Cooperative Design: Techniques and Experiences From the Scandinavian Scene

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This chapter is based on a vision, an ideal, of what system development should achieve and how it should take place. First of all, we see the ideal project as one that encourages the users-to-be in an organization, i.e., all the involved groups and individuals, to decide themselves how to develop their work by means of new computer support. This ideal is seldom realized, because organizations are characterized by conflicts, most significantly between management and labor, and because different groups have different power and resources in the organization. It is not only a matter of democracy, though. In our experience, most traditional systems development methods are too abstract and detached from the work and life of most people, even from management. Thus we need to develop and work with techniques that allow for more use of everyday experiences and professional skills in design.

At the Participatory Design Conference (PDC '90), Seattle, the authors of this chapter and their collaborators were invited to present their approaches to participatory design, together with other researchers and designers from Scandinavia. These approaches originate from a diversity of projects where researchers and designers have been cooperating closely with groups of workers, shop stewards, and other union representatives, and where the organizational framework provided by the local unions played an important role (Ehn & Kyng, 1987). Hence, one of the key questions discussed over the 2-day conference was whether the Scandinavian “Model” for system design, as summarized in our earlier vision could be applied in a North American setting—a setting where industrial democracy and strong union relationships cannot be assumed to be found in most organizations, as is the case in Scandinavia. We do not attempt here to answer this question. Rather, we do discuss a set of techniques to support
our earlier vision. We also describe the underlying perspectives and leave it to the
readers to judge whether the perspective and the techniques can be adopted in
their particular settings. For detailed discussions of the techniques, and the
rationale behind them, we refer to a recent book, *Design at Work: Cooperative

To begin, we present our perspective on computer applications and design as a
list of statements or assumptions:

**Computer Applications**

- When computer applications are brought into a workplace, they should
  enhance workplace skills rather than degrade them.
- Computer applications should be viewed as tools, and designed to be under
  the control of the people using them. They should support work activities, not
  make them more rigid.
- The introduction of computer applications changes the organization of work
  around them. The interplay between the computer application and work organi-
  zational issues should be a specific focus of the design and introduction of
  computer applications into organizations.
- Although computer applications are generally ordered to increase produc-
  tivity, they also need to be looked at as a means to increase the quality of the
  results.

**The Design Process**

- The design process, as any process taking place in an organization, is a
  political one and leads to conflict. Managers who order an application see things
differently from the workers who will use it. Different groups of users will need
different things from the application, and system designers often pursue their
own interests. Conflicts are inherent in the process. If they are ignored the
solution may be less useful and continue to create problems.
- Computer applications that are created for the workplace need to be de-
  signed with full participation from the users—both from a democratic point-of-
  view and to ensure that competencies central to the design are represented in
  the design group. Full participation, of course, requires training and active coo-
  peration, not just token representation in meetings or on committees. We use the term
  cooperative design to designate such cooperation between users and designers.
  However, to users, designing a new computer application is a secondary activity
  whereas for designers it is their primary work. This means that the designers

should know how to set up the process and need to make sure that everyone gets
something out of the interaction.
- The design process highlights the issue of how computers are used in the
  context of work organization. We see this question of focusing on how computers
  are used, which we call the *use situation*, as a fundamental focus for the design
  process. We put our attention on how people work, and take the practice of the
  users as the starting point for the design process.
- Encouraging user participation and designing for skill means paying atten-
  tion to things that are often left out of the formal specifications, like tacit
  knowledge or shared knowledge and communication. Computer applications
  are a lot more than the simple flow of information represented in the flowcharts
  that systems analysts present to their clients. When users participate in actual
  design activities it is necessary to use tools that are familiar to them. Traditional
  tools such as flowcharts, dataflow diagrams, and programming languages are insuffi-
  cient (or even useless) as means for cooperating with users. In our experience,
  some of the techniques we discuss later do in fact encourage user participation
  and creativity.
- To enable users to contribute with their tacit knowledge in design, it is
  important to simulate future work situations, creating the illusion of actually
  working with the projected system. In this way changes in the use practice can,
  to some extent, be predicted and evaluated.

