 1985 coincided with a renewed acceptance of the socio-technical systems design research being conducted in Britain.

3.3. Autonomy of the work group: socio-technical systems

The British researchers were interested in the phenomena of group dynamics that had been observed in the early Tavistock inquiries into "leaderless groups," originally

[8] Randi Markussen (pers. commun.), one of the original research participants, reports that where these projects were successful, the trade unions would also provide funds for workers and their families to attend weekend "retreats" where the classes and seminars would be conducted.

motivated by founding member Eric Trist's personal fascination with the efficiency of German panzer tank divisions (Mumford, 1987, p. 61) and Britain's War Office Selection Boards' interest in choosing and training military officers in order to utilize the phenomena of emergent group dynamics (Trist, 1993, p. 42; see also Bion, 1946). The actual experiments involved observing coal miners and how they organized their labor practices around technological systems. Miners working in large shafts were organized around assembly-line type machinery and showed little variation in their repetitive tasks, while miners working in small shafts or exposed faces, where the machinery could not be installed, developed novel dynamic and efficient work practices. Amenable to psychological and biological theory,[9] the researchers developed their "organic" theoretical approach from systems theory, and focused particularly on the notion of "open systems," which itself drew heavily on a bio-organic metaphor (Mumford, 1987, p. 65). Thus work organization was theorized as an organic relationship between workers and technology—the socio-technical system—which ought to be analyzed according to criterion of "health" instead of the raw productive output measures of purely mechanistic analyses. From their studies of miners working under Tayloristic methods, they concluded that inefficiency resulted from optimizing the technical components of the system at the expense of the human components. The optimization of the socio-technical system as a whole would thus require a joint optimization of both aspects with an eye towards the social and psychological impact of technology on workers (Mumford, 1987, p. 63). Research focused on the concept of the "autonomous work group" in which workers were allowed to spontaneously develop their own work routines, make decisions, and change tasks with little or no supervision.[10] It was this theoretical conception of the labor process that would motivate much of the later development of participatory design.

During the time that the Scandinavian researchers were concerned with empowering unions, the British researchers had been developing "socio-technical design principles" and management philosophies.[11] It was just these projects which were at the time being criticized by Marxist theorists in Scandinavia for promoting values that were fundamentally capitalist—increasing productivity and decreasing worker resistance. While these criticisms carry some force with respect to how the principles were often applied within the workplace, they still depended on a mechanistic conception of labor process organization which pits capitalist demands against humanist concerns and leaves no real space for compromise.

It was against this same background of concerns that a broad international social movement, called the Quality of Working Life movement, began demanding more humane work environments and transforming the conception of workers' relation to their work away from a purely economic conception to one which included an

[9] The researchers included several medical and psychiatric professionals.

[10] The features they noted as indicative of the "autonomous work group" are essentially the same as the "humanistic values" we will see more vividly later (Section 4.3 below) being touted as the advantages of Xerox's Engineering Codevelopment.

[11] See Churns (1976) and Hill (1971) for these general theoretical perspectives, or see Mumford & Henshall (1979) for the earliest applications to computer systems design.

emotional investment in, and personal attachment to, work. This was in part achieved through a reconception of the identity of the worker as an enterprising agent seeking personal fulfillment through job satisfaction. Miller and Rose (1995) have argued that by conceiving of the labor process as an organic process in which the most productive system was the healthiest and happiest system, socio-technical systems research made a significant contribution to this movement by offering a space for the negotiation of humanistic and economic concerns. They go on to argue that it is not as important to note the success or failure of the movement as to recognize the alignment of ethical, political, economic and technological elements through which it was possible for the Quality of Working Life movement to establish a particular identity for the worker and to restore the legitimacy of the corporation in industrial democracies.

The alignment of heterogeneous conceptions of work in the Quality of Working Life movement also opened a novel space for theorizing technology in which it could now be seen as serving multiple interests and values. So while it had been observed by Marxist critics like Noble and Braverman that technology could exploit and subjugate workers, it was now seen as also being able to promote workers' interests by making work more interesting, reintroducing skill, and by making practically feasible the "autonomous work group." The key to this lay in granting the worker direct control over the nature of the technology encountered in their day-to-day job. This also allowed the Scandinavian researchers to explain why the trade union approaches had failed—because the available technologies were not being designed in step with the new conception of workplace autonomy, union-supported technology had been just as mechanistic as management-supported technology. By 1985 the British and Scandinavian traditions had rejoined under a common banner of democratizing technological systems design. The consequence was to be an increased emphasis on the involvement of the worker in technological design, which had already begun in the UTOPIA project. This was to be the essential feature of the tradition from that point on.

3.4. Participatory Design

Participatory Design researchers encountered two main barriers to the successful participation of users/workers in the design process. The first of these was a lack of appreciation by workers for their own knowledge of what they do—as one researcher reported:

> It is a widespread opinion among workers that they themselves know nothing about technology, and that the necessary information must be obtained from management. This paralyzes the workers as far as actions are concerned. . . . [It] is at least as important to collect and prepare the knowledge of the workers, a knowledge they have obtained through their jobs. (Kensing quoted in Clement & Van den Besselaar, 1993, p. 29)

There was also a reluctance among technical experts to give project control to

users, as this threatened their technical authority and traditional work practices. As a worker in one project remarked to the researchers: "But you don't always listen to us—you do what you think is right for us and the project. And, you are the expert; so who are we to dispute your decisions?" (Nurminen & Weir, 1991, p. 297). These two barriers together constituted the socio-political resistance to the democratization of the design process. Both users/workers and design experts found it difficult to leave their traditional socio-political roles in order to participate as intelligent and capable equals. The common response to this problem was to send the experts "into the field." Rather than trying to rely exclusively upon special interviews or meetings to learn about users' work practices (as the union projects had done), researchers utilized "action research" methods whereby they spent a great deal of time observing and interacting with workers in their workplace. The reported consequences of this were an enhanced appreciation on the part of both workers and experts for workers' knowledge, and an increased understanding by workers of technology and its influence on their work practices.

