4 Scandinavian Design: On Participation and Skill

Pelle Ehn
Aarhus University

In Scandinavia we have for two decades been concerned with participation and skill in the design and use of computer-based systems. Collaboration between researchers and trade unions on this theme, starting with the pioneering work of Kristen Nygaard and the Norwegian Metal Workers' Union, and including leading projects like DEMOS and UTOPIA, has been based on a strong commitment to the idea of industrial democracy. This kind of politically significant, interdisciplinary, and action-oriented research on resources and control in the processes of design and use has contributed to what is often viewed abroad as a distinctively Scandinavian approach to systems design.

This Scandinavian approach might be called a work-oriented design approach. Democratic participation and skill enhancement—not only productivity and product quality—themselves considered ends for the design. This chapter is based on two research projects, DEMOS and UTOPIA. I have elaborated this approach in detail in *Work-Oriented Design of Computer Artifacts* (1989).

Two important features of participatory design shape its trajectory as a design strategy. The political one is obvious. Participatory design raises questions of democracy, power, and control at the workplace. In this sense it is a deeply controversial issue, especially from a management point of view. The other major feature is technical—its promise that the participation of skilled users in the design process can contribute importantly to successful design and high-quality products. Some experiences, perhaps most developed in Scandinavia, support this prediction and contribute to the growing interest in participatory design in the United States and other countries; by contrast, "expert" design strategies have too often turned out to be failures in terms the usability of the resulting system. These two features together suggest that there is a firm link between the skill and product quality aspect of user participation and the democracy and control aspect, or else participatory design would be a deeply controversial issue from the point of view of the employees and trade unions.

The trade-union-oriented democracy aspect of skill and participation in design is discussed in the first part of this chapter. I start with an introduction to the concept of industrial democracy and an overview of the Scandinavian setting. After this background, research projects forming the Scandinavian work-oriented design approach are presented and discussed.

In the second part, I focus on the role of skill and participation in design as a practical activity. This focus has grown out of a dissatisfaction with traditional theories and methods for systems design. Not only has traditional design been oriented towards deskilling workers, but this traditional approach has been encouraged by a theoretical assumption, namely, that skill can be exhaustively characterized by a purely formal description. The political critique of the design process discussed in the first part leads to a theoretical critique of the scientific rationality of methods for systems description and systems development. In the second part, a philosophical foundation for a skill-based participatory design approach is outlined based on the language-game philosophy of Ludwig Wittgenstein. Taken together, these critiques shape the Scandinavian work-oriented design approach, an approach based on an emancipatory perspective and encompassing both the inner everyday life of skill-based participatory design and the societal and cultural conditions regulating this activity.

DESIGNING FOR DEMOCRACY AT WORK

The democratic ideal is a beautiful human invention: Every human should have the right to participate equally in decisions concerning his or her life. In practice this freedom has always been limited. The first democrats, the ancient Greeks, constrained participation to free men, excluding women and a class of slaves. The modern democratic state in capitalistic societies has, in theory and in many practical aspects, removed these constraints. Representative democracy is a formal arrangement for securing decisions in the interest of the majority, and often manages to assure freedom for minority groups.

In many sectors of life, however, democratic rights remain merely formal, without real content for those concerned. In this paper, I am concerned with democracy behind the factory gates and office doors—democracy at work.

Fundamentally, democracy at work or industrial democracy concerns freedom, another value-laden concept. It concerns *freedom from* the constraints imposed by the market economy and the power of capital. And it also concerns *freedom to* practically formulate and carry out particular projects that further democratize work. Attempts to democratize at work address:

1. The power of capital owners to control how resources are used. Possible uses include economic goals, structural changes in the company, investments in new technology, choice of business idea, and product range:
2. Owner's organizational and technological power to decide how the production process in general is organized and how technology is designed and used:
3. Their power over the workers to decide how work is to be organized, planned, and controlled:
4. Their power to limit an individual's autonomy at work, including the individual's choice of tools and pace of work (Dahlström, 1983).

The research projects on work-oriented design that I discuss in this paper address industrial democracy in all these aspects. They aimed both at a better understanding of freedom from managerial control and at freedom to develop and implement strategies for democratization at work. In particular, the studies looked at the design of computer-based systems in the context of democratization of work in Scandinavia.

The Scandinavian Setting

Scandinavian countries have for quite some time been well known for their distinctive industrial relations. The following features are particularly noteworthy:

1. A highly educated and relatively homogeneous workforce:
2. A high level of unionization:
3. Strong national trade union federations:
4. Centralized negotiation systems:
5. Large social democratic parties with strong links to the the national trade union federations of blue (and some white) collar workers, parties which for long periods of time have led the governments:
6. Relations between trade unions and employers that are, to a large extent, regulated by laws and central agreements:
7. A positive attitude to new technology from the trade union federations, at least since World War II and despite some opposition at the local level, based on the assumption that job loss due to the introduction of new technology would be compensated by active labor market government policies.

These features have contributed to the relative stability of Scandinavian labor relations and the relatively high degree of workplace democratization:

> Democracy [in the United States] stops at the office door and the factory gate. Western Europe is extending democracy into working life. Democratization of work has gone further in Scandinavia than elsewhere in Europe. Job redesign projects, codetermination arrangements, health and safety legislation, employee representatives on corporate boards. (Einhorn & Logue, 1982)

These historical factors help explain the emergence of the participatory trade-union-based work-oriented approach to design of computer artifacts. But just as important is the other side of the coin: The Scandinavian countries are still market economies, and an integral part of international capitalism. Workers and their unions therefore confront basically the same forces or rationalization of work and technology as those in other market economies.

Laws on Democratization of Work

The 1970s was the decade when democracy at work truly appeared on the agenda for industrial policy. In that decade, an intensive debate took place in trade unions, and a number of new labor laws were enacted (Fry, 1986).

In Norway, employees obtained the right to elect one-third of the members of the so-called "company assembly." In 1975, the first collective agreement on the development and introduction of computer-based systems was concluded, giving the trade unions the right to appoint so-called data shop stewards. In 1977, the Norwegian Work Environment Act gave workers extensive rights to stop production that was dangerous to their health. New codetermination procedures for work environment issues were established, and a system of sanctions was defined for employers who did not fulfil the new work environment requirements.

The Swedish "work democracy package" in the 1970s revised existing legislation and introduced several new acts. The work democracy package included the act concerning Labor Representatives on Company Boards, the Companies Act concerning disclosure of financial information, the act concerning the Status of Shop Stewards, and the Work Environment Act.

Finally, and most important, the Joint Regulation Act (MBL) concerning workers and trade unions' right to codetermination in production issues such as design and the use of new technology and work organization was enacted in January 1977. It was this law that the late Prime Minister Olof Palme described as the greatest reform in Swedish society since the introduction of the universal right to vote. In practice this act's impact has turned out to be far less dramatic, and as a result there was considerable disappointment among many union members who had received the impression that the Act was the decisive step towards democracy at work.

Nevertheless, MBL did create new conditions for the design and use of computer-based systems and other production equipment. Article 11 stipulates that the employer has to negotiate with the local union before making "major changes" in production. Article 12 give the union the right to initiate negotiations on any production issue. Articles 18 and 19 stipulate the right of unions to have access to documents to which management refers in negotiation, and to receive information continually on production issues, their employer's financial situation, and personnel policy.

These were important changes encouraging democratic control over the introduction and use of new technology, but they were limited. The Act gave the employer the exclusive right to make decisions when trade unions and management could not reach an agreement in negotiations. Furthermore, the "major changes" in production to which the Act referred are open to interpretation, as is the obligation to inform, which may or may not include early plans, say, to introduce a computer-based system.

Finally, Article 32 should be mentioned. This article concerns the right for trade unions to negotiate agreements on "the management and assignment of working duties, and the conduct of the operation at large." The number of this article was chosen to parallel Article 32 in the Swedish Employer's Confederation (SAFs) Statutes, which requires its members to retain the right of decision when entering collective agreements. The Act stipulates that if a collective codetermination agreement (MBA) is reached, the union has "priority of interpretation" over disputed issues covered by the agreement until the dispute is settled in negotiations. This gives the trade unions the opportunity to postpone decisions. However, the main idea behind Article 32 was that central agreements should be negotiated, and that local agreements should be developed on the basis of these agreements.

In 1978, the first central collective agreement on codetermination was reached in the public sector the (MBA-S). Not until 1982 was an agreement reached in private industry. By that time the forms of codetermination had become more concrete, but the trade unions' democratization offensive had to a significant extent faded out. What started as a trade union response to local demands for democratization in the late 1960s, often expressed as wild-cat strikes concerning the work environment and the introduction of new technology, had assumed a form sanctioned by parliament, national trade union federations, and national employers' federations.

The wild-cat strike by the workers' collective of iron miners at the Ikab mines in the north of Sweden was the starting point for these democratization reforms that concerned not only the democratization of the work place, but also internal trade union democracy. The work-oriented design approach emerged in the midst of the practical implementation of these reforms.

The Trade Unions as Vehicles for Industrial Democracy

In Scandinavia, trade unions have served as the vehicles for industrial democracy by advancing the interest of the workers' collective. The workers' collective is a concept developed by the Norwegian sociologist Sverre Lysgaard (1961) to designate the informal defense organization of workers in the workplace. The workers' collective is manifested as shared norms concerning how workers should behave in relation to management and the rationality of technical-economic organization. The norms shape workers' responses to management's efforts to intensify work, to tighten control of the labor process, and to rationalize the use of new technology. As hired labor, the workers are also part of the technical-economic organization of the workplace, but the workers' collective reflects workers' response to their subordinated position in this technical-economic organization.