This perspective on computer applications and design processes has evolved over
more than 15 years, strongly influenced by the experiences from several research
projects of our own as well as those of other groups. An overview of this
development follows.

**HISTORICAL BACKGROUND**

The research projects that we have been involved with since the early 1970s,
have developed in interplay with the society around them. Employee influence
through unions and cooperation with management has for a long time been an
integral part of the industrial relations in the Scandinavian countries. The Scan-

dian projects on worker influence on development and use of computers
began in the early 1970s, when new legislation increased the possibilities for
worker influence. The projects supplemented the earlier strategy, called codeter-
mination, with a series of activities set up by central and local unions indepen-
dent of employer organizations and management. In these "first generation"
projects, workers aided by consultants and researchers struggled to develop a
better, more coherent platform for worker influence on the use of new technology
at the workplace. New work practices, focusing on group work and the develop-
ment of local resources for action, were being shaped, tried out in practice, and reshaped in the projects. Some of the work groups produced criteria for better working environments and suggestions for applications to support groups of workers planning their own work. As a result of the first of these projects the existing legislation on worker influence was supplemented by Technology Agreements that gave workers a direct say in the development and use of technology in their workplaces. This also led to an extensive series of union education programs. The first of these projects was the NMF project, set up by Kristen Nygaard and Olav-Terje Bergo together with the Norwegian Iron and Metal Workers’ Union (Nygaard & Bergo, 1975). This was followed by the Swedish DEMOS project in which Pelle Ehn and Åke Sandberg played major parts, and the Danish DUE project organized by Morten Kyng, Lars Mathiassen, and Niels Erik Andersen together with the Trade Union Council (Ehn & Kyng, 1987).

In the 1970s these early projects introduced the notion of worker participation in decisions about technology, but, whereas workers had a legal say in workplace technology, the laws did little to shift the balance of power from a managerial perspective. And the rationalistic tradition embedded in computer system development did little to give workers a voice in putting forth their own ideas when trying to agree on the introduction of new technology. As in the United States, this was reflected in the tools of system development, which emphasized developing technical specifications rather than seeing the application from the perspective of the users.

By the early 1980s, a “second generation” of projects was initiated in Scandinavia. These projects focused on design of new kinds of computer support using skill and product quality to push computer system design more towards a users’ perspective. They took the issue of dehumanization and put it on the table as a central problem in the design and use of computer systems. Thus, to put some muscle on the bones of the Technology Agreements, the issues of quality of work and product were put into the forefront of the new design-oriented projects. An example of this was the Utopia project, named both for its ideals and as an acronym for its use (Bødker, Ehn, Kammersgaard, Kyng, & Sundblad, 1987). In this project computer system developers and researchers worked with a group of typographers helping to formulate the ways that computer technology could be used to enhance their skills and better the typographic quality of newspapers. These researchers came from the Swedish Center for Working Life, the Technical University in Stockholm, and from Aarhus University.

From the first projects in the 1970s, developing strategies and techniques for worker influence on design and use of computer applications, through the focus on skill in the early 1980s, computer system development in Scandinavia developed the concept of user participation. In Work Oriented Design of Computer Artifacts, Pelle Ehn (1989) outlines the story of these changes and delves into some of the theoretical work that influenced the thinking of the earlier as well as later projects. Rethinking the actions and experiences in these projects he develops a theoretical understanding of design work based on phenomenology, marxism, and ordinary language understanding.

This theoretical understanding has been supplemented with inspiration from activity theory (Bødker, 1991; Christiansen, 1988), and the so-called work development research (Engeström, 1987; Bisgaard et al., 1989). Together with the insight developed during our writing of Design at Work (Greenbaum & Kyng, 1991) it has lead to a new round of empirical work, which we present in part next.