Because the second-generation European Participatory Design projects sought to establish democratic participation among the workers influenced by a given technology, they saw their initial objective as breaking down traditional concepts of work and expertise among the design group (workers and experts). A second key concern for practitioners of European Participatory Design was enlisting external support for their projects and methods. Almost all projects reported resistance within or friction between the different organizations involved in the projects. Also, due to the nature of the legal, political and economic conditions (they were primarily academic and government initiatives) in which the European projects were situated, they sought to realize their objectives at a highly local contextual level, resulting in few immediately generalizable design principles. The confluence of these factors had led to a very nebulous concept of just what was entailed in utilizing a European Participatory Design methodology—it started to become an ideological approach rather than a prescriptive set of techniques. As a consequence of this, North American systems designers were very skeptical of European Participatory Design and worried that it was only viable in a context such as that which existed in Scandinavia and Britain. This is to say that as a design philosophy, during most of the 1980s European Participatory Design was unable to "sell itself" to a North American market still committed to its own tradition of software engineering practices and ideals. Skeptical system designers asked what methods it prescribed and what techniques it utilized, while European Participatory Design's proponents insisted that the key factors were the promotion of democratic ideals and an enormous creative effort on the part of designers.

4. Redesigning design: mid-1980s to mid-1990s

4.1. Background

Several changes in the late-1980s and early 1990s were to alter the way in which participatory design was perceived and which would both transform it and carry it

across the Atlantic. Early European Participatory Design focused purely on democratic participation and overcoming various difficulties in achieving this; moreover, it was primarily conceived and pursued by an academic community that held little concern for business interests and only limited responsibility for producing actual systems. This was in turn a very different set of problems than those which gave rise to Joint Application Design and similar methodologies in North American corporations, where the problems addressed by system design professionals focused on promoting business goals by increasing the efficiency and effectiveness of technical design. The consequence was that for more than a decade both Joint Application Design and European Participatory Design developed in isolation with almost no interaction between designers working in the two traditions. The interesting exception to this was Xerox PARC which was an early supporter of European Participatory Design in North America, though it stood in relative isolation in this regard. Joint Application Design grew up in the halls of North American industry[12] and received very little academic attention, while European Participatory Design was conceived by academics and grew up in the progressive social democracies of Scandinavia.

In recent years, the two traditions have grown close enough together to find themselves publishing in the same professional journals and exchanging techniques and tools. This convergence was not the result of deep theoretical insights stemming from either side, but of separate movements by each toward filling a space opened by a newly emerging organizational regime. This new regime, described by Agre (1995) as the "empowerment and measurement regime,"[13] was constituted by elements taken from management theories concerned with product quality and business process efficiency, accountancy methods seeking more precise cost and expenditure measurements, and nationalist political rhetoric over the global competitiveness and security of national industries and their workers. This regime not only transformed the discourse of management theory but, when combined with global information networks, it also made possible global factories and very large distributed control systems through modularized organization, outsourcing, and the electronic transmission of office communications, design requirements, software products, and even programming labor. Co-evolving with and informed by these changing conceptions of workers and business organization, the current heterogeneous field of participatory design claims the twin goals of increasing efficiency (of both technical experts *and* users) and increasing democracy (primarily for users).

[12] Shortly after its official adoption by IBM Canada in 1980, the methodology spread widely among small and large North American companies and has been used in the design of tens of thousands of implemented systems. There are many similar competing and derived methodologies, each slightly different but all seeking the same basic objectives. I take Joint Application Design as being exemplary of these various methodologies.

[13] Agre (1995) sees participatory design as only one element among many in the symbolic convergence of the empowerment and measurement regime, which I would agree with. It is important to recognize, however, the ways in which the other elements of this regime were reflected back into participatory design and altered it. It is also important to note the essential contribution of participatory design to this regime insofar as it has been able to bring material technologies into alignment with theoretical conceptions of business organization and governance.

4.2. Reinventing the corporation, representing the customer, redefining the worker

In the mid-1980s, North American business experienced a trend toward maximizing the efficiency and flexibility of its organization.[14] This movement toward "reinventing the corporation"[15] led to a series of hot topics in professional management literature, the most significant to participatory design being Total Quality Management (TQM) and Business Process Reengineering (BPR). While these management theories each claim principled distinctions between them, their historical development reflects their joint participation in a larger trend and they have been combined along with other elements under the broad rubric of corporate restructuring. More importantly, they each constitute a field of discourse which has given shape to the empowerment and measurement regime (Agre, 1995) and the impact of each can be seen distinctly on the face of participatory design literature.

Total Quality Management is a management approach conceived largely as a response to the perceived shortcomings of American productivity in comparison to Japanese industry in the 1980s, and is comprised of an enormous and heterogeneous body of literature. A recent book[16] on Total Quality Management lists eleven management theories which have made significant contributions to Total Quality Management: Scientific Management, Group Dynamics, Training and Development, Achievement Motivation Theory, Employee Involvement, Linking-Pin Organizations, Socio-technical Systems, Organizational Development, Corporate Culture, New Leadership Theory, and Strategic Planning (Schmidt & Finnigan, 1992, pp. 13–23). This broad field, containing several familiar theories, is brought together in Total Quality Management as a business and management philosophy that promotes the conception of a "customer-centered" business organization which is subjected to intense scrutiny and measurement. The objectives are to instill a conception of customers and their needs at every organizational level and production process in the company. This includes disseminating information about customer needs and the company's market position and objectives to workers at every level of the company, as well as benchmarking individual processes and products against those of like competitors. It is the provision of benchmarking performance and quality reports to teams and individuals which is supposed to give them a tangible sense of their participation in the company's objectives, i.e. the satisfaction of the customer, and to allow them to set their own performance standards and reach their greatest productive potentials. Total Quality Management thus epitomizes Agre's (1995) conception of the empowerment and measurement regime by giving workers a sense of accomplish-

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[14] For some connections between this trend and the Quality of Working Life movement, see Miller & O'Leary (1994).

[15] An often cited early work of this movement is Naisbitt & Aburdene (1985).

[16] It is interesting to note that this book is co-authored by a human resource manager at Xerox who was involved in that corporation's Total Quality Management restructuring during the 1980s. The book, *The race without a finish line* (Schmidt & Finnigan, 1992), takes its title from former Xerox CEO David Kearns' own conception of Total Quality Management (p. xii). Kearns was credited with restoring Xerox's viability against its Japanese competitors before leaving to become the US Deputy Secretary of Education.

ment in their work while subjecting them to increasing degrees of scrutiny and productivity demands.