According the Lysgaard, the degree of strength in the workers' collective comes from the "we-feeling" created by shared experiences. The basis for this we-feeling is physical proximity at the workplace, which makes interaction possible; similarity in working conditions, which makes the workers identify with each other; and a similar problem situation that they interpret in a similar way. The norms of the workers' collective define what it means to be a "good work mate" as well as what it means to be a "traitor." The workers' collective is a "buffer" between the individual worker and management's interests in shaping the technical-economic organization of the workplace.

However, the workers' collective has two major weaknesses when compared with institutionalized forms of industrial democracy. First, the workers' collective can only informally defend the individual worker. It is not an acknowledged formal organization, meaning that it has no formal organizational power for achieving structural changes in the workplace. Second, as a defensive organization responding to management initiative, it lacks the organizational ability to formulate and carry through an offensive strategy for changes in the direction of industrial democracy.

The trade union movement is a formal organization through which workers' interests can be developed and implemented. This by no means implies that trade unions always represent the interests of the workers' collective. Trade unions have a hierarchical structure, and the gap between shop-floor experiences and central decisions can be huge. Furthermore, the trade union movement is far from homogeneous. Different groups of workers have different interests. There are differences in interests and power between skilled and unskilled workers, between men and women, between workers organized in different trade unions, etc. In the design and introduction of new technology, these differences can manifest themselves as jurisdictional disputes and conflicts concerning skill development, work organization, and the right to operate the new technology. The problem of solidarity is a central one in the trade union movement's struggle for industrial democracy.

Nevertheless, trade unions have served the interest of the workers' collective in two ways that are important for the present argument: They have been an essential instrument for workers in wage negotiations, and they have been a key instrument for furthering democracy in society as a whole.

Unions and Design

The design and use of new technology requires new trade union activities. Traditionally, trade unions have focused on what Åke Sandberg (forthcoming) calls *distribution* issues such as wages, working hours, and general terms of employment. Such issues are characterized by:

1. Relatively well-developed union objectives;
2. Clearly formulated demands, often quantified;
3. Demands based on the workers' own practical experience; and
4. Clearly delimited, short negotiation cycles.

In contrast, the design and use of computer-based systems are, in Sandberg's terminology, *production* issues. They are characterized by:

1. Only vaguely formulated union objectives;
2. Demands that are difficult to quantify;
3. Practical on-the-job experiences that must be supplemented by more theoretical, technical/scientific knowledge;
4. Design processes that stretch over long periods of time; and
5. Negotiation situations that are difficult to define clearly.

As Sandberg points out, the design of new models for work seem to require the consideration of more deep-seated and qualitative aspects than can easily be fitted into the traditional trade union strategy or the traditional management-labor negotiation process.

What are the key elements of a union technology strategy? Obviously, one element is decentralization of decision making coupled with participation in the design process, which can give workers more influence and better access to important information. However, the position we took in DEMOS, UTOPIA, and the other projects that constituted the work-oriented design approach was that decentralization of decision making and a participative approach to the design process are not sufficient.

Our position is based on a recognition of the different interests of management and workers concerning industrial democracy. We rejected the harmony view of organizations, according to which conflicts in an organization are seen as stemming from misunderstandings and can resolved by good analysis. We also rejected an understanding of design as a rational decision making process based on common goals. Instead, our research was based on a conflict view of industrial organizations in our society. In the interest of emancipation, we deliberately made the choice of siding with workers and their organizations, supporting the development of their resources for a change towards democracy at work (Sandberg, 1979; Ehn & Sandberg, 1979). We found it necessary to identify with the we-feeling of the workers' collective rather than with the overall we-feeling and "modern management" attempts to create in order to elicit greater effort from the work force. Although trade unions had a structure that was problematic for functioning as vehicles for designing for democracy at work, they were also the only social force that in practice could be a carrier of that ideal.

From Sociotechnical Solutions to Work-Oriented Design

It is difficult to overstate the influence of the sociotechnical approach on user participation and industrial democracy initiatives (Kubicek, 1983) in Scandinavia in the early 1970s. Hence, it may appear paradoxical that some Scandinavian researchers and trade unions developed the work-oriented approach to democratization of design and use of computer-based systems in opposition to the sociotechnical tradition rather than within that tradition. I will try to explain why, and outline the main points of this alternative, "collective resource" approach.

Although initially implemented in Norway, the widespread use of the sociotechnical approach in Scandinavian industry took place in Sweden. Thoralf Qvale, in one of the evaluations of the sociotechnical approach to democratization in Norway, gives the following explanation:

> Apart from the researchers, there are very few persons trying to convey experience from one company to another. In Sweden, "job satisfaction" and "productivity" have been the slogans, and a network of employers/production engineers have taken care of the diffusion. In Norway, the slogans were "industrial democracy" and "participation," and the union networks were expected to play a central part. As explained, ideological support has come from the top of LO (the Norwegian national trade union federation), but the practical involvement from the individual unions' officials has systematically been lacking. (Qvale, 1976)

In the late 1960s in Sweden, rapid technological and structural change was considered a problem by both the trade unions and employers. The unions were concerned about deskilling, lack of influence, health, and safety. Employers experienced personnel problems in recruitment, turnover, and absenteeism, and production problems in efficiency, planning, and quality. Both parties came to see the Tayloristic organization of production—its narrowly specialized jobs and separation of conception and execution—as the source of these problems. The sociotechnical experiments in Norway seemed a promising way forward.

Similar experiments were initiated by the central unions and employer organizations jointly in both private and public sectors in Sweden. Increased job satisfaction and higher productivity were considered equally important goals in these tests. Several of the experiments that started in the late 1960s came up with

interesting ideas on work organization and democratic participation, but practical implementation was a different story, as explained by Åke Sandberg:

> However, the second phase of deciding upon an actual program of change made manifest differences of interest: management was primarily seeking solutions to personnel problems and possibilities for better control of the wages, whereas unions viewed the experiments as part of a strategy for democratization and union influence at various levels. (Sandberg, 1982)

Most of the Swedish sociotechnical experiments were controlled by local management and coordinated by the Technical Department of the Swedish Employers' Confederation (SAF). The employers were obviously satisfied with the sociotechnical approach but not with the joint experiments. The LO (the Swedish national trade union federation) was also skeptical of joint work, as expressed in a program document:

> This method of working proved difficult to implement. Later, when the conflict of views between the two sides with regard to industrial democracy development became more manifest, the problems grew greater. Within the private sector, SAF drew its own conclusions from this fact and set up its own development projects with the aid of its Technical Department. In its development projects, SAF stressed the individual in a form which complicated collective solutions and the possibilities available to the trade union movement. (Swedish Federation of Trade Unions, 1977).

In 1975, SAF launched a new sociotechnical strategy. The Technical Department of SAF coordinated the "new factory" project, which aimed at creating more stable production systems based on the principle of coordinated independence of small subsystems (Arguren & Edgren, 1979). This principle was not new—it came from basic sociotechnical theory—but this project used a different strategy. On the one hand, it went further than earlier projects—it did not accept production technology as given, but as something that should be designed to allow the control of semiautonomous groups rather than individuals. On the other hand, changes were restricted to the shopfloor production level, and the vertical division of labor was not altered at all. Management's overall control was therefore strengthened. Democratic participation was not one of the aims of these experiments (Kronlund, 1978). The internationally known production technology at the Volvo Kalmar plant is as good an example as any of these new experiments. Participation for democracy was not an aim of the design (Ehn & Sandberg, 1979).

As we understand it, democratization of design and the use of computer-based systems in the Scandinavian setting had to be based on strong local union involvement. In practice, the sociotechnical approach had failed to support such democratization. The first action program on industrial democracy and computers from LO, issued in 1975, outlined the situation and union strategy:

> The workers and the trade unions are not satisfied with managers and their experts who say they develop systems for planning and control which take human beings into consideration by paying attention to needs for self-realization and the social impact of technical systems, etc. On the contrary, the unions must work for a situation that makes it possible for workers to develop their own organizational and knowledge resources. This creates the capability to scrutinize and influence, via negotiations, the various aspects of corporate planning and control, and, by extension, to develop worker-controlled systems. Thus, the present situation in organizations makes increasing demands upon the commitment and knowledge of the workers. The crucial point is whether these demands become absorbed in an employers' strategy for decentralization and so-called autonomous groups, or whether they will be developed within a workers' strategy for democratization, transcending the level of the work organization. (Swedish Federation of Trade Unions, 1975)

This critique of the sociotechnical approach should not be seen as a complete rejection of all aspects of the sociotechnical approach. Many of the sociotechnical tools are extremely useful in analyzing work organization and production technology, and the job requirements and group autonomy criteria are, when taken seriously, important criteria for democracy at work. The problem is that these requirements have often disappeared in the practical application of the approach. This flaw reflects questionable assumptions of harmony between social forces and a lack of sensitivity to the pervasive influence of the asymmetrical distribution of power. The critique is therefore not directed at sociotechnical design methods but at its theory and practice in the context of the democratization of work. We should also note that over the past decade the sociotechnical approach has evolved in a much more participatory and less manipulative direction (Gustavsen, 1985; Hedberg, 1980), making it more of an instrument for democratic design.