In retrospect, when looking at the strategies and techniques applied in the aforementioned projects, there has been continuous development and some major changes: In general, we have today a much better theoretical understanding of possibilities for and limitations to active user participation in design processes. This understanding comes from our interpretations of theories that can be grouped under the philosophical heading of social construction, seen in contrast with the rationalistic tradition of computer science. At the practical level this is reflected in our continued revisions of our set of development tools and techniques, where we try to modify those aspects of our techniques that are influenced by the older rationalistic perspective pervading system development theory and practice. One illustration of these revisions is our move from system descriptions to mock-ups and game-like design sessions (see the following). Also, where many of the techniques of the early projects followed the line of analyzing, followed by setting up goals, for example, for local unions, and then making action programs, today, many of our techniques use fantasy and imagined futures to move from problems in the present specific setting to reality and specific actions. This “substitution” of goals with positive visions/fantasy without the need for rationalistic arguments to support the visions is an important step in encouraging creative contributions from the users (Kyng, 1989).

**CASE: THE AT PROJECT**

The following case example is a project taking place at the National Labour inspection service (AT) office in Aarhus. The purpose of the project seen from the point-of-view of the managers and workers at AT is to design a number of computer applications for AT and to develop a long-term strategy for decentralized development and maintenance. Decentralization here is relative to the existing strategy in which all AT offices in Denmark subscribed to centralized computer applications run by a department in Copenhagen. This aspect, that the project is useful for the people in the participating organization, is central to our research. As with all the empirical projects that researchers from our tradition engage in, the project is one of action research, which in our understanding, means that the work we work with should get something out of the process as
well. The purpose for the researchers is an improved understanding and further development of the techniques described in *Design at Work*, among others, and of the applied theoretical basis.

We use the case primarily for presenting our choice of techniques, based on experiences from previous cases. The AT project itself is still only in the first stages. Presenting the techniques by means of a concrete case also serves to illustrate the situated nature of our techniques. The way we combine and apply the techniques at AT is dependent on specific conditions at AT. So, for instance, the techniques are presented differently in *Design at Work*. And obviously, the way we planned the work at AT differs from what actually happened.

In the project, 8 researchers work together with the people at the AT office in Aarhus. This office is part of a country-wide labor inspection service, under the auspices of the Danish State, mandated to take care of the workers’ health inspection at all workplaces. Employed are inspectors, who are partly specialized in different areas, as well as administrative personnel, and a centrally located support staff of researchers. In the Aarhus office, the staff amounts to approximately 40 people.

The inspectors are trained in many different ways, as engineers, craftspeople, biologists, nurses, medical doctors, psychologists, and more. The contact between the inspectors and the companies takes place in three different ways: (a) an inspector selects, and visits, a randomly chosen company; (b) an accident is reported by a company, a doctor, or a shop steward, upon which the inspector may choose to pay a visit; (c) and through a so-called campaign. A campaign is a coordinated (often from the main office) effort to visit companies within a certain area, or where certain kinds of work hazards are very common. For example, all plastic-producing factories are paid visits to inform about cancer. The inspectors in general give information and advice, and they have the legal power to order changes in the production facilities when these are not in accordance with the law.

The administrative staff consists of office workers, who perform numerous support functions, maintain files of different kinds, and give immediate help to people calling on the phone.

For the researchers, this project is somewhat different from most previous projects in that we cooperate both with the local management and with the workers. Furthermore, the project from the outset includes all groups at the organization, with their different roles and skills.

Following are presentations of the techniques that the project works with as outlined in Fig. 8.1. We also discuss specific measures. The following activities were planned during the first part of the AT project:

- Researchers learning about the work at AT through workplace visits during which people from AT were interviewed and demonstrated their work practices.
- Compilation of an inventory of existing problems with and new ideas for
work organization and computer support through the critique and fantasy phases of a Future Workshop.

- An Organizational Game investigating current roles, new technological possibilities—illustrated by means of mock-ups and prototypes—and changed roles, and developing an action plan.
- Embodying ideas—continued cooperative design of selected computer applications using mock-up design and cooperative prototyping, and trying out new/modiﬁed work organizations.

At this point, a detailed plan for development of a strategy for decentralized system development or for the conclusion of the project has not been made.