Business Process Reengineering seeks a radical reorganization of offices, departments, and entire companies around specific "business processes." One method employed is task-analysis, which seeks to establish the "process flow" of business functions, analyze out the distinct tasks and their functional relations, and logically reintegrate these into a more nimble and efficient business machine (Sachs, 1995, pp. 38–39). The reengineered processes are argued to provide workers with a more direct and enterprising relationship with their work and a stronger identification with their corporate culture. Much like Total Quality Management, Business Process Reengineering seeks to reorganize processes around the customer, and does so by creating entrepreneurial teams which are treated as autonomous and accountable entities within the company. The principal difference between the two is that Business Process Reengineering calls for a radical transformation of work organization and the subsequent elimination of jobs that this necessitates (Willmott & Wray-Bliss, 1995).

The applications of Total Quality Management and Business Process Reengineering in American companies have met with mixed success generally, but seem to have been particularly successful in establishing customer-centered product development processes in office and information technology industries. While the reengineering process has been realized in different ways in different companies, a Digital Electronic Corporation design-leader's experience is not unusual:

> In the summer of 1993, the central engineering organization in Digital began the implementation of a re-engineering effort under the name of Achieving Engineering Excellence (AEE). This in turn was an integral element of Digital's overall re-engineering effort, inspired by a desire to streamline all our dealings with customers. A major goal of this effort was the reduction by 50% in new product development cycles. Internal data collected within Digital showed that the most significant contributor to excessive development cycles was a phenomena known as "requirements churn."
>
> The AEE data, gleaned from a survey of hundreds of Digital's staff and an analysis of the corporate planning database, found that on average, 40% of the requirements specified in the Feasibility and Requirements Phase of the Lifecycle were redefined in the subsequent four Lifecycle Phases. The cost of requirements churn, using an industry-wide regression model, found that on average Digital spent 50% more than budgeted. (Hutchings & Knox, 1995, pp. 72–73)

This led to the development of a Requirements Management reengineering team which sought to eliminate the "churn" by forming cross-functional design groups (with members from marketing, service, management, and customer representatives in addition to engineers), restructuring the requirements-gathering process into an iterative "listen–define–validate" model that relies on continual feedback instead of an initial exhaustive establishment of requirements (Hutchings & Knox, 1995, p.

74). Though not all companies approached this new problem in the same way, this is essentially the basic process by which many North American companies began using more participatory design methodologies.[17] Through a demand for the representation of the user/customer in the design process, Business Process Reengineering and Total Quality Management transformed both the problematic of design and the standard of value for judging the design process and its products.

4.3. The autonomous engineer: Engineering Codevelopment

In many ways, Xerox's Engineering Codevelopment (EC) exemplifies the impact of socio-technical system design and customer-centeredness on North American systems design. Various other projects could serve this purpose as well—see, for example, Holtzblatt & Beyer (1995)—but Engineering Codevelopment does a good job of bringing together many of the themes and issues with which this paper is concerned. Engineering Codevelopment was more daring than most design methodologies in that it recognized that the successful integration of the user/customer in that process will necessarily transform the work practices of the engineers. It approached the methodological problems of design with essentially the same general objectives sought by reengineering—reducing development time, improving product quality and customer satisfaction—but with a slightly different set of values. Besides improving the product through the integration of users in design, Engineering Codevelopment sought to improve the practices and skills of engineers by engaging them in novel situations where traditional practices and routines cannot be readily applied:

> Working directly with users and supporting their day-to-day work require engineers to be committed to helping users in a personal way. Hierarchical dependency relationships between engineers and managers do not work in a codevelopment effort that bridges two different enterprises. In addition to independence, team members are encouraged to develop a diverse set of technical, interpersonal, and often interdisciplinary skills. Finally, individuals develop their own direct and informal contacts within their own and the users' organizations. (Anderson & Crocca, 1993, p. 49)

[17] The Joint Application Design literature also makes frequent references to the loss of productivity through poor methods of requirements gathering:

> Gary Rush states that "error removal constitutes up to 40% of the cost of a system. Between 45% and 65% of these errors are made in system design" [9, p. 11]. Likewise, James Martin cites one corporation which found that 64 percent of its bugs were in analysis and design even though users had formally signed off on the documentation. He also notes that 95 percent of the cost of correcting bugs for a large bank project was for requirements and design errors [8]. Citing a Government Accounting Office study of nine software development projects, Charles Martin concludes that "less than 5 percent of the money put into the nine software developments resulted in software that could be used as delivered or with minor changes. . . . The report suggests that these system were not properly described in the first place" [6]. (August, 1991, p. 4).

This "radicalization" of engineers' work was not in fact an objective at the beginning of the experimental project, and was one of the causes of the project's failure. Thus it was neither arbitrary nor purely philanthropic, but reflected Xerox's committed objective to experiment with and develop improved engineering methodologies—they were willing to try it in order to "see what would happen." Xerox's desire to participate in the Class project with Cornell librarians was primarily motivated by a theoretical rather than a purely practical concern, but one which still sought to achieve business objectives valued by an office technologies industry seeking to improve its technological advantage through organizational change. It should also be noted that the Class project was undertaken by Xerox researchers outside of PARC, though PARC researchers did consult on the project.

The Engineering Codevelopment methodology was characterized by two essential features. The first of these was a customer-centered prototyping methodology. The system being designed was a scanning and retrieval system for some 1000 brittle books in Cornell's libraries. The project consisted not just in designing an information archiving system, but in the development of the physical digital scanning and printing devices necessary for its effective use. Hence, the methodology placed a great deal of emphasis on obtaining customer reactions to working prototypes placed in the customers' workplace. The idea was thus to "tune" the artifact to the work environment in which it was to serve. In addition, Engineering Codevelopment was characterized by its willingness to let engineering practices develop openendedly around the requirements of prototype development. This was reflected in the enormous amount of autonomy granted to the design team by their own corporate management. Where traditional engineering methods are organized according to a hierarchical and functional structure, the division of design labor tends to be rigidly controlled by management, who maintain authority in key decision-making situations. The semi-autonomous Engineering Codevelopment group dissolved its internal organizational hierarchy and also obtained some degree of executive autonomy from their corporate supervisors (Anderson & Crocca, 1993, p. 54). This limited autonomy resulted in a profound transformation of engineering practices in the design process, and it also contributed to the political tensions which ultimately led to the project's poor reception within the company.