In the early 1970s, however, the sociotechnical approach seemed inadequate for democratizing the design and use of computer-based systems in the workplace. We had to look for an alternative based on a historical, social, and political understanding of the Scandinavian situation—an alternative that allowed the trade unions to play a major role. These were basic criteria in the emerging work-oriented approach to the design of computer-based systems.

The NJMF Project

In 1970, the Norwegian Iron and Metal Workers Union (NJMF) decided to initiate research of its own. When the NJMF project was first set up, the design was quite traditional. It involved a steering committee, a project group, and

associated local unions at four different work places. The associated local unions were to act as reference groups. The project group consisted of two researchers and two staff members from the national union, and, according to the research plan, the researchers were to carry out a number of investigations in close cooperation with the two other members of the project group. Those investigations included:

1. A study of two or three computer-based planning and control systems;
2. A survey of the goals of the union in areas such as working conditions and control of organizations;
3. Formulation of demands on computer-based systems based on the survey;
4. An evaluation of the need for knowledge within NJMF in the areas of planning, control, and data processing, and possibly development of teaching material.

However, as the project progressed, it turned out to be impossible for the union people involved to apply the project's findings to the daily work at the factories, the local unions, and the national unions. The original project design had to a large extent been copied from a traditional research project approach used by managers and management consultants in a context where the goals were clear and the means for applying the project results had been discussed for decades. For the unions, there had been no extensive discussions on planning, control, and computer-based systems, and there were no established or clear goals for their involvement.

A completely new research strategy had to be developed. In the new strategy, the most important change was the new role to be played by the local unions. Instead of supporting the researchers, the researchers would support them. The local unions would choose the topics for study from important problems at the workplace, and they would receive assistance from external consultants as well as consultants and other resources provided by the company. At each of the four workplaces, a number of investigative groups consisting of union members was formed to

1. Accumulate knowledge about planning, control, and data processing;
2. Investigate selected problems in these areas, that were considered of special importance by the local unions; and
3. Take actions directed at management to change the use of new technology.

The groups always began with discussions of practical workplace problems, problems with which every worker was familiar. Attempts to analyze and to solve these problems led to the search for new knowledge and the start of an educational process. The groups met regularly, for two to three hours at least twice a week, and between the meetings, the members did a lot of "homework," such as preparing proposals, discussing ideas with fellow workers, and participating in different kinds of educational activities.

One investigation group made evaluations of some of the computer-based planning and control systems in the company, including an on-line production information system under development. The other investigation groups evaluated experiences of participation in the planning of a new plant, made proposals for reorganizing one of the main assembly lines, and drafted a company policy action program for the local union.

One of the most tangible, and certainly the most widely studied and publicized outcome, of the NJMF project was the earlier-mentioned data agreements. These agreements primarily regulate the design and introduction of computer-based systems, especially the availability of information. The first agreement, a local one, was signed at the beginning of 1974. It was followed in April 1975 by a central agreement between the Norwegian Trade Union Federation and the Norwegian Confederation of Employers. A large number of local agreements soon followed, as did the election of numerous so-called data shop stewards, a new kind of shop steward introduced in the central agreement.

Among other things, the central agreement stated:

> Through the shop stewards, the management must keep the employees orientated about matters that lie within the area of the agreement in such a way that the shop stewards can put forward their points of view as early as possible and before the management puts its decisions into effect. The orientation must be given in a well-arranged form and in a language that can be understood by nonspecialists. It is a condition that the representatives of the employees have the opportunity to make themselves acquainted with general questions concerning the influence of computer-based systems on matters that are of importance to the employees. The representatives must have access to all documentation about software and hardware within the area of the agreement. (Norwegian Employers Federation and Norwegian Federation of Trade Unions, 1975)

The NJMF project inspired several new research projects throughout Scandinavia and the development of a research tradition of cooperation between researchers and workers and their trade unions. This tradition is known as the *collective resource approach,* or the Scandinavian approach to work-oriented design.

The DEMOS Project

In Sweden, the DEMOS project on "trade unions, industrial democracy, and computers" started in 1975, and lasted four years. The Swedish Trade Union Confederation (LO) supported the project, with its "data council" acting as an advisory group. The project was carried out by an interdisciplinary research team (with competence in computer science, sociology, economics, and engineering) in cooperation with workers and their trade unions at four different enterprises—a daily newspaper, a locomotive repair shop, a metal factory, and a department store.

This cooperative effort tried to identify possibilities for the unions to influence the design and use of computer-based systems at the local level in the companies. It emphasized what the unions could do to safeguard and promote their members' interest in meaningful work when the technology, the work organization, and the supervision of work are altered. As a complement to these local activities, the project also sought to examine obstacles and limits confronting this democratization process.

The design work at a locomotive engine repair shop in Örebro serves as an example of the local approach to the DEMOS project. In 1974, the State Employees' Union was informed by the State Railway's central administration that a computer-based planning system, ISA-KLAR, would be introduced in its work shops in, among other places, Örebro. The main responsibility of the repair shop in Örebro was engine maintenance.

Management wanted to use ISA-KLAR to adapt the general maintenance system to local circumstances, and, in the process, to test ISA-KLAR. The union had won an elimination of piecework at the repair shop, and management hoped ISA-KLAR would help it redesign the workplace and develop automatic work orders and instructions to direct employees.

To implement ISA-KLAR, management formed project groups that included at least one trade union representative each. These groups interviewed workers in the workplace on how they carried out their jobs. The workers' tasks were then analyzed into smaller steps and the information coupled with an MTM database compiled from several big companies. ISA-KLAR used the combined information to specify detailed work steps, including their timing and sequence, and the tools to be used. The level of detail was very fine. The computer generated work sequences such as: (1) get tools A and B, (2) go to carriage, (3) crawl into position, (4) remove cotter pin, (5) remove washer and bolt, (6) repeat steps 3 through 5 for other bolts, (7) remove bolts, etc.

After two years' work with ISA-KLAR, the union turned to DEMOS to resolve dissatisfaction with its lack of influence and information on the project. In March 1976, the union established an investigative group of its own with 14 participants. At first, the local union asked for researchers from DEMOS to serve only as "data experts" to check the timings of the various tasks that were to be incorporated into the computer-based system for measuring performance. In subsequent discussions, the union researchers agreed that the key implication of ISA-KLAR—that work on the shopfloor could be deskilled—was a far more significant issue for investigation than the timing of steps in the performance of various tasks.

They shifted the investigation's focus to the whole question of production planning. There was further agreement that the union should conduct its own investigation, using the DEMOS researchers, separate from that of the management project groups. The DEMOS researchers would provide technical expertise in an analysis of the computer-based system and a structure for the union study. The union's basic investigation was completed in June 1977. Followup by the local union committee and researchers consumed another year.

The group's findings were summarized and transformed by the union into demands for local agreements of codetermination and rationalization. As a first step, the group issued a report describing the current work situation, pointing out what was good and what was bad. This description was then used as a basis for further studies regarding planning, control, and computer use, as well as for collective agreements within the Joint Regulation Act (MBL). It should be emphasized that the investigation was initiated before the introduction of MBL.

The report stressed that the changeover from piecework to a system of fixed monthly wages was extremely important, not only in terms of group solidarity among the workers and job satisfaction, but also in terms of the quality of production. Lack of planning and an uneven rate of work on the engines had created major problems, and the fact that neither the tools nor the spare parts were always available had been a great source of irritation at all workshops. Too much time was taken up searching for tools and spare parts. The poorly maintained work facilities had caused a number of problems in the work environment, such as draughts and working positions that were damaging workers' health. Uncertainty over the consequences of ISA-KLAR did not make the working conditions any better, and there was great dissatisfaction about the lack of information workers were receiving.

The investigation was completed by studies of various topical issues important to the trade union. These studies gave rise to a special group on planning, control, and computer use. This group compared the principles of Taylorism to the current work situation at the workshops and reviewed basic facts on computers, design, and planning methods in order to broaden worker discussions and to elicit views from as many members as possible.

One demand of the union—presented in various management project groups—was that problems with the planning, material administration, and work organization be solved before any discussion of computer-based time measurement. However, it became obvious that the union's chances of influencing the design of production planning by participating in the project groups were more or less illusory. Under the cover of technical discussions, management and its consultants continued to develop ISA-KLAR. The basic question of how planning in the shops would be conducted in the future never appeared on the agenda.

In response to management's investigation, and based on its own analysis of ISA-KLAR, the union's investigation group concluded that the system had to be stopped until an agreement on codetermination could be reached that would

regulate its design and use. The local union demanded, and got, central union support for this position.

Management officially accepted the position of the union and appointed planning groups to "construct and test a planning model" for two different items in the production process (railway truck components and work on certain types of engines). Each of the planning groups consisted of two repair workers, a supervisor, and a production technician.

The investigation group of the union collaborated with the two planning groups. It appointed workers from its own investigation on ISA-KLAR as union participants and supported them. In practice the repair workers themselves did the design work. A technical specialist was asked to look over the proposals, and only minor adjustments were made.

Although the planning groups had very little time at their disposal, they managed to present concrete propositions on changes in work organization as well as other conditions. Their basic proposition was that repair workers should be granted flexibility in their work—predemolition, demolition, test of cracks, welding, installation, mounting of wheel axles, and final installation. Flexibility meant that all workers would participate in the entire work cycle, from demolition to final installation, and that all workers should all be able to handle all the tasks. The main emphasis were on skill, training, and job rotation. Special emphasis was placed on the work teams' right to plan their own work. This was considered necessary not only as a move towards democratic work organization but also as a measure facilitating production.