The initial step of the first activity was for 4–5 researchers to visit the organization for a couple of days. We wanted to learn more about the work tasks of the inspectors and the administrative staff. Furthermore, we needed to focus on the materials and instruments that were applied in the different work tasks, and the cooperation between people in the work tasks. This involved following some of the inspectors on workplace inspections. In general the strategy was one of interviewing people in their offices or wherever they were working, asking them to demonstrate to us parts of their work tasks, the files that they keep, the instruments, in particular computer programs that they apply, etc. Inspired by Engström (1987) and Bisgaard et al. (1989) focus was not only on the normal state of affairs, but also on exceptions and problems. The work of managers and workers was treated in the same way, and the outcome was improved knowledge of the organization as well as a number of ideas and problem areas to focus on in the process to come.

FUTURE WORKSHOPS

Following the workplace visits at AT, a Future Workshop was conducted to help focus more directly on the problems and ideas that the workers at AT had, or could bring forward collectively. In Design at Work (Greenbaum & Kyng, 1991) the use of the Future Workshop technique for system design is described in detail. (See Halskov Madsen & Kensing (1991) who have developed the Future Workshop technique for system development in combination with a technique denoted Metaphorical Design.)

Robert Jungk and Norbert Müllert (1987) originally developed the Future Workshop technique for citizen groups with limited resources who wanted a say in the decision-making processes of public planning authorities (town planning, environmental projection, energy crisis, etc.). The technique is meant to shed light on a common problematic situation, to generate visions about the future, and to discuss how these visions can be realized. Those participating should share the same problematic situation, they should share a desire to change the situation according to their visions, and they should share a set of means for that change. Usually, a Future Workshop is run by at least two facilitators, with no more than 20 participants. The facilitators attempt to ensure an equal distribution of speaking time and they should also ensure that all participants can follow the discussion, by letting the participants write their ideas as short statements on wall charts (a large sheet of paper taped to the wall). A Future Workshop is divided into three phases: the Critique, the Fantasy, and the Implementation phase. Essentially the Critique phase is designed to draw out specific issues about current work practice, the Fantasy phase allows the participants the freedom to imagine "what if" the workplace could be different; and the Implementation phase focuses on resources needed to make realistic changes. These phases are surrounded by preparation and follow-up periods.

At the beginning of the Future Workshop the facilitators introduce the technique to the participants. Basically the Critique phase is like a structured brainstorming that focuses on current problems at work. Speaking time is allotted to all participants and is often restricted to 30 seconds to make it possible for everyone to speak. As a preparation for the next phase the statements are grouped under a number of critique-headings/themes. As the first part of the following Fantasy phase the critique themes are inverted to positive guiding themes. During the following brainstorming no statement about the future is considered too extreme—if somebody wants it, it's OK. As a preparation for the second part of the Fantasy phase the short statements are regrouped under a number of fantasy-headings/themes. Some of these are then selected for elaboration in the following group work, where they are elaborated into "utopian outlines." The Implementation phase may start by having each group present their version of a utopian outline. The general idea is to make plans for how to start acting in the immediate future of the workshop. In the AT project the Future Workshop idea was adapted as follows.

The researchers' understanding of the problems of the organization was mainly based on interviews with individuals at AT. After that, they encouraged workers to also formulate their own understanding of problems and changes, preferably as a collective. Not that they expected everybody to share needs and problems, but at least to create a mutual understanding of these.