Traditional design methods at Xerox place marketing research and development groups in charge of producing detailed system specifications, often through survey research. These specifications are in turn transmitted from marketing to design groups and subgroups via the established management hierarchy and functional subdivisions in the engineering organization. Engineering Codevelopment, by contrast, seeks to develop a system for a customer with needs that cannot be formalized by market research methods. The design team is thus charged with the novel task of evoking and verifying the system requirements through personal interactions with users. The idea is to establish the needs of users and codevelop the prototype in real time by letting users judge the adequacy of the prototype's features (rather than test engineers as is traditional).

The consequence of this new demand on the designers in such a situation, at least in the Class project, was a radical transformation of engineering practices. Whereas

design traditionally begins with the division of tasks and responsibilities among the design team, the Engineering Codevelopment group members "float" among tasks and leadership roles through the course of the project based on personal initiative and experience. This had five advantages as reported by group members: (1) decisions were made by those most involved with a problem rather than by a manager with no antecedent knowledge of the matter; (2) because designers are not locked inside functional "black boxes" they are each aware of the overall situation at hand and how their activities are situated within it, resulting in a better overall design; (3) designers were able to participate in diverse tasks which broadened their skills and knowledge while enriching their work experience; (4) all members are fully employed and do not spend large amounts of time waiting for others to complete their tasks before they can begin; and (5) group members are chosen and valued for their particular and unique skills rather than their conformity to a homogenizing structure (Anderson & Crocca, 1993, p. 54).

In contrast to Joint Application Design methodologies which sought to alter the hierarchical and functional design process by merely adding a new functional component to that process, Xerox's Engineering Codevelopment was willing to forego the organizational structure of its design process in the hope that the flexibility provided would produce a working system where its traditional market research methods could not reach. While Xerox's explicit objectives were to design a highly customized system for their customer, they were also interested in studying the novel methods and group dynamics that would evolve in a design team organized around a customer-centered design process and granted a great deal of autonomy. The experiment not only resulted in a product which satisfied the customer but also in a reconstitution of the engineers' work organization, which led to the promotion of some empowering humanistic values—job satisfaction, diversity of experience, skill appreciation, personal autonomy, and educational development.

It is worthwhile to note that the project's leader, Bill Anderson, began his career at the Tavistock, and that the account of engineering practice presented as an outcome of this project echoes the virtues of the "autonomous workgroup." More importantly, the promotion of these humanistic values was limited to the *engineers* of the technological system, and did not extend to the *users/customers*. While interactions with the users stimulated this organizational transformation, the users' organizational situation was not profoundly changed. The introduction of a new technological system in the librarians' workplace certainly transformed their work practices in various ways, but from a design perspective there was an established objective to maintain a value-neutral approach to these transformations: "Even though engineers are changing the customer's work practice, they need to avoid interfering with the social and political dynamics that characterize that workplace" (Anderson & Crocca, 1993, p. 55). The result of pursuing such a methodology was a work practice very much like the ideal "autonomous workgroup" originally sought by the socio-technical systems researchers at the Tavistock, yet here it has again shifted its focus toward the design process and away from the consequences of technological change on the reorganization of worker's practices. And, like the European Participatory Design researchers,

Engineering Codevelopment recognized the difficulties of communicating design concepts between engineers and librarians.

5. Reflections on technology and critical theory

Participatory design emerged at the convergence of two approaches: (1) a critical project which sought to rectify political imbalances caused by technologies in the workplace and to protect workers from technological change, and (2) the evolution of a technological rationalism which sought to increase the success and efficiency of new systems. We have just recounted the historical development of that convergence and noted the moments at which its purposes and practices shifted to accommodate new concerns and to abandon futile efforts. What can this history of participatory design tell us about the social implications of technology, and the possible roles for a critical theory of technology?

There are a great many issues bundled up in this history, and many of the individual strains have been discussed in isolation by various authors. I find such isolated discussions dissatisfying because, to borrow Heidegger's words, they leave us "utterly blind to the essence of technology." These discussions take on several forms in which technology is either a political tool or politically neutral, and if a political tool it is either completely plastic and subject to the predominating political will (whether this be derived from underlying political structures or a consequence of political negotiation) or it is a rigid and unbending servant of political hegemony. None of these is quite right, and teasing apart the real essence of technology must confront both its empirical and political aspects.

In this final section, I will begin by examining the nature of "representation" as it plays out in the "representation of users" through the history of participatory design. This constitutes the scientific or empirical side of participatory design—its material and practical consequences for systems design. I will then turn to a discussion of the role of technology in political theories, and in particular the perspectives on technology taken by critical theory.

The conclusion I will reach is that representation is neither purely objective nor subjective, but is ultimately pragmatic. And technology is neither politically neutral nor deterministic, nor is it a perfectly plastic media waiting to be molded by political forces, but different technologies are more or less plastic and subject to being inscribed with political ideologies or enforcing political policies. Accordingly, technological artifacts are able to stand as shared referents by virtue of their material and practical consequences, and when engaged in a dialectic they offer resistances of their own which must be dealt with. A given technology will only be empirically and politically successful if it is able to survive a dialectic of design and use. While it is possible to get a technology "right" the first time around, the best guarantee of a technology's success is to subject it to successive redesigns informed by user reactions. The advantage of this dialectic approach is that it is able to address empirical and political, material and symbolic, issues simultaneously at each iteration. A system will be a failure if it cannot achieve the intended design goals, if it is unreliable

or breaks internally, if it never gets used as intended or at all, or if it actually impedes the jobs of workers. Thus, participatory design methods can be a highly successful way to build technological systems because it integrates an assessment of material, practical and political consequences of a system in a single dialectic of resistance and accommodation.

5.1. Representing users: the science of participatory design

European Participatory Design had always been concerned with how technology alters work practices. At its inception, however, it did not consider the technological design process itself to be a key point of interest. Once projects like UTOPIA had begun to problematize technological design, they saw their challenges as being the overcoming of traditional roles, power relations and preconceptions of designers and users. Very quickly they added to this the problem of "communication." What researchers found most difficult, once socio-political barriers had been bridged, was that designers and users tended to talk past one another. Similarly, researchers taking the approach of technological rationalism to design thought initially that knowledge of users' requirements could be acquired straightforwardly through organized meetings. They learned quickly that this process was not so straightforward, and the make-up of a Joint Application Design meeting reflects a recognition of the difficulty of achieving this understanding—the need for visual aids, the importance of "scribes" to record "lists" of priorities and requirements which arise during meetings. These approaches thus shared a recognition of the problem of communicating technical designs early on.