The repair workers claimed that their proposition had demonstrated that they could have a well-functioning workplace without ISA-KLAR. The local union that their approach could serve as a model for other workplaces as well. Its experiences were reflected in May 1978 in a number of demands that served as a basis for local agreements on rationalization and codetermination on the design and use of computer artifacts. The demands were adjusted to MBL and to a central collective agreement on codetermination. Among the demands were:

1. That long-term planning be conducted by management for (among other things) technical development, training, and staff policy;
2. That repair and maintenance work be carried out within the company;
3. That rationalization not reduce the requirements for skilled repair personnel; and
4. That rationalization not result in work measurement of individuals or groups or in incentive payments of any kind.

With special regard to the design process, the union demanded

1. That directives for a project be negotiable before the project starts;
2. That design methods be approved by the union;
3. That investigations in the design work not only include technical and economic considerations, but also changes in employment, work environment, work organization, and possibilities for cooperation, codetermination, and development in the daily work;
4. That the union be provided the necessary resources for conducting a parallel independent investigation;
5. That the cost for these resources be calculated as part of the investment in the rationalization;
6. That participation by trade union representatives and users be a natural aspect of the design work, and that it be planned to allow this; and
7. That participants receive what the union regards as the necessary training to participate in the design work.

What has been the long-term impact of the DEMOS investigation work at the repair shop in Örebro? We ourselves did not conduct such evaluations, but a report (Brulin, 1988) from an ongoing democratization project at the State Railroad sums up developments during the decade since DEMOS in the following way:

> The trade union work in Örebro from DEMOS onward has given a trade union perspective that perhaps is best formulated in the title of the DEMOS report: "We are opposed to Detailed Control." The collective agreement on design and use of computer-based systems created conditions for a dialogue with management. The repair shop in Örebro got a new managing director with a view on efficient organization that, to a great extent, overlaps the trade union perspective. In summary, as we understand it, what happened and is happening in Örebro can be explained by the above-mentioned three motivating forces: a trade union perspective, use of the collective agreement on design and use of computer-based systems, and a real dialogue with management.

The UTOPIA Project

Although growing, the extent and impact of research on designing for democratization in NJMF, DEMOS and similar projects did not meet initial expectations. It seemed that one could only influence the introduction of technology, training, and the organization of work to a certain degree. From a union perspective, important aspects for workers such as the opportunities to develop skills and to increase influence on work organization were limited. Societal constraints, especially those of power and resources, had been underestimated. In addition, the existing technology presented significant limits to finding desirable alternative local solutions.

To broaden the scope of available technology, we decided to try to supplement the existing elements of the work-oriented approach with union-based efforts to design new technology. The main idea of the first projects, to support democratization of the design process, was complemented by the idea of designing tools and environments for skilled work and good-quality products and services. To try out these ideas, the UTOPIA project was started in in 1981 as a cooperation between the Nordic Graphic Workers' Union and researchers in Sweden and Denmark with experience from the first generation of work-oriented design projects. It was a research project on the trade-union-based design of, and training in, computer technology and work organization. The research focused on page makeup and image processing in the newspaper industries. In the Scandinavian languages, UTOPIA is an acronym for Training, Technology, and Products from a Quality of Work Perspective.

Besides working directly in the project group, the Scandinavian graphic workers' unions followed and supported the project through a reference group consisting of representatives from Sweden, Denmark, Finland, and Norway, appointed by the Nordic Graphic Workers' Union (NGU). At various stages, the project involved the computer supplier Liber/Tips and the newspaper Aftonbladet in Stockholm.

In the UTOPIA project, we developed a design approach that we called the tool perspective (Ehn & Kyng, 1984; see also Bødker, forthcoming, and Kammersgaard, 1985). The tool perspective was deeply influenced by the way the design of tools takes place within traditional crafts. The idea is that new computer-based tools should be designed as an extension of the traditional practical understanding of tools and materials used within a given craft or profession. Design must therefore be carried out by the common efforts of skilled, experienced users and design professionals. Users possess the needed practical understanding but lack insight into new technical possibilities. The designer must understand the specific labor process that uses a tool. Computer-based tools present special challenges because they are technically complex but, if designed well, can be simple and powerful for the skilled worker.

In the UTOPIA project, we tried such a process of mutual learning. Graphics workers learned about the technical possibilities and constraints of computer technology, while we as designers learned about their craft or profession. Initially, the group worked to build a mutual understanding of the specific labor processes of the profession, of the design situation, and of the technical possibilities and limitations. Apart from discussions, visits to workplaces employing different generations of technology and visits to research laboratories and vendors proved to be important early activities.

However, as designers we ran into severe difficulties when we tried to communicate with the graphic workers using traditional approaches such as data or information flows. The situation drastically improved when we shifted towards a design-by-doing approach. With the use of mockups and other prototyping design artifacts, the skilled workers could actively participate in the design process and express their craft skills by actually doing page makeup. (The theoretical foundation of the tool perspective and these design methods will be discussed in the second part of this chapter.)

The UTOPIA project was in many ways a success story. An appreciative article in *Technology Review* concluded:

> So the impact of Utopia is continuing to expand, and the idea that workers and their unions have an important role in the design of new technology is reaching a wider and wider audience. Today Scandinavia, tomorrow, perhaps, the rest of the world. (Howard, 1985)

However, as in all success stories, UTOPIA had its share of failures as well. The failures were due to the limited resources in Scandinavian countries rather than to limitations of the model itself. The system, TIPS, was tried at several newspaper test sites, but before final development as a market product, the vendor ran short of capital and was forced to sell the rights to the system to another company interested mainly in image processing. These experiences indicate that a shortage of both technological competence and financial resources within small Scandinavian countries may keep them from successfully competing in the international technological race.

The UTOPIA project clearly showed that the latest technology may be designed and put into use to improve, not decrease, the skills of graphics workers. Whether the Scandinavian newspaper owners will exploit the possibilities for a constructive discussion on technology, organization, and training depends to a great extent upon whether the graphics workers and journalists succeed in overcoming their professional clash of interests and develop a common strategy.

The historical study conducted by the project provides some insight into this. New technology creates "demarcation disputes" between professional groups as well as between trade unions. The UTOPIA project demonstrated that solutions can, however, be found. For newspapers, there are technical and organizational alternatives that do not harm any professional group and that ensure product quality and reasonable efficiency. Nevertheless, the lack of trade union cooperation—rather than the technology, the newspaper owners, or the equipment vendors—may become the decisive factor frustrating the dream of UTOPIA.

The design process in the UTOPIA project was really utopian. The preconditions for such a design process are not present in corporate business as we know it today. Resources for skilled workers, trade union staff, and computer and social scientists to work together over a long period of time designing tools in the interest of the end users do not generally exist as yet, not even in Scandinavia, UTOPIA was not only a challenge to design, but also to a more democratic working life.

Other Projects

The NJMF, DEMOS, and UTOPIA projects are by no means the only projects of the participatory work-oriented design approach, nor is the approach restricted to the design and use of computer-based systems. Some other projects within or related to this Scandinavian tradition are:

1. The DUE project on "democracy, education, and computer-based systems" was a sister project to DEMOS carried out in Denmark (Kyng & Matthiassen, 1982).
2. The Dairy Project, which was conducted by architects but used methods and perspectives similar to the DEMOS and DUE projects (Steen & Ullmark, 1982).
3. The PAAS project, which in addition to contributing to a theoretical understanding of changes of skills when computer artifacts are used also contributed to methods for trade union design work (Göranzon, 1984).
4. The Bank Project, which was conducted by researchers originally from the sociotechnical tradition, although they worked closely with trade unions and with methods and perspectives very similar to the work-oriented design projects (Hedberg & Mehlmann, 1983).
5. The TIK-TAK project, in which local trade unions in the public sector developed union resources in relation to "office automation" (Foged et al., 1987).
6. The Carpentry Shop project, which worked with methods and a design perspective similar to the UTOPIA project but within a "low-tech" area (Sjögren, 1979–83).
7. The Florence project, focusing on the work situation of nurses, which was another second-generation work-oriented project designing computer-based environments for skill and quality production (Bjerknes & Bratteteig, 1987).

These are by no means the only work-oriented design projects. Today the approach is no longer limited to Scandinavia. Despite a very different trade union structure, there are several projects using similar perspectives and methods in Britain (Williams, 1987).

Some Lessons on Design and Democratization

Some of the *general lessons* learned from DEMOS, UTOPIA, and other work-oriented design projects include:

1. A participatory approach to the design process is not sufficient in the context of democratization at work.
2. In democratization of design and use of computer-based systems in Scandinavia, trade unions—especially on a local level—must play an active role.

Some specific lessons about the *participation of local trade unions* in the design of computer-based systems include:

1. A clear distinction based on negotiations between union and management roles in the design process is not in opposition to, but a prerequisite for cooperation and the democratization of decision making in the work organization.
2. The design and use of computer-based systems requires new trade union activities.
3. The most important prerequisite for trade union participation in the design process is a parallel and independent process of accumulation of knowledge on the part of the union.
4. Local unions need external resources and support in their design activities.
5. A local trade union strategy has to be based on solidarity between the different groups of workers involved—a solidarity that goes beyond the traditional division of labor in the labor process and the traditional jurisdictions between the unions involved.