Given previous experiences with Future Workshops where different groups were involved (see for example, Design at Work, Chapter 7), the researchers decided to ask management to stay away from the workshop and leave the scene to the workers. One of the problems experienced earlier in having a mixed group of managers and workers do a Future Workshop together is that the workers may be afraid of management retaliation if they express serious critique of current conditions in the organization. Also, in many organizations, the workers are less used to expressing themselves orally than management, resulting in a workshop where management interests set the agenda.
It is quite difficult to get everybody together in an organization like AT, where the inspectors are out a lot, and where many people work part-time. Thus, a 2½ hour slot in a regular monthly staff meeting was set aside for a meeting focusing on the Critique and Fantasy phases of a Future Workshop. In addition to this, a 2-day meeting for a smaller group was scheduled for later. For this meeting, the researchers decided to use the design-by-playing technique described shortly. In order to make the best possible use of the 2½ hours, the Implementation phase was seen as something going on after the meeting (in many ways, the rest of the project can be seen as implementation). To make use of the insight already collected two of the four researchers present in the meeting were to observe the statements in the Critique phase and try to come up with themes for the Fantasy phase. This also reflects an experience of ours saying that formulating themes is often hard and time consuming. The Fantasy phase was conducted in four groups, each of which had a different theme and had a researcher as facilitator. Some of the ideas that came up here were selected for further exploration in the Organizational Game. The themes arising out of the Future Workshop were used in setting up the playground of the Organizational Game, and the discussions as well as the earlier investigations were used in setting up the situations for the game.

ORGANIZATIONAL GAMES

The major problems in AT are centered around the organization of work and how this relates to the use of computer technology: For instance, much of the information that the inspectors report about their inspections is rewritten three times by the inspectors in slightly different forms. Following this, the information is filed by different secretaries into different files. It was suggested by the researchers, and accepted by AT, that the 2-day meeting should focus on such work organization problems. The Organizational Game technique, developed by Sjögren and Ehn (1991) seemed appropriate for this. It supports considering alternative work organizations by playing them out and confronting the different problems they create.

Organizational games build on the idea that:

- they make a difference for the participants
- implementation of the results is likely
- they are fun to participate in.

The first two points concern the political side of participation in design; the 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 should transcend the boredom of traditional design meetings to really support design as meaningful and involved action. The design work is treated as a theatrical play. Furthermore the organizational games share with future workshops the idea that the overall structure of the game moves from the present situation, via an imagined future, back to reality. One of the early attempts to develop organizational games came from the UTOPIA project where an Organizational Kit was developed to enrich work with abstract system descriptions. The basic ideas behind the organizational design game in the UTOPIA project were that:

- It should be fast and easy for a group of people to work with;
- it should be cheap and flexible to use, allowing several alternatives to be tested during discussions; and
- it should be based on concepts relevant to the actual type of production and support design discussions of existing and future work and technology.

Based on experiences from UTOPIA and other projects, the technique has been developed and applied in several projects, by Sjögren and Ehn (1991). The main example of the use of the technique is the Desktop Publishing Game. It was developed for and played in a few public administration offices in Sweden, the main case being the Consumers Agency Konsumentverket. The technique borrows its way of thinking from theater. Its dramatic design context is based on six concepts:

The playground is a subjective and negotiated interpretation of the work organization in question. The professional roles are represented by both individual professional ambitions and organizational requirements. The situation cards introduce prototypical examples of breakdown situations. Commitments are made by individual role players as actions related to a situation card. Conditions for these commitments are negotiated, and an action plan for negotiations with the surrounding organization is formulated.

The game designed for AT was based on a group of 10–12 people from different parts of the organization, workers as well as management. The game started with a Prologue, where the rules of the game were introduced, and the roles and competences of the participants chosen. For Act 1, which followed the Prologue, the playground and situation cards were designed by the researchers to focus on the problems that had surfaced during the initial activities in the project, i.e., the workplace visits and the Future Workshop. In later parts of Act 1, the participants were to create and play their own situation cards. This was done to bring the game closer to the actual problematic situations of the organization, as perceived by the participants from AT. A lot of work was put into preparing Act 2, where some amount of not-yet-implemented or well-defined technology ap-
applications were to appear on the scene. The researchers decided to instantiate this technology by means of prototypes and mock-ups (see the following) letting participants get a chance to experience these as part of the game. Act 2 focused on possible new pieces of technology to be applied in the organization, and how they would affect the work in the organization. Act 3 focused on changes of roles and new commitments, with new technology. This act applied scenarios rather than situation cards. One scenario was the small autonomous group, and one was focused on process and product quality. Once again the roles and competences of the participants were negotiated. In the final part, a new playground was brought in, and the participants negotiated an action plan, based on the experiences from the game. This action plan focused both on what could be done here and now and by groups or individuals in AT, and on what needed external resources. All of this was scheduled to take place at a 2½-day seminar. However, we did not finish the action plan. This was done 10 days later at a half-day meeting.