Historically, representing the practices and needs of workers grew out of the old and adversarial traditions of worker advocacy by unions, and the Tayloristic analysis of work practices. Producing such representations has been a long-standing and controversial enterprise. On the one hand, expertise and skill are identified as the personal traits of skilled individuals, and are therefore are a human value which is alienated from the individual in the process of extracting that knowledge and producing a representation of it. On the other hand, there are the needs of workers which the union attempts to represent as a political agent acting on the behalf of the worker. In the case of skilled workers in a factory, these needs and expertise can often be clearly delineated. In the case of information-intensive office work, this task can be more difficult: when is certain information required by a certain task and when is access, or the privacy from others having access, to that information a right of the worker? When is a task a valuable skill, and when is it merely a burdensome chore? The rationalization of work and the political needs of workers are themselves difficult to represent, and in the process of information systems design the problems frequently seem to mix together and become even more difficult to get a grip on.

A great deal of literature has been produced by both approaches on the problem of communicating the needs of users. In fact, this problem can be seen as an aspect of the problem of representing users' skilled practices and needs in general, where asking them to communicate this knowledge is simply the approach taken by participatory design. For example, the essence of Joint Application Design is to involve

users in meetings *during the requirements gathering phase of the system development project*—the desired objects of knowledge are the requirements, and the users are a means to this end.

Researchers also encountered problems in uncovering knowledge of tacit skills or embodied routines, and realized a necessity for respecting the fact that workplaces have a rich local vocabulary that takes time to master and is not always easily translated to individuals outside the workplace. Thus there emerged a recognition of the problem of communicating users' knowledge to engineers. It was expected that bringing the users into the design process would also bring their tacit knowledge into the technological product. This turned out to be more difficult than expected, and the different approaches responded differently to this challenge. The technological rationalists saw the problem as one of properly "representing the user"— that there was some objective knowledge held by the user which needed to be elicited, but there was resistance to this elicitation, either in the users or in the system of communication between users and engineers.

From the socialist and humanist perspectives, there did not exist the same faith in the existence of some objective knowledge on the part of users about their own skills and practices, but there was a recognition of the politically charged nature of the workplace and any interactions which might occur between engineers and users. They believed that some users may not feel politically safe in articulating their needs, or that the needs of a collective of workers were essentially a coalition of different and sometimes conflicting interests which had to be negotiated among participants. The solution in both cases was to bring users and engineers into closer practical interactions—in structured and unstructured meetings, and by sending engineers into the workplace to observe users or even participate in the work practices of users, as users.[18]

The problem of representing the worker, and its ambivalent status, has been well articulated by Suchman (1995). Suchman offers several key points for reflection to social scientists and systems designers involved in representing workers for the support of work. These points stem from the recognition that attempts at empirical objectivity and accuracy often neglect political realities. One point is that the ways in which representations are utilized in design can limit user autonomy regardless of their accuracy. The principal limitation on autonomy presented by information systems is the managerial control and surveillance that is made possible by these systems. Once a task is embodied within an information system, the observation of that task or of its products, and thus their measurement, becomes an easy prospect for managers and administrators.[19] Thus, system designers need to be aware of the poten-

[18] Systems designers in Hitachi's Software Factory spend an extended apprenticeship in their application's workplace before they begin programming the software and thus experience their application as a user before entering the engineering environment. InContext Enterprises Inc. is an example of a consulting firm which specializes in establishing workplace apprenticeships for designers in a method they call Contextual Inquiry (Beyer & Holtzblatt, 1995, p. 46).

[19] See Zuboff (1988) for a discussion of the many ways in which information systems can be implicated in workplace politics.

tial applications of their work even if they themselves have no ill intentions. It may also be the case that by the embodiment of a task in a technological system one limits the personal autonomy of the worker. However flexible they are intended to be, a computer system always offers only a limited set of ways to do things and by requiring workers to proceed in certain specific ways it can limit their ability to organize their other tasks, thus limiting their autonomous space of task scheduling. In short, regardless of the political or other intentions behind designs based on knowledge obtained from workers, the use of that knowledge has practical consequences and these will not necessarily conform to the design intentions, whether practical or pragmatic.

The notion of "representing the user" is further complicated by participatory design insofar as workers are expected to "speak for themselves." The next section will make a more careful consideration of the nature of user participation as one of political participation, but we should note here that the very idea of "representing the user" can be seen as a way of silencing the user. Moreover, not all of a system's users will ever be present during the design process. Only some will be present, and new users will have to be trained as they enter the workplace. Thus, even when users are fully involved in design, they are only representatives of a larger group of potential users. Still, there are challenges to the full participation of these user representatives, not the least of which is conveying to them the significance of various design alternatives.

The nature of the problem of communicating designs to users and its solutions revolve around the different practical requirements for a design. What researchers found to be most difficult in communicating a technical system's design to users was that users lacked technical knowledge, and system designs are typically expressed in highly technical form. A formalized design made by and for engineers will amount to instructions and requirements for the necessary components and their functional interactions with one another—a technical "blueprint." An engineer's design specification will rarely describe features in terms of a user's actions, which are assumed to be given or implied by a "good" design—the blueprint of a house rarely depicts its occupants. To a user, the internal functional specification is almost meaningless, as their concern is with the practical activities it supports and the ways in which their own practices will be altered by a new system. Since users were not participants in the actual technical execution of the design, they found it difficult to understand the various system designs which the engineers proposed. What was needed was a new way to represent a system design which did not require technical knowledge to interpret its practical consequences. The various prototyping and visualization methods developed by participatory design researchers thus attempt to build a bridge from the engineers' design alternatives to the users needs by creating an intermediate representation which is technically feasible and affords practical interpretation.

The initial attempt at this kind of representation in the UTOPIA project was to develop exemplary "screen shots" of what the potential design would look like. This helped, but users found it impossible to judge whether such a design would satisfy their needs since they could not conceive of how it would actually operate. In response to this problem, the researchers developed many innovative means for com-

municating the practical functionality of various designs and design elements to potential users. The participatory design literature has since produced numerous articles on "prototyping," "visualization," "mock-ups," "storyboarding," "metaphorical design," and "future workshops" which all have the expressed purpose of offering suggestions of how to develop and use videos, transparencies, functional prototypes, and even cardboard boxes and plywood to give users a sense of how a proposed system will work.