Some specific lessons on *national trade union support for democratization* of the design and use of computer-based systems include:

1. Today's computer-based systems often restrict the ability of trade unions to reach local objectives, especially with respect to skill but also with respect to work organization.
2. However, it is possible to design computer-based technology based on criteria such as skill and democracy at work.
3. National trade unions must influence the process of research and development of new technology to change the supply of technological and organizational solutions.
4. Equally important is a trade union strategy to influence the demand for these technological and organizational alternatives.
5. National trade unions must provide training with a trade union perspective on the design and use of computer artifacts, and influence the supply of professional training for skilled work.
6. A strategy like the new Scandinavian model for research and technological development—focusing on a new form of cooperation among governments, trade unions, and high tech industry in the production of new technology that supports good working conditions and good use quality products and services—is a promising approach to support more democratic design and use of computer-based systems.

TOWARDS A PHILOSOPHICAL FOUNDATION FOR SKILL-BASED PARTICIPATORY DESIGN

This paper does not argue for a reinvention of the wheel. The instrumental power of systems thinking for purposive rational action is beyond doubt. Many of the computer applications that function well today could not have been designed without rational methods. Instead, I suggest a reinterpretation of design methods to take us beyond the deeply embedded Cartesian mind-body dualism and beyond the limits of formalization towards an understanding that supports more creative ways of thinking and doing design as participatory work (involving the skills of both users and designers).

Efforts to pursue such a rethinking of the design of computer-based systems and to develop a new practice of design are now emerging within computer science. One important example is a new orientation in software engineering proposed by Christiane Floyd (1987). It is based on a dissatisfaction with "anomalies" in the product-oriented view of software engineering that treats computer programs as formal mathematical objects derived by formalized procedures from an abstract specification. Floyd argues that the product-oriented view leaves the relationship between programs and the living human world entirely unexplored, providing no way to check the relevance of the specification or to accommodate learning and communication.

As a remedy to these anomalies, Floyd sees a new process-oriented paradigm in software engineering with a focus on human learning and communication in both the use and development of the software. She views the products of this process as tools or working environments for people and not as pieces code or an abstract software system. Hence, the quality of the product depends on its relevance, suitability, or adequacy in practical use. Quality cannot be reduced to features of the product such as reliability and efficiency. From this perspective, prototyping can be seen as an alternative or complement to traditional, more formalized, and detached descriptions.

Another important example of new tendencies in the design of computer-based systems is the development of a new philosophical foundation in the tradition of hermeneutics and phenomenology proposed by Hubert and Stuart Dreyfus (1986) and Terry Winograd and Fernando Flores (1986). This philosophical endeavor focuses on the differences between human activity and computer performance. In doing so, it departs from other traditions by focusing on what people *do* with computers, how in cooperation with one another they use computers, and what they might do better with computers. In this approach, the origin of design is in involved practical use and understanding, not detached reflection, and design is seen as an interaction between understanding and creation. This research aims not to create just another design method but to create a new foundation for a science of design.

In the following, I will propose that this new understanding can be buttressed by an awareness of language games and the ordinary language philosophy of Ludwig Wittgenstein. My focus is on the shift in design from *language as description* towards *language as action*.

Rethinking Systems Descriptions

A few years ago I was struck by something I had not noticed before. While thinking about how perspectives make us select certain aspects of reality as important in a description, I realized I had completely overlooked my own presumption that descriptions in one way or another are mirror images of a given reality. My earlier reasoning had been that because there are different interests in the world, we should always question the objectivity of design choices that claimed to flow from design as a process of rational decision making. Hence, I had argued that we needed to create descriptions from different perspectives in order to form a truer picture. I did not, however, question the Cartesian epistemology and ontology of an inner world of experiences (mind) and an outer world of objects (external reality). Nor did I question the assumption that language was our way of mirroring this outer world of real objects. By focusing on which objects and which relations should be represented in a systems description, I took for granted the Cartesian mind-body dualism that Wittgenstein had so convincingly rejected in *Philosophical Investigations* (1953). Hence, although my purpose was the opposite, my perspective blinded me to the subjectivity of craft, artistry, passion, love, and care in the system descriptions.

Our experiences with the UTOPIA project caused me to re-examine my philosophical assumptions. Working with the end users of the design, the graphics workers, some design methods failed while others succeeded. Requirement specifications and systems descriptions based on information from interviews were not very successful. Improvements came when we made joint visits to interesting plants, trade shows, and vendors and had discussions with other users; when we dedicated considerably more time to learning from each other, designers from graphics workers and graphics workers from designers; when we started to use design-by-doing methods and descriptions such as mockups and work organization games; and when we started to understand and use traditional tools as a design ideal for computer-based systems.

The turnaround can be understood in the light of two Wittgensteinian lessons. The first is not to underestimate the importance of skill in design. As Peter Winch (1958) has put it, "A cook is not a man who first has a vision of a pie and then tries to make it. He is a man skilled in cookery, and both his projects and his achievements spring from that skill." The second is not to mistake the role of description methods in design: Wittgenstein argues convincingly that what a picture describes is determined by its use.

In the following I will illustrate how our "new" UTOPIAN design methods may be understood from a Wittgensteinian position, that is, why design-by-doing and a skill-based participatory design process works. More generally, I will argue that design tools such as models, prototypes, mockups, descriptions, and representations act as reminders and paradigm cases for our contemplation of future computer-based systems and their use. Such design tools are effective because they recall earlier experiences to mind. It is in this sense that we should understand them as *representations*. I will begin with a few words on practice, the alternative to the "picture theory of reality".

Practice is Reality

Practice as the social construction of reality is a strong candidate for replacing the picture theory of reality. In short, practice is our everyday practical activity. It is the human form of life. It precedes subject-object relations. Through practice, we produce the world, both the world of objects and our knowledge about this world. Practice is both action and reflection. But practice is also a social activity; it is produced in cooperation with others. To share practice is also to share an understanding of the world with others. However, this production of the world and our understanding of it takes place in an already existing world. The world is also the product of former practice. Hence, as part of practice, knowledge has to be understood socially—as producing or reproducing social processes and structures as well as being the product of them (Kosik, 1967; Berger & Luckmann, 1966).

Against this background, we can understand the design of computer applications as a concerned social- and historical-conditioned activity in which tools and their use are envisioned. This is an activity and form of knowledge that is both planned and creative.

Once struck by the "naive" Cartesian presumptions of a picture theory, what can be gained in design by shifting focus from the correctness of descriptions to intervention into practice? What does it imply to take the position that what a picture describes is determined by its use? Most importantly, it sensitizes us to the crucial role of skill and participation in design, and to the opportunity in practical design to transcend some of the limits of formalization through the use of more action-oriented design artifacts.

Language as Action

Think of the classical example of a carpenter and his or her hammering activity. In the professional language of carpenters, there are not only hammers and nails. If the carpenter were making a chair, other tools used would include a draw-knife, a brace, a trying plane, a hollow plane, a round plane, a bow-saw, a marking gauge, and chisels (Seymour, 1984). The materials that he works with are elm planks for the seats, ash for the arms, and oak for the legs. He is involved in saddling, making spindles, and steaming.

Are we as designers of new tools for chairmaking helped by this labeling of tools, materials, and activities? In a Wittgensteinian approach the answer would be; only if we understand the practice in which these names make sense. To label our experiences is to act deliberately. To label deliberately, we have to be trained to do so. Hence, the activity of labeling has to be learned. Language is not private but social. The labels we create are part of a practice that constitutes social meaning. We cannot learn without learning something specific. To understand and to be able to use is one and the same (Wittgenstein, 1953). Understanding the professional language of chairmaking, and any other language-game (to use Wittgenstein's term), is to be able to master practical rules we did not create ourselves. The rules are techniques and conventions for chairmaking that are an inseparable part of a given practice.

To master the professional language of chairmaking means to be able to act in an effective way together with other people who know chairmaking. To "know" does not mean explicitly knowing the rules you have learned, but rather recognizing when something is done in a correct or incorrect way. To have a concept is to have learned to follow rules as part of a given practice. Speech acts are, as a unity of language and action, part of practice. They are not descriptions but actions among others in a given practice.

Below I will elaborate on language-games, focusing on the design process, descriptions in design, design artifacts, and knowledge in the design of computer applications.

Language Games

To use language is to participate in language-games. In discussing how we in practice follow (and sometimes break) rules as a social activity, Wittgenstein asks us to think of games, how they are made up and played. We often think of games in terms of a playful, pleasurable engagement. I think this aspect should not be denied, but a more important aspect for our purpose here is that games are mainly interested activities, as are most of the common language-games we play in our ordinary language.

Language-games, like the games we play as children, are social activities. To be able to play these games, we have to learn to follow rules, rules that are socially created but far from always explicit. The rule-following behavior of being able to play together with others is more important to a game than the specific explicit rules. Playing is interaction and cooperation. To follow the rules in practice means to be able to act in a way that others in the game can understand. These rules are embedded in a given practice from which they cannot be distinguished. To know them is to be able to "embody" them, to be able to apply them to an open class of cases.

We understand what counts as a game not because we have an explicit definition but because we are already familiar with other games. There is a kind of family resemblance between games. Similarly, professional language-games can be learned and understood because of their family resemblance to other language-games that we know how to play.