The following two sections present some of the techniques we have developed to involve users actively and creatively in the design of computer applications. Their main value is that they allow users to experience future work-like situations where emerging new applications are tried out, evaluated, and changed or discarded—in cooperation between users and (system) designers. This use of the techniques is part of the action plan developed in the Organizational Game described earlier, but thus far the techniques have, in the AT project, only been used in a learning process, where the designers illustrated new technological possibilities by means of mock-ups and prototypes as part of the Organizational Game (cf. the second act described earlier). As Fig. 8.1 shows, mock-up design and cooperative prototyping activities are planned to embody a subset of the ideas that surfaced in the previous activities.

**Mock-up Design**

The idea of mock-ups was developed in the UTOPIA project as a way to encourage active user involvement, as opposed to the use of traditional specification documents. In addition, they actually help users and designers transcend the borders of reality and imagine what is currently impossible, such as a screen of 100" with 1000 pixels per inch. As opposed to descriptions, mock-ups remind the users of familiar work situations. And with mock-ups there are meaningful roles for them to play in the use of these design artifacts.

The idea of mock-ups is presented by Ehn and Kyng (1991). They ask why mock-ups work, despite having low functionality and being only a kind of simulacrum. Some of the answers, they suggest, are that mock-ups:

- they are understandable, hence there is no confusion between the simulation and the "real thing," and everybody has the competence to modify them;
- they are inexpensive, hence many experiments can be conducted without big investments in equipment, commitments, time, and other resources; and last but not least,
- they are fun to work with.

Some of these characteristics are shared by mock-ups and prototypes, as described in the following section. However, some are not, and in the following we focus on these characteristics, that is, why at times it may be a good idea to design without computers. First, mock-ups are built with inexpensive materials. To buy expensive hardware and build advanced software early in a project may, in most situations, be directly counterproductive, especially given the possibilities of mock-ups. In other situations, however, the investments in hardware and software may not be a problem—PCs may already be massively used in the organization. Still, the use of mock-ups may pay off, because it can help generate new visions and new options for use. Second, the characteristics of these simple tools and materials are familiar to everybody in our culture. With this type of mock-ups nothing mysterious happens inside a 'black box.' If a picture taped to the blackboard drops to the floor everybody knows that was due to difficulties of taping on a dusty chalkboard, and not part of the design. There is no confusion between the simulation and the 'real thing.' Third, such mock-ups lend themselves to cooperative modifications. The possible operations on the material, for example, pens and scissors, are well known to all, and with simple paper-and-cardboard mock-ups people often make modifications jointly or take quick turns changing the mock-up. The physical changes are visible, and, with proper display, visible to all the participants.

However, as with any tool or technique, simple mock-ups have their limitations, too. First, changes to a mock-up may be very time consuming. If, for example, a different way of presenting menus is chosen, changes may have to be done to dozens of drawings, or a whole new set of slides will have to be made. Second, it is hard to illustrate behavioral aspects of future applications as realistically as it can be done with prototypes. Third, although mock-ups allow a design group to experiment without the limitations of current technology, this freedom is only a partial blessing. In the end, good design results from a creative exploitation of the technological possibilities and limitations, not from ignoring them. Thus, as paradoxical as it may sound, the demands for computer knowledge in a design group using mock-ups are very high.