It is interesting to note the similarity of many of the early European Participatory Design visualization techniques and future workshops to the techniques and meetings developed by Joint Application Design practitioners over a decade earlier, though there appears to have been no direct influence from the older Joint Application Design tradition on the European researchers. Xerox's Engineering Codevelopment takes the methods of technological imagination one step further by introducing the working prototypes into the user environment. This final step, however, turns out to be qualitatively different from the others insofar as users interact directly with a prototype of the new technology, rather than with a representation which is still subject to interpretation by an engineer.

When taken together, we can see in these two "problems of communication" an image of the basic mode of scientific knowledge. The image that science extracts objective knowledge from the world is highly problematic, but a discussion of this metaphysical issue is beyond the scope of this article (see Latour & Woolgar, 1979; Hacking, 1983; Pickering, 1995). Let it suffice to say that according to this image, there is a matter of fact out in the world which is observed, understood and assimilated into a theory, the theory has certain consequences, and these consequences can be reliably expected to occur under specific circumstances. In the way that a doctor discusses symptoms with a patient and prescribes a remedy, or a physicist probes a system and predicts the outcomes of future manipulations, the system designers ought to elicit knowledge of workers and prescribe a better system. There is, of course, a great deal of noise in both directions of this communication model; understanding a patient's symptoms, and getting a patient to take a prescribed medicine, setting up and interpreting instrumental measurements, and getting a system to react properly to an intervention, eliciting system requirements from workers, and getting workers to use a new system proficiently are all difficult tasks. But this model of scientific understanding and expertise is only an ideal, and there is really much more complexity to the situation. Indeed, it was been well argued that much of the work of science involves making what actually happens in the laboratory "fit" with this ideal of what ought to happen (Pickering, 1995).

Many would argue that the comparison to natural sciences is unfair, and that systems design is really more of a human science in which knowledge is inextricably subjective. Indeed, the objective model of science is itself only a caricature which fails to take account of the many social and material negotiations which take place in the process of producing and exercising scientific knowledge, while social sciences are concerned primarily with these negotiations. The epistemic problem is not one of correctly communicating information from object of inquiry to the understanding subject, but as one of bridge-building—synthesizing a new field of symbolic meaning

through a series of symbolic and material interactions. In the case of systems design, the interactive process is between engineers and users, and knowledge of system requirements is the outcome of the confluence of two different fields of symbolic discourse and sets of material practices. The objective of user participation in this situation is to align the concepts and representations of both workers and engineers around a common discourse and set of practices through which the desired technological artifact can emerge, evolve and become useful.

It is thus helpful to consider the case of a social science which has struggled a great deal with issues of representation—cultural anthropology and ethnography. Systems designers themselves have recognized the relevance of ethnographic techniques to their work. In fact, an entire sub-discipline of systems design called the "Ethnography of Information Systems" has emerged which identifies the role of the systems designer, or at least one role of a member of a design team, as being fundamentally that of an anthropologist—to produce a representation of the practices of a work culture which can be used as a basis for systems design. These representations are sought out as a basis for the reorganization of observed work practices in order to increase efficiency and productivity, as well as workers' job satisfaction.

One recent article from this discipline even echoes some themes from the early Tayloristic practices of filming workers to identify and isolate the key motions of their jobs. Produced by Xerox's Work Practice and Codevelopment Group, the article outlines and analyses the use of video for the recording and analyzing of office workers (Brun-Cottan & Wall, 1995). Instead of analyzing the kinesthetic properties of tasks as in Taylor's analyses, the videos are viewed and analyzed by ethnographers to reveal the hidden aspects of a culturally informed work practice.[20] What is important to understand about this kind of representation is that it is necessarily reductive and for some purpose. A representation is valuable for what it leaves out as much as for what it contains, and the practice of creating representations does not seek completeness or objectivity but practical usefulness. It was precisely these kinds of practical representations which anthropologists came to recognize as the product of their profession. Many anthropologists felt confronted by an ethical crisis because such representations had been generated so readily to serve the interests of colonial control in many parts of the world.

Clifford (1986) has insightfully articulated the anxieties faced by cultural anthropologists reflecting on their role in the era of colonialism. His analysis focuses on the role of the ethnographer in representing another culture through interactions, photographs and writings in particular. The intriguing comparison to participatory design which strikes me in Clifford's account is that he conceives of the text as a consequence of a series of interactions—broadly construed as being between two distinct cultures, and narrowly construed as specific interactions between individuals. Under either construal, the text emerges as a synthesis of different perspectives which does not necessarily take on a single perspective. There are different ways to interpret

[20] It must be noted that these video methods are integrated into a larger codevelopment process where users evaluate the representations which ethnographers elicit from the videotapes.

the resulting text; in colonial anthropology the resulting texts can be criticized for their attempts to impose an imperialist perspective and take ownership of the knowledge of another culture by reconciling or exoticizing the differences between two cultures according to the purposes motivating authorship—the politics of colonialism. Similarly, the representations of workers which inform and justify the reorganization of work are criticized by authors such as Braverman (1974), Noble (1977, 1979) and Winner (1977, 1995) and Suchman (1995) as having the potential to disempower workers. Under such an interpretation, participatory design can be seen as a form of technological colonialism.

Another way to interpret the interaction between cultures is that a novel text is produced which does not have an identifiable perspective, but instead is decentered and multi-vocal. This is the way in which Clifford (1986) argues that ethnography can be redeemed from colonialism. By making explicit that different voices, experiences and perspectives are participating in the text, the reader is allowed access to the processes of interaction between cultures that the anthropologist has, without being required to draw the same conclusions.

In Joint Application Design, for instance, the Design Document could be interpreted as just such a multi-vocal text, representing not the objective needs of workers or system requirements but the negotiated outcome of interactions between users and system designers. Whether this is a legitimate interpretation depends very much on the context in which the document is produced and the practical consequences of systems which utilize that representation. The discourse between users and system designers is mediated and permeated by political imbalances, and lies somewhere on a continuum between the extremes of participants acting as free and capable equals in what Habermas (1990) calls an "ideal speech situation," and participants acting as interrogator and informant. As Hirschheim et al. (1995) make clear, the actual stance taken towards the explicit knowledge extracted through interactions between system designers and users is dependent on the paradigmatic assumptions of the system designers who use the knowledge to build systems. Whoever organizes the system development project and organizes the interactions between users and designers does so according to their own assumptions about what the goals of that interaction ought to be: technical requirements, user needs, political reconciliation, worker empowerment, etc. Of course, successfully imposing metaphysical and political assumptions on the design process depends on the success of attempts to maintain social roles within such meetings.