Language games are performed both as speech acts and as other activities, as meaningful practice within societal and cultural institutional frameworks. To be able to participate in the practice of a specific language-game, one has to share the form of life within which that practice is possible. This form of life includes our natural history as well as the social institutions and traditions into which we are born. This condition precedes agreed social conventions and rational reasoning. Language as a means of communication requires agreement not only in definitions, but also in judgments. Hence, intersubjective consensus is more fundamentally a question of shared background and language than of stated opinions (Wittgenstein, 1953).

This definition seems to make us prisoners of language and tradition, which is not really the case. Being socially created, the rules of language games, like those of other games, can also be socially altered. There are, according to Wittgenstein, even games in which we make up and alter the rules as we go along. Think of systems design and use as language games. The very idea of the interventionistic design language-game is to change the rules of the language-game of use in a proper way.

The idea of language-games entails an emphasis on how we linguistically discover and construct our world. However, language is understood as our use of it, as our social, historic, and intersubjective application of linguistic artifacts. As I see it, the language-game perspective therefore does not preclude consideration of how we also come to understand the world by use of other tools.

Tools and objects play a fundamental role in many language-games. A hammer is in itself a sign of what one can do with it in a certain language-games. And so is a computer application. These signs remind one of what can be done with them. In this light, an important aspect in the design of computer applications is that its signs remind the users of what they can do with the application in the language-games of use (Brock, 1986). The success of "what-you-see-is-what-you-get" and "direct manipulation" user interfaces does not have to do with how they mirror reality in a more natural way, but with how they provide better reminders of the users' earlier experiences (Bødker, forthcoming). This is also, as will be discussed in the following, the case with the tools that we use in the design process.

Knowledge and Design Artifacts

As designers we are involved in reforming practice, in our case typically computer-based systems and the way people use them. Hence, the language-games of design change the rules for other language-games, in particular those of the application's use. What are the conditions for this interplay and change to operate effectively?

A common assumption behind most design approaches seems to be that the users must be able to give complete and explicit descriptions of their demands. Hence, the emphasis is on methods to support this elucidation by means of requirement specifications or system descriptions (Jackson, 1983; Yourdon, 1982).

In a Wittgensteinian approach, the focus is not on the "correctness" of systems descriptions in design, on how well they mirror the desires in the mind of the users, or on how correctly they describe existing and future systems and their use. Systems descriptions are design artifacts. In a Wittgensteinian approach, the crucial question is how we use them, that is, what role they play in the design process.

The rejection of an emphasis on the "correctness" of descriptions is especially important. In this, we are advised by the author of perhaps the strongest arguments for a picture theory and the Cartesian approach to design—the young Wittgenstein in *Tractatus Logico-Philosophicus* (1923). The reason for this rejection is the fundamental role of practical knowledge and creative rule following in language-games.

Nevertheless, we know that systems descriptions are useful in the language-game of design. The new orientation suggested in a Wittgensteinian approach is that we see such descriptions as a special kind of artifact that we use as "typical examples" or "paradigm cases." They are not models in the sense of Cartesian mirror images of reality (Nordenstam, 1984). In the language-game of design, we use these tools as reminders for our reflection on future computer applications and their use. By using such design artifacts, we bring earlier experiences to mind, and they bend our way of thinking of the past and the future. I think that this is why we should understand them as *re*presentations (Kaasbøll, forthcoming). And this is how they inform our practice. If they are good design artifacts, they will support good moves within a specific design language-game.

The meaning of a design artifact is its use in a design language-game, not how it "mirrors reality." Its ability to support such use depends on the kinds of experience it evokes, its family resemblance to tools that the participants use in their everyday work activity. Therein lies a clue to why the breakthrough in the UTOPIA project was related to the use of prototypes and mockups. Since the design artifacts took the form of reminders or paradigm cases, they did not merely attempt to mirror a given or future practice linguistically. They could be experienced through the practical use of a prototype or mockup. This experience could be further reflected upon in the language-game of design, either in ordinary language or in an artificial one.

A good example from the UTOPIA project is an empty cardboard box with "desktop laser printer" written on the top. There is no functionality in this mockup. Still, it works very well in the design game of envisioning the future work of makeup staff. It reminded the participating typographers of the old "proof machine" they used to work with in lead technology. At the same time, it suggested that with the help of new technology, the old proof machine could be reinvented and enhanced.

This design language-game was played in 1982. At that time, desktop laser printers only existed in advanced research laboratories, and certainly typographers had never heard of them. To them, the idea of a cheap laser printer was "unreal."

It was our responsibility as professional designers to be aware of such future possibilities and to suggest them to the users. It was also our role to suggest this technical and organizational solution in such a way that the users could experience and envision what it would mean in their practical work, before the investment of too much time, money, and development work. Hence, the design game with the mockup laser printer. The mockup made sense to all participants—users and designers (Ehn & Kyng, 1991).

This focus on nonlinguistic design artifacts is not a rejection of the importance of linguistic ones. Understood as triggers for our imagination rather than as mirror images of reality, they may well be our most wonderful human inventions. Linguistic design artifacts are very effective when they challenge us to tell stories that make sense to all participants.

Practical Understanding and Propositional Knowledge

There are many actions in a language-game, not least in the use of prototypes and mockups, that cannot be explicitly described in a formal language. What is it that the users know, that is, what have they learned that they can express in action, but not state explicitly in language? Wittgenstein (1953) asks us to "compare knowing and saying: how many feet high Mont Blanc is—how the word 'game' is used—how a clarinet sounds. If you are surprised that one can know something and not be able to say it, you are perhaps thinking of a case like the first. Certainly not of one of the third."

In the UTOPIA project, we were designing new computer applications to be used in typographical page makeup. The typographers could tell us the names of the different tools and materials that they use such as knife, page ground, body text, galley, logo, halftone, frame, and spread. They could also tell when, and perhaps in which order, they use specific tools and materials to place an article. For example, they could say, "First you pick up the body text with the knife and place it at the bottom of the designated area on the page ground. Then you adjust it to the galley line. When the body text fits you get the headline, if there is not a picture," and so forth. What I, as designer, get to know from such an account is equivalent to knowing the height of Mont Blanc. What I get to know is very different from the practical understanding of really making up pages, just as knowing the height of Mont Blanc gives me very little of understanding the practical experience of climbing the mountain.

Knowledge of the first kind has been called *propositional knowledge*. It is what you have "when you know that something is the case and when you also can describe what you know in so many words" (Nordenstam, 1985). Propositional knowledge is not necessarily more reflective than practical understanding. It might just be something that I have been told, but of which I have neither practical experience nor theoretical understanding.

The second case, corresponding to knowing how the word *game* is used, was more complicated for our typographers. How could they, for example, tell us the skill they possess in knowing how to handle the knife when making up the page in pasteup technology? This is their practical experience from the language-games of typographic design. To show it, they have to do it.

And how should they relate what counts as good layout, the complex interplay of presence and absence, light and dark, symmetry and asymmetry, uniformity and variety? Could they do it in any other way than by giving examples of good and bad layouts, examples that they have learned by participating in the games of typographical design? As in the case of knowing how a clarinet sounds, this is typically sensuous knowing by familiarity with earlier cases of how something is, sounds, smells, and so on.

Practical understanding—in the sense of practical experience from doing something and having sensuous experiences from earlier cases—defies formal description. If it were transformed into propositional knowledge, it would become something totally different.

It is hard to see how we as designers of computer systems for page makeup could manage to come up with useful designs without understanding how the knife is used or what counts as good layout. For this reason we had to have access to more than what can be stated as explicit propositional knowledge. We could only achieve this understanding by participating to some extent in the language-games of use of the typographical tools. Hence, participation applies not only to users participating in the language-game of design, but perhaps more importantly to designers participating in use. Some consequences of this position for organizing design language-games will be discussed in the following.

Rule Following and Tradition

Now, I turn to the paradox of rule-following behavior. As mentioned, many rules that we follow in practice can scarcely to be distinguished from the behavior in which we perform them. We do not know that we have followed a rule until we have done it. The most important rules we follow in skillful performance defy formalization, but we still understand them.

As Michael Polanyi (1973), the philosopher of tacit knowledge, has put it: "It is pathetic to watch the endless efforts—equipped with microscopy and chemistry, with mathematics and electronics—to reproduce a single violin of the kind the half-literate Stradevarius turned out as a matter of routine more than 200 years ago." This is the traditional aspect of human rule-following behavior. Polanyi points out that what may be our most widely recognized, explicit, rule-based system—the practice of Common Law—also uses earlier examples as paradigm cases. Says Polanyi, "[Common Law] recognizes the principle of all traditionalism that practical wisdom is more truly embodied in action than expressed in the rules of action." According to Polanyi this is also true for science, no matter how rationalistic and explicit it claims to be: "While the articulate contents of science are successfully taught all over the world in hundreds of new universities, the unspecifiable art of scientific research has not yet penetrated to many of these." The art of scientific research defies complete formalization; it must be learned partly by examples from a master whose behavior the student trusts.

Involving skilled users in the design of new computer application when their old tools and working habits are redesigned is an excellent illustration of Polanyi's thesis. If activities that have been under such pressure for formalization as Law and Science are so dependent on practical experience and paradigm cases, why should we expect other social institutions that have been under less pressure of formalization to be less based on practical experience, paradigm cases, and tacit knowledge?