In the AT case, we plan to build mock-ups to explore more details of possible future technology, by managers, workers, and researchers in cooperation. Suggestions for how to use mock-ups and prototypes have arisen from the action program, as described next, but the specific areas in which to proceed remain to be chosen.
COOPERATIVE PROTOTYPING

The way we do prototyping—cooperative prototyping—is different from traditional prototyping in that traditional prototyping approaches mainly take the perspective of the developers: Analyst/Designers conduct investigations in the user organization and develop prototypes on their own. Such prototypes are tested by or demonstrated to users to give the developers feedback on their solution. It has a superficial resemblance to our use of prototypes for illustrating new technological possibilities, but whereas we see this use of prototypes as part of the users' learning, traditional approaches view it as part of the feedback to developers. Traditional approaches put little emphasis on active user involvement in the actual design process. Bødker and Grønbæk (1991) introduce a different approach called Cooperative Prototyping. The approach is an exploratory approach (Floyd, 1984) where prototyping is viewed as a cooperative activity between users and designers, rather than an activity of designers utilizing users' more or less articulated requirements. In cooperative prototyping the aim is to have users achieve a familiarity with the tools that comes close to what was achieved with mock-ups, although this may be infeasible in the immediate future.

The cooperative prototyping approach establishes a design process where both users and designers are participating actively and creatively with their different qualifications. A key point in facilitating such a process is to let the users experience prototypes in a fluent work-like situation. The users' current skills must be confronted with new technological possibilities. This can be done in a simulated future work situation or in a real use situation. When breakdowns occur in the simulated use situation, users and designers analyze the situation and discuss whether the breakdown occurred because of the need for training, a bad or incomplete design solution, or for some other reason. Breakdowns caused by bad or incomplete design solutions should rapidly be turned into improved designs, in order to reestablish the fluent work-like evaluation of the prototype. In many cases users can participate actively in improving the prototypes. Prototype modifications that can be made by direct manipulation are made immediately in the session, whereas modifications requiring a larger programming effort are postponed and made by designers after the session.

Setting up alternative prototypes is useful for users and designers to get their imagination going and thereby for the group to discuss different ways of organizing work. A Future Workshop often displays a diversity of alternative fantasies about how to improve work with computers or by changing work organization. Exploring some of these alternatives through prototyping is a fruitful way to move from fantasy into the actual development process and to focus on improving the users' work through computer support.

At present the prototypes for the AT case are seen primarily as learning vehicles for the workers and managers as part of the Organizational Game. This use of prototypes supports imagination and discussion about the future work with new technology. The Organizational Game becomes more concrete than if technology is just talked about. For instance, prior to the AT project, there had been a lot of talk about the inspectors carrying portable computers on their visits. But hardly any of the inspectors had seen one. Letting them experience the general capabilities of a portable computer in itself grounds the discussions. And of course experiencing prototypes of what the portable may be used for in their specific situation brings the discussion much further and also raises a number of questions related to work organization. For instance, if the inspectors directly enter into the computer the information that they now record on forms, what will happen to the work tasks of the secretaries who are now responsible for this data entry?

As with mock-ups these initial discussions help delimit areas in which to proceed with prototyping. And part of this is to let the users get more actively involved with the existing prototypes. To learn the best ways to set up these sessions, a diversity of questions are considered, such as: What is the purpose of the session? How stable should the prototype be in advance? To what extent should in-session modifications be done? What setting should be chosen? How should the outcome be documented/evaluated? In prototyping sessions, designers often like to demonstrate all the features they believe are wonderful. However, our claim is that demonstrations do not necessarily tell the users anything about how the prototype or the final application fulfills their needs. To fully experience the prototype, the users need to be in control of its use for some period of time, to try it out in work-like situations. If the prototypes are not sufficiently stable to let the users work on their own with it, the designer should be prepared to give first aid for breakdowns caused by the prototype. While designers are, initially, the ones who know how the process should be set up, it is important that the process be adjusted to the needs and wishes of the users.

The product of the prototyping process is not only a computer prototype. Prototyping is a learning process, and much of the new understanding must be spread to workers and managers who do not participate directly in the prototyping. One way is to use the different prototypes in a process in which all involved personnel are guided through a compacted version of the prototyping process (Bisgaard et al., 1989). In general, the prototypes are valuable means in the education of future users, because education can start while the final computer application is being implemented. Similarly, the participants from a prototyping process can often act as teachers. These ideas are being developed in the AT project.