The notion of a technology being like a text at the point of intersection between two cultures has been well articulated in Star's (1989) concept of a "boundary object." But while information technologies do support the inscriptions and articulations of incongruent or even incommensurable perspectives and interests, Clifford's notion of the ethnographic text can add something more subtle to our understanding of participatory design. What he presents is a way to understand ethnography as a performance:

> Cultures are not scientific "objects" (assuming such things exist, even in the natural sciences). Culture, and our views of "it," are produced historically, and are

> actively contested. There is no whole picture that can be "filled in," since the perception and filling of a gap leads to the awareness of other gaps. . . . If "culture" is not an object to be described, neither is it a unified corpus of symbols and meanings that can be definitively interpreted. Culture is contested, temporal, and emergent. Representation and explanation—both by insiders and outsiders—is implicated in this emergence. (Clifford, 1986, pp. 18–19)

Understood as a temporally emergent performance, ethnography becomes a way of interacting with the world centered around the production of a material record of those interactions. The same can be said regarding the processes of design which provide for interactions between users and engineers—the result in a system which stands as a material archive of their interactions with each other.

With the introduction of functional and working prototypes into the user environment, and thus into the interactions between system designers and users, the dialog between users and designers becomes dialectic. In cultural anthropology, the cultural insiders are rarely given the chance to challenge the representations made by the anthropologists' text. If the outcome of an interactive process of systems design is merely a document, it is still the prerogative of systems designers to produce whatever system they please, and it is the prerogative of users to resist whatever system the designers attempt to impose on their work practices. But when the technological artifact itself becomes part of the interaction, the material and practical consequences of design are reworked in the process. Designers are no longer attempting to interpret design requirements in isolation, but must respond directly to the users' reactions to the consequences of the existing system. Users cannot so easily reject a system as being remote from their needs and ineffectual when it has gone through several revisions motivated by their own challenges to its relevance and usefulness. And throughout the redesign process, the practical and material resistances of the technology itself to being reworked in certain configurations becomes manifest to users and designers.

We have thus seen how two different perspectives on information systems design, one approaching from the side of the technological rationality and one from the side of social and human empowerment, have converged upon the same set of problems. By arriving at the point of contact between the human and the technological as the source of resistance in the development of information systems, both perspectives converge upon the problems of understanding and incorporating the practices and needs of the user in the process of developing new technologies. The consequence is that social progress and technological progress both come to socio-technological progress, and arrive at a common set of problems as a result.

5.2. Technology as politics: the critical theory of technology

In the end, participatory design went beyond the initial suggestions of written criticism to become an agent of technological change in the workplace. Many of its methods and ends were shared by the Quality of Working Life movement, and ultimately the corporate restructuring of the late-1980s. How are we to understand these

critical and technological transformations and what can be learned from them? We could note the weakening of the critique itself—and we might try to explain this by appealing to the realities of business and technology as having confronted and overtaken political ideals. Or we could interpret the participatory and ethnographic approaches to systems design as enabling the regimes of empowerment and measurement and new forms of technological colonialism. Or we could instead note the success of enlightened design practice as one of the factors contributing to economic success and job satisfaction for many corporations and their employees. The development of participatory design is complicated by the historical turns it took and the diversity of projects that carry its banner, but it is hoped that careful attention to these complications provides an appreciation for the tensions we find in the current practice of participatory design. It is also hoped that the study of this particular historical strand of technological criticism can provide some lessons for technological criticism in general. What might this history tell us about the role for a critical theory of information technology?

The original motivations of researchers in the early Scandinavian projects was explicitly to counteract the dehumanizing effects of an increasing technological presence in the workplace. This was principally informed by a Marxist critique of the labor process and targeted Tayloristic rationalization as an assault on the human aspects of this process. Early Scandinavian researchers were also critical of the Tavistock researchers' desire to design and optimize the social side of socio-technical systems for being another form of the furthering of capitalist goals at the expense of workers—an objective toward making workers less resistant and more efficient. This disagreement over what counts as "democratizing work" exemplifies different conceptions of the nature of technology itself.

Feenberg (1991) is critical of traditional Marxist critiques for essentializing technological bias—the belief that technology has an essential bias towards serving the values of the capitalist society which produces it and thus that truly democratic technology can only be produced after revolutionary social reformation. He is equally critical of viewing technology as being essentially neutral and thus develops a notion of "ambivalent technology", stressing its instrumental nature in support of any values that one wishes to build into it, which suggests that democratic social reformation can itself be affected by developing technologies which embody democratic values. This is essentially the same position that the Scandinavian researchers had finally arrived at with the second-generation projects and their renewed acceptance of the Tavistock researchers. It is important to note the way in which this view assumes that technologies are perfectly plastic and subject to human interests.

The shift is thus from a generalized resistance to new technology to the belief that some technologies may be genuinely progressive, and with this shift comes the insistence on introducing democratic ideals into technological design. But what are these ideals? Feenberg identifies essentially the same positive ideals that the Scandinavian researchers gleaned from Braverman's negative points: recontextualizing design, respect for the promotion and preservation of skill, the reintegration of aesthetic and educational value in work, and anti-hierarchical and peer-oriented interaction. The ideals are certainly democratic, but in their abstract form how are they to

be effectively realized in an actual technological system? The design process is an enormously complex one, and in any actual system there will be other values of utility and efficiency in play and possibly competing with democratic ones. In fact, it is precisely the issue of what counts as efficient and useful in a technology that problematizes requirements gathering and led even the most techno-rational corporate cultures to seek out the methods of social sciences for assistance.

It is these competing and overlapping values which meet in the current methods of participatory design and it is within specific design contexts that these values must be weighed out and matched to specific proposals and technological possibilities. Every design process is thus permeated with issues of value and how these will be decided is contextually dependent on work and process organization, power relations among individuals which implicate expertise, information access, authority, and rhetorical skill, restrictions on time and financial resources, and a myriad of incidental factors, not the least of which are the actual material capabilities and practical demands of the technology in question. Besides promoting abstract democratic values generally and in the design process, there would seem to be no specific, formal or structural prescriptions available for the "democratization of work" through design, and such a view ignores the possible limits of technological capabilities.