Rule Following and Transcendence

If design is rule-following behavior, is it also creative transcendence of traditional behavior. Again, this is what is typical of skillful human behavior, and is exactly what defies precise formalization. Through mastery of the rules comes the freedom to extend them. This creativity is based on the open-textured character of rule-following behavior. To begin with, we learn to follow a rule as a kind of dressage, but in the end we do it as creative activity (Dreyfus & Dreyfus, 1986). Mastery of the rules puts us in a position to invent new ways of proceeding. As the Wittgenstein commentator Alan Janik has put it: "There is always and ineliminably the possibility that we can follow the rule in a wholly unforeseen way. This could not happen if we had to have an explicit rule to go on from the start . . . the possibility of radical innovation is, however, the logical limit of description. This is what tacit knowledge is all about" (Janik, 1988). This is why we need a strong focus on skill both in design and in the use of computer systems. We focus on existing skills, not at to inhibit creative transcendence, but as a necessary condition for it.

But what is the role of "new" external ideas and experiences in design? How are tradition and transcendence united in a Wittgensteinian approach? It could, I believe, mean utilizing something like Berthold Brecht's theatrical "alienation" effect *Verfremdungseffekt* to highlight transcendental untried possibilities in everyday practice by presenting a well-known practice in a new light: "the aspects of things that are most important to us are hidden because of their simplicity and familiarity" (Wittgenstein, 1953). However, as Peter Winch (1958, p. 119) put it, in a Wittgensteinian approach: "the only legitimate use of such a *Verfremdungseffekt* is to draw attention to the familiar and obvious, not to show that it is dispensable from our understanding."

Design artifacts, linguistic or not, may in a Wittgensteinian approach certainly be used to break down traditional understanding, but they must make sense in the users' ordinary language-games. If the design tools are effective, it is because they help users and designers to see new aspects of an already well-known practice, not because they convey such new ideas. It is I think fair to say that this focus on traditional skill in interplay with design skill may be a hindrance to really revolutionary designs. The development of radically new designs might require leveraging *other* skills and involving *other* potential users. Few designs, however, are really revolutionary, and for normal everyday design situations, the participation of traditionally skilled users is critical to the quality of the resulting product.

The tension between tradition and transcendence is fundamental to design. There can be a focus on tradition or transcendence in the systems being created. Should a word processor be designed as an extension of the traditional typewriter or as something totally new? Another dimension is professional competence: Should one design for the "old" skills of typographers or should new knowledge replace those skills in future use? Or again, with the division of labor and cooperation: Should the new design support the traditional organization in a composing room or suggest new ways of cooperation between typographers and journalists? There is also the tension between tradition and transcendence in the goods or services to be produced using the new system: Should the design support the traditional graphical production or completely new services, such as desktop publishing?

Tradition and transcendence, that is the dialectical foundation of design.

Design by Doing: New "Rules of the Game"

What do we as designers have to do to qualify as participants in the language-games of the users? What do users have to learn to qualify as participants in the language-game of design? And what means can we develop in design to facilitate these learning processes?

If designers and users share the same form of life, it should be possible to overcome the gap between the different language-games. It should, at least in principle, be possible to develop the practice of design to the point where there is enough family resemblance between a specific language-game of the users and the language-games in which the designers of the computer application are intervening. A mediation should be possible.

But what are the conditions required to establish this mediation? For Wittgenstein, it would make no sense to ask this question outside a given form of life: "If a lion could talk, we could not understand him" (1953). In the arguments below, I have assumed that the conditions for a common form of life are possible to create, that the lions and sheep of industrial life, as discussed in the first part of this chapter, can live together. This is more a normative standpoint of how design ought to be, a democratic hope rather than a reflection on current political conditions.

To develop the competence required to participate in a language-game requires a lot of learning within that practice. But, in the beginning, all one can understand is what one has already understood in another language-game. If we understand anything at all, it is because of the family resemblance between the two language-games.

What kind of design tools could support this interplay between language-games? I think that what we in the UTOPIA project called design-by-doing methods—prototyping, mockups, and scenarios—are good candidates. Even joint visits to workplaces, especially ones similar to the ones being designed for, served as a kind of design tool through which designers and users bridged their language-games.

The language-games played in design-by-doing can be viewed both from the point of view of the users and of the designers. This kind of design becomes a language-game in which the users learn about possibilities and constraints of new computer tools that may become part of their ordinary language-games. The designers become the teachers that teach the users how to participate in this particular language-game of design. However, to set up these kind of language-games, the designers have to learn from the users.

However, paradoxical as it sounds, users and designers do not have to understand each other fully in playing language-games of design-by-doing together. Participation in a language-game of design and the use of design artifacts can make constructive but different sense to users and designers. Wittgenstein (1953) notes that "when children play at trains their game is connected with their knowledge of trains. It would nevertheless be possible for the children of a tribe unacquainted with trains to learn this game from others, and to play it without knowing that it was copied from anything. One might say that the game did not make the same sense as to us." As long as the language-game of design is not a nonsense activity to any participant but a shared activity for better understanding and good design, mutual understanding may be desired but not really required.

User Participation and Skill

The users can participate in the language-game of design because the application of the design artifacts gives their design activities a family resemblance with the language-games that they play in ordinary use situations. An example from the

UTOPIA project is a typographer sitting at a mockup of a future workstation for page makeup, doing page makeup on the simulated future computer tool.

The family resemblance is only one aspect of the methods. Another aspect involves what can be expressed. In design-by-doing, the user is able to express both propositional knowledge and practical understanding. Not only could, for example, the typographer working at the mockup tell that the screen should be bigger to show a full page spread—something important in page makeup—he could also show what he meant by "cropping a picture" by actually doing it as he said it. It was thus possible for him to express his practical understanding, his sensuous knowledge by familiarity. He could, while working at the mockup, express the fact that when the system is designed one way he can get a good balanced page, but not when it is designed another way.

Designer Participation and Skill

For us as designers, it was possible to express both propositional knowledge and practical understanding about design and computer systems. Not only could we express propositional knowledge such as "design-by-doing design tools have many advantages as compared with traditional systems descriptions" or "bit-map displays bigger than 22 inches and with a resolution of more than 2000 × 2000 pixels are very expensive," but in the language-game of design-by-doing, we could also express practical understanding of technical constraints and possibilities by "implementing" them in the mockup, prototype, simulation, or experimental situation. Simulations of the user interface were also important in this language-game of design.

As designers, our practical understanding will mainly be expressed in the ability to construct specific language-games of design in such a way that the users can develop their understanding of future use by participating in design processes.

As mentioned above, there is a further important aspect of language-games: We make up the rules as we go along. A skilled designer should be able to assist in such transcendental rule-breaking activities. Perhaps, this is the artistic competence that a good designer needs.

To really learn the language-game of the use activity by fully participating in that language-game is, of course, an even more radical approached for the designer. Less radical but perhaps more practical would be for designers to concentrate design activity on just a few language-games of use, and for us to develop a practical understanding of useful specific language-games of design (Ehn & Kyng, 1987). Finally, there seems to be a new role for the designer as the one who sets the stage for a shared design language-game that makes sense to all participants.

Some Lessons on Design, Skill, and Participation

As in the first practice-oriented part of this paper on designing for democracy at work, I end this second philosophically oriented part on skill-based participatory design with some lessons for work-oriented design.

General lessons on work-oriented design include:

1. Understanding design as a process of creating new language-games that have family resemblance with the language-games of both users and designers gives us an orientation for doing work-oriented design through skill-based participation—a way of doing design that may help us transcend some of the limits of formalization. Setting up these design language-games is a new role for the designer.
2. Traditional "systems descriptions" are not sufficient in a skill-based participatory design approach. Design artifacts should not be seen primarily as means for creating true "pictures of reality," but as means to help users and designers discuss and experience current situations and envision future ones.
3. "Design-by-doing" design approaches such as the use of mockups and other prototyping design artifacts make it possible for ordinary users to use their practical skill when participating in the design process.

Lessons on skill in the design of computer-based systems include:

1. Participatory design is a learning process in which designers and users learn from each other.
2. Besides propositional knowledge, practical understanding is a type of skill that should be taken seriously in a design language-game since the most important rules we follow in skillful performance are embedded in practice and defy formalization.
3. Creativity depends on the open-textured character of rule-following behavior, hence a focus on traditional skill is not a drawback to creative transcendence but a necessary condition. Supporting the dialectics between tradition and transcendence is the heart of design.

Lessons on participation in design of computer-based systems include:

1. Really participatory design requires a shared form of life—a shared social and cultural background and a shared language. Hence, participatory design means not only users participating in design but also designers par-

ticipating in use. The professional designer will try to share practice with the users.

2. To make real user participation possible, a design language-game must be set up in such a way that it has a family resemblance to language-games the users have participated in before. Hence, the creative designer should be concerned with the practice of the users in organizing the design process, and understand that every new design language-game is a unique situated design experience. There is, however paradoxical it may sound, no requirement that the design language-game make the same sense to users and designers. There is only requirement that the designer set the stage for a design language-game in which participation makes sense to all participants.

Beyond the Boredom of Design

Given the Scandinavian societal, historical, and cultural setting, the first part of this chapter focused on the democratic aspect of skill-based participatory design, especially the the important role of local trade unions and their strategies for user participation. In the second part, some ideas inspired by Ludwig Wittgenstein's philosophical investigations were applied to the everyday practice of skill-based participatory design. Practical understanding and family resemblance between language-games were presented as fundamental concepts for work-oriented design.

The concept of language-games is associated with playful activity, but what practical conditions are needed for such pleasurable engagement in design? Is the right to democratic participation enough?