GENERAL CONDITIONS

A design process in which a group of users and designers cooperate takes place in a complex context with different types of societal conditions and contractual relationships among the partners (see Chapter 5 by Grønbæk et al., this volume).
System designers in some settings will have to fight to involve users in the design process. For instance, the application to be developed may be specified in a product contract stating requirements and a fixed price. Or the application is a brand new product to be marketed. Thus it may be difficult to identify a suitable group of potential users.

One of the frequent obstacles to increased user involvement in design projects is resources, or rather, the lack of them. Throughout a design project resources must be secured for user participation if there is to be real cooperation. Users who get no reduction in their daily workload cannot be expected to engage themselves in a design project over long periods of time. But resources are not only time and money; they also include education and assistance from a variety of experts.

Another frequent obstacle is the current structure and the traditions in the involved organizations. For instance, marketing groups within product development organizations may restrict user involvement in the development process even when the developers do find it important (see chapters by Grudin and by Grønåke & et al., in this volume). One such reason could be that the product development organization does not want to design a product that is tied too closely to a certain customer or customer type.

In most organizations, some groups have more power and resources than others. Those who have the most power and resources are usually management, not the end-users. To help users get a forum where they can take an active part in design means to set up situations where they can act according to their own interests and rules, and not simply according to those of their managers. The right to make decisions about how to spend resources is also a crucial aspect of the resource question mentioned before. Most projects have to follow the rules of the organization to which they belong. In some cases this implies that a project group consisting of designers and users collectively makes the decisions, as was the case with the UTOPIA project mentioned earlier. In most cases, however, standard managerial procedures will determine the way decisions are made. When a crisis or a conflict arises under these circumstances, decisions often run contrary to the wishes of users, and perhaps contrary to those of the designers as well. The result is usually that the users withdraw from the process, either totally by leaving the design group, or by becoming passive members, losing their initial belief in the possibilities of their influencing the design. To give users a better chance of continued participation, we recommend that from the outset the designers argue for a certain amount of resources to be allocated for user initiatives.

The weakest groups in particular need the strongest support in formulation of their demands and ideas for the future. There can be conflicting interests among the groups, but these conflicts may be turned into resources for the project, if the situations are set up in appropriate ways. This can mean that designers and users should not just establish one project group of all involved parties, but should work with different groups of people at different times (Ehn & Kyng, 1987; Ehn & Sandberg, 1979; Engeström, 1987). At the same time, the different groups need to be exposed to each other's demands and suggestions, which emphasizes the need for designers to be coordinators of the activities.

CONCLUDING REMARKS

One of the issues confronted when we tear down the barriers of traditional design is that the roles of the system developers shift from that of project managers to project facilitators. Cooperative design, which in our perspective means empowering users to fuller participation and cooperation, changes the rules of the game. Within traditional system development, each step, from feasibility study through implementation, is supposed to be controlled by system developers and management through discrete procedures, and marked by clear-cut milestones and exit criteria. In our view, the traditional system approach makes it easier for designers to create the impression that things are under control. But often the supposedly last act, where a system is put into operation, shows that it does not fit the work of the users, and an almost unending epilogue of modifications begins. The cooperative design approach begins by creating an environment in which users and designers can actively consider the future use situation. It is a process where users and designers don't have to wait until the final act to know if the application will fit the practice of the users.

Finally, we recall the situated nature of cooperative design. Each application of the techniques described in this chapter will be different depending on the type of project in which they are applied. In Design at Work (Greenbaum & Kyng, 1991) the techniques have been presented using a variety of examples of their use; in this chapter we have done a somewhat similar thing using a single project as our example. A reader who examines both sources will see that the techniques have been applied differently. The point is that the next application of the techniques will again be different. This is why we think example driven presentations, like the one here, are more appropriate than stating general guidelines and methods. Trying to apply techniques that have been described by example will force the reader to consider similarities and differences between the described example and the current situation. This exercise will move the attention towards how to fit the technique to the current setting, rather than just sticking to a guideline that most likely doesn't fit the situation.

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