Despite these complexities in the design process, participatory design has been argued to stand as a model of how critical theory might approach technology. Some authors, such as Winner (1995), have proposed that participatory design might bring us one step closer to realizing a humanist ideal of Enlightenment democracy—a world in which people are universally empowered to determine the rules which govern their social practices—by providing a forum for bringing technological choice to the people. This was much of the motivation behind the Scandinavian participatory design researchers' interests in worker empowerment, but what does this assume about the political role of technology?

First, it is important to note that Winner (1995) is primarily concerned with the participation of users in discussions of system requirements, not necessarily with the accommodation of their reactions to working prototypes. Ultimately, politics are played out between the participants in the public discourse, and technology joins the politically marginalized as a pawn in the political game—having no agency as a political actor in its own right. Such a conception is difficult to maintain when we consider the technologies that Scandinavian researchers first attempted to subject to political control—heavy machinery—only to discover that it was not plastic enough to be the negotiated subject of collective bargaining.

It is also crucial to note that Winner is holding out a procedural notion of justice as his political ideal—it is the very participation of people in design that is democratic, just as the right of all citizens to vote makes a nation democratic. It does not follow necessarily from universal participation that the society or technology which results will be free or empowering—just as people are free to elect a tyrant or the right to vote may not come with other human rights attached. Instead, like "due process," participatory design is argued to provide a process which is the realization of justice even when the outcomes of the process may not be found agreeable to everyone. What Winner and many of the authors who promote Habermas' (1984)

critical theory focus on is the centrality of public discourse to politics. This is to say that the rational political ideal is the participation of individual voices in debating and arriving at a mutual agreement on normative issues. The challenge facing such views is that participants in such discourse are never able to escape their power relationships with one another in order to participate on an equal footing in an "ideal speech situation" (Habermas, 1990) from which genuinely universal normative claims could be arrived at.

But I think such public discourse theories of politics suffer from another sort of idealism as well when they address technology issues. Consider a fundamental political issue such as the distribution of goods. Some of the most basic goods happen to be material—food, shelter, clothing—and their production and distribution entail practical considerations apart from normative claims. While material considerations may not be germane in a debate about how to split a cake which sits between us at arm's length, there are certainly many norms which we could agree to that could easily fail to be practically or materially realizable (e.g. we should each get 55% of the cake). The point is simply that there are constraints on the norms that can be practically realized which are not determined by the discursive participants. That the nature of the material world has implications for politics is hardly a revelation, but discourse theories have no simple way to address this fact.

The general way of handling the material world in such discourse theories is to say that experts, scientific and technological elites, are responsible for debating and arriving at rational norms about the physical and material properties of the world. This, however, leaves non-experts ill-equipped to challenge such norms, and thus limits their ability to participate in a discourse based on those norms. But if we take such an approach, how are we ever going to be able to provide a useful critical theory of technology? Technological elites will always have a disproportionate amount of power in debates about technology, and to exclude technological elites or disregard the norms they have established is to ignore what is known about existing and potential technologies. What Winner hopes is that merely bringing technocrats and the masses together in participatory design will promote discourse, but this fails to address how the inherent power differential between the technocrats and the masses can be overcome.

While I believe that this techno-populism is a worthy objective, if only because it brings together people of diverse perspective and purpose to engage in the application of technologies, the promotion of such highly abstract ideals often contributes little more than rhetoric and motive to actual design projects. Moreover, it stresses *democratic participation in technological choice* as the principal lesson to be learned from participatory design—but it is not clear that it is practical or desirable to have universal participation in design choice. As was mentioned in the previous section, like many modern nations, participatory design only offers representational democracy, and thus introduces the possibility of misrepresentation. It would be unnecessary, or even impossible, for everyone who will ever ride a bus to participate in the design of that bus, yet it seems highly desirable to have meetings in which the bus-riding public voices their concerns over routes and schedules. The point is not that everyone gets a voice, but that *everyone who has engaged the technology and is in*

a position to assess its usefulness in their daily practices has the ear of those who have the power to alter its potential usefulness. Participatory design researchers themselves stress the virtue of participation, but much of the value of their contribution lies in the consequences of realizing participation—the confrontation of the material and practical implications of their technological artifacts.

A critical theory of technology must include technology as an agent to be dealt with in political discourse. Unlike human political agents, technology does not challenge norms as illegitimate, but as unworkable. There is a danger of confusing this notion with a common assumption of techno-rationalism—that the technology itself imposes a logic on discourse. This is not what is meant by considering technology as an agent. Technologies are certainly open both to application and development, and are thus not inflexible to the political will. But neither are they infinitely flexible and perfectly plastic. Some configurations work, some cannot work, and many others may remain uncertain. Specific technologies may or may not be possible, and the only way to arrive at a legitimate conclusion is to pursue research, and thus commit resources, into exploring those possibilities. The material dialectic process can be most clearly seen in Engineering Codevelopment's "tuning" of an artifact to its environment. Such technological research is then a double dialectic: between political agents who determine the direction and goals of research, and between researchers and the material and practical resistances of specific technologies. What participatory design does is to add a third and shorter feedback loop to these interpenetrating dialectics. At the beginning of our history, these dialectic loops only touched at the points of project proposals and final system evaluation. Over time, the points of contact increased and the loops wound together. At the end of this history there are three dialectics: (1) users engage directly in a dialectic with the material and practical implications of a technological design, (2) enabling them to reformulate their desires and objectives within the dialectic between designers and users of the technology, (3) which in turn motivates designers in their dialectic engagement with the technology. Feenberg and Winner are concerned almost exclusively with (2). A critical theory of technology ought to recognize that ensuring an environment in which a public discourse occurs demands informed users and responsive technicians, and thus requires dialectics (1) and (3). It is only through a direct engagement with the technology that one can decide whether a design can be realized, or whether the technology has satisfied the needs which motivate its construction.

Participatory design is an intriguing critical project which has successfully crossed multiple disciplinary, organizational, political and cultural boundaries. It traces the leading edges of technological application, business management, and social science and for this reason alone should be looked at carefully for its broader historical ramifications. But above all, participatory design has demonstrated that the critical engagement of technology requires not only a great deal of thoughtful reflection in the confrontation of political and ethical demands, but also that critical practice must fill the difficult role of articulating the technological alternatives which are actually capable of satisfying those demands.

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