In fact, the experiences from the work-oriented design projects indicates that most users find design work boring, sometimes to the point where they stop participating. This problem is not unique to the Scandinavian work-oriented design tradition. It has, for example, been addressed by Russell Ackoff (1974), who concluded that participation in design can be only successful if it meets three conditions: (1) it makes a difference for the participants, (2) implementation of the results is likely, and (3) it is fun.

The first two points concern the political side of participation in design. Users must have a guarantee that their design efforts are taken seriously. The last point concerns the design process. No matter how much influence participation may give, it has to transcend the boredom of traditional design meetings to really make design meaningful and full of involved action. The design work should be playful. In our own later projects, we have tried to take this challenge seriously and have integrated the use of future workshops, metaphorical design, role playing and organizational games into work-oriented design (Ehn & Sjögren, 1991).

Hence, the last lesson from Scandinavian designs is that formal democratic and participatory procedures for designing computer-based systems for democracy at work are not sufficient. Our design language-games must also be organized in a way that makes it possible for ordinary users not only to utilize their practical skill in the design work, but also to have fun while doing so.

ACKNOWLEDGMENTS

This chapter is reprinted from P. S. Adler and T. A. Winograd (Eds.), *Usability: Turning technologies into tools* (pp. 96–132). New York: Oxford University Press, 1992.

REFERENCES

Ackoff, R. L. (1974). *Redesigning the future*. New York: Wiley.

Aguren, S., & Edgren, J. (1979). *Annorlunda fabriker—Mot en ny produktionsteknisk teori*. Stockholm: The Swedish Employers Confederation.

Berger, P. L., & Luckmann, T. (1966). *The social construction of reality—A treatise in the sociology of knowledge*. New York: Doubleday.

Bjerknes, G., & Bratteteig, T. (1987). Florence in wonderland—systems development with nurses. In G. Bjerknes, P. Ehn, & M. Kyng (Eds.), *Computers and democracy: A Scandinavian challenge*. Aldershot, UK: Avebury.

Bødker, S. (forthcoming). *Through the interface—A human activity approach to user interface design*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Brock, S. (1986). Wittgenstein mellem fænomenologi og analytik. In S. Brock et al. (Eds.), *Sprog, Moral & Livsform*. Århus Denmark: Philosophia.

Brulin, G., et al. (1988). *På rätt spår*. Stockholm: Arbetsmiljöfonden.

Dahlström, E. (1983). *Bestämmande i arbetet—Några idékritiska funderingar kring arbetslivets demokratisering*. Gothenburg: Department of Sociology, University of Gothenburg.

Dreyfus, H. L. & Dreyfus, S. D. (1986). *Mind over machine—The power of human intuition and expertise in the era of the computer*. Glasgow: Basil Blackwell.

Ehn, P. (1989). *Work-oriented design of computer artifacts*. (2nd Edition). Hillsdale, NJ: Lawrence Erlbaum Associates.

Ehn, P., & Kyng, M. (1984). A tool perspective on design of interactive computer support for skilled workers. In M. Sääksjärri (Ed.), *Proceedings of the Seventh Scandinavian Research Seminar on Systemeering*. Helsinki.

Ehn, P., & Kyng, M. (1987). The collective resource approach to systems design. In Bjerknes et al. (Eds.), *Computers and democracy—A Scandinavian Challenge*. Aldershot, UK: Avebury.

Ehn, P., & Kyng, M. (1991). Cardboard computers—mocking-it-up or hands-on the future. In J. Greenbaum & M. Kyng (Eds.), *Design at work*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Ehn, P., & Sandberg, Å. (1979). *Företagsstyrning och löntagarmakt—planering, datorer, organisation och fackligt utredningsarbete*. Stockholm: Prisma.

Ehn, P., & Sjögren, D. (1991). From systems descriptions to scripts for action. In J. Greenbaum & M. Kyng (Eds.), *Design at work*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Ehn, P., et al. (1985). *Datorstödd Ombrytning*.Stockholm: Swedish Center for Working Life.

Einhorn, E., & Logue, J. (Eds.), (1982). *Democracy at the shop floor—An American look at employee influence in Scandinavia today*. Kent, OH: Kent Popular Press.

Floyd, C. (1987). Outline of a paradigm change in software engineering. In G. Bjerknes et al. (Eds.). *Computers and democracy: A Scandinavian challenge*. Aldershot, UK: Avebury.

Foged, J., et al. (1987). *Håndbog om klubarbejde, edb-projekter og nye arbejdsformer*. Århus: HK kommunal.

Fry, J. (Ed.). (1986). *Towards a democratic rationality—Making the case for Swedish labor*. Gower: Aldershot.

Göranzon, B. (1984). *Datautvecklingens Filosofi*. Malmö: Carlsson & Jönsson.

Gustavsen, B. (1985). Workplace reform and democratic dialogue. *Economic and Industrial Democracy, 6*(4), Nov. 461–479.

Hedberg, B. (1980). Using computerized information systems to design better organizations. In N. Bjørn-Andersen (Ed.). *The human side of information processing*. Amsterdam: North-Holland.

Hedberg, B., & Mehlmann, M. (1983). *Datorer i bank*. Stockholm: Swedish Center for Working Life.

Howard, R. (1985). UTOPIA—Where workers craft new technology. *Technology Review, 88*. April, 43–49.

Jackson, M. (1983). *System development*. Englewood Cliffs, NJ: Prentice-Hall.

Janik, A. (1988). *Style, politics and the future of philosophy*. London: Kluwer Academic Publishers.

Kaasbøll, J. (forthcoming). *A theoretical and empirical study of the user of language and computers*. Dissertation. Department of Informatics, University of Oslo.

Kammersgaard, J. (1985). *On models and their role in the use of computers*. Paper Presented at Working Conference On Development and Use of computer Based Systems and Tools. Aarhus University. Denmark. Aug 19–23.

Kosik, K. (1967). *Die Dialektik des Konkreten*. Frankfurt: Suhrkampf.

Kronlund, J. (1978). *Produktionslivets förnvelse—teknik, organisation, manniska, miljö*. Conference in Uppsala. The Swedish Work Environment Fund.

Kubicek, H. (1983). User participation in system design. In Briefs et al. (Eds.), *Systems design for, with, and by the users*. Amsterdam: North-Holland.

Kyng, M., & Mathiassen, L. (1982). Systems development and trade union activities. In N. Bjørn-Anderson (Ed.), *Information society, for richer, for poorer*. Amsterdam: North-Holland.

Lysgaard, S. (1961). *Arbeiderkollektivet*. Stavanger: Universitetsforlaget.

Mumford, E. (1987). Sociotechnical system design—Evolving theory and practice. In G. Bjerknes et al. (Eds.). *Computers and democracy—A Scandinavian challenge*. Aldershot, UK: Avebury.

Nordenstam, T. (1984). Två oförenliga traditioner. In B. Göranzon (Ed.), *Datautvecklingens Filosofi*. Malmö: Carlsson & Jönsson.

Nordenstam, T. (1985). *Technocratic and humanistic conceptions of development*. Stockholm: Swedish Center for Working Life.

Norwegian Employers Federation and Norwegian Federation of Trade Unions. (1975). *General Agreement on Computer-Based Systems*. Stockholm.

Polanyi, M. (1973). *Personal knowledge*. London: Routledge and Kegan Paul.

Qvale, T. (1976). A Norwegian strategy for democratization of industry. *Human Relations, 5*. 468.

Sandberg, Å. (1976). *The limits to democratic planning—Knowledge, power, and methods in the struggle for the future*. Dissertation. Liber, Stockholm.

Sandberg, Å. (1979). (Ed.), *Utredning och föröndring i förvaltningen*. Stockholm: Liber förlag.

Sandberg, Å. (1982). *From satisfaction to democratization—On sociology and working life changes in Sweden*. Stockholm: Swedish Center for Working Life.

Sandberg, Å. (forthcoming). *Technological change and co-determination in Sweden—Background and analysis of trade union and managerial strategies*. Philadelphia: Temple University Press.

Seymour, J. (1984). *The forgotten arts—A practical guide to traditional skills*. London: Dorling Kindersley.

Sjögren, D. (Ed.) (1979–83). *Nyhetsblad från Snickeriprojektet*. Stockholm: Swedish Center for Working Life.

Steen, J., & Ullmark, P. (1982). *De anställdas Mejeri*. Stockholm: Royal Institute of Technology.

Swedish Federation of Trade Unions. (1975). *Handlingsprogram för företagsdemokratt och data*. Stockholm.

Swedish Federation of Trade Unions. (1977). *Codetermination on the foundation of solidarity*. Stockholm: Prisma.

Williams, R. (1987). Democratising systems development—technological and organisational constraints an opportunities. In G. Bjerknes et al. (Eds.), *Computers and democracy—A Scandinavian challenge*. Aldershot, UK: Avebury.

Winch, P. (1958). *The idea of a social science and its relation to philosophy*. London: Routledge & Kegan Paul.

Winograd, T., & Flores, F. (1986). *Understanding computers and cognition—A new foundation for design*. Norwood, NJ: Ablex.

Wittgenstein, L. (1923). *Tractatus Logico-Philosophicus*. London: Kegan Paul.

Wittgenstein, L. (1953). *Philosophical investigations*. Oxford: Basil Blackwell & Mott.

Yourdon, E. (1982). *Managing the system life cycle*. New York: Yourdon Press.