This paper describes work on the AT project. ("AT" stands for "Arbejdstilsynet", the Danish national labor inspection service.) The AT project is a collaboration between AT-Århus and Aarhus University (AU).

Participating in the project from the Århus branch of the AT are 40-50 people from a variety of occupations including secretaries, administrative workers, machinists, engineers, lawyers, and therapists. The researchers on the project are all connected in some way to Aarhus University (AU) and include: Susanne Bødker, Ellen Christiansen, Pelle Ehn, Randi Markussen, Preben Mogensen, and Randy Trigg.[1]

The paper provides an overview of the project through descriptions of its various activities. For more thorough analyses of project activities, the reader is referred to the bibliography. The paper ends with preliminary discussions of the present state of the project and our long-term outlook.

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[1] This paper draws on drafts and articles written by these researchers in various combinations (see the list of references).

1 Project background

In Scandinavia, the concept of user participation as an integral part of computer system development originated in the 1970s. At that time, the goal was to develop strategies and techniques by which workers could influence the design and use of computer applications. In the early 1980s, the focus was broadened to include skill development. As a result, the tradition has emphasized a process-oriented approach to systems development; as much attention has been paid to the process, for example the learning that takes place, as to the computer applications.

In *Work Oriented Design of Computer Artifacts*, Pelle Ehn (1989) outlined the history of these changes and delved into the theoretical work that influenced them. Reflecting on experiences from these projects he developed a theoretical understanding of design work based on phenomenology, Marxism and ordinary language understanding. This theoretical understanding has since been supplemented with inspiration from activity theory (Bødker, 1991, Christiansen, 1988), and *work development research* (Engeström, 1987, Bisgaard et al., 1989). Together with the insights we gained from writing *Design at Work* (Greenbaum & Kyng (Eds.), 1991) this has led to a new round of empirical work, of which the AT-project is a part.

Here, researchers experienced in participatory design, cooperative prototyping and organizational conflicts meet those experienced in close studies of work and communication and historical analysis. The collective goal has been to achieve an improved understanding of the constraints and possibilities for participatory design, and to further develop the techniques and theoretical bases described in *Design at Work*.

The basic objective of AT, the labor inspection service is to ensure (some degree of) workers safety, primarily accomplished through inspectors from the AT visiting companies throughout the country - issuing demands for changes in technology or procedures if necessary. Workers at the AT cover a broad spectrum of roles and skills involved in labor inspection and management. As mentioned above, the researchers also span a wide range of skills. This "multivoicedness" has challenged the ability of project members to communicate throughout the process.

When the AT project started, the local branch of AT in Aarhus and AT as a whole were instituting major organizational changes of which computer technology formed only a part. The purpose of the project

seen from the point of view of AT managers and workers was to create long term visions concerning computer applications for the branch, to develop a long-term strategy for decentralized development and maintenance, and to support the organizational change process through technology.

For us as researchers, the coupling between technical and organizational issues should have priority, meaning that the project should take its lead from the AT concerning questions to take up. Nonetheless, we had two complementary ambitions:

- to use prototyping to explore the possibilities for tailoring "advanced" software to local needs, and

- to try out techniques for describing work situations in ways relevant for prototyping and for general processes of organizational change.

Our participatory research and design strategy is discussed further in (Bødker, 1992, Bødker et al., 1991, Bødker et al., 1992, Mogensen, in preparation).

1.1 Historical background

Markussen (in press) provides a useful historical account of the AT as an institution and of the interwoven development of work environment laws, the bureaucracy, and the changing role of inspectors.

Until the mid-1970s AT dealt primarily with the inspection of physical work environments in factories. This preoccupation with *workers' safety* involved, for example, setting up machines. The inspectors were engineers and machinists, there was little bureaucracy, and each inspector was largely responsible for selecting factories to inspect. With the work environment act of 1975, the scope was broadened to include non-factory work, and a more holistic view of the work environment. The act prescribed a measure of bureaucracy, spread existing resources throughout the organization, and changed the professional profile; therapists and psychologists were hired, and prevention became a central issue. With the late 80s came further decentralization combined with a client orientation. The new focus on quality assurance was accompanied by an accountability "upwards" in the bureaucracy for what had formally been achieved locally. At the same time, more work was put into cooperative, structured activities, for example, a "cancer campaign" rather than the traditional independently planned visits to companies.

As Markussen observes, these changes mirror trends in the labor market in general, at the legislative as well as local executive level.

Indeed, the organizational turbulence experienced at AT during the project seems to be widespread in society, making the project especially interesting from a research standpoint.

1.2 Project history

In the following we give a short project chronology. Key activities (appearing in bold) are discussed further in later sections.

Fall 1989

The researchers joined forces and started looking for a case to work on. The aims and methods of the project were heavily debated in the project group; indeed, this debate has continued throughout the project. Taking practice seriously also means being prepared to shift the focus as the process goes along.

Spring 1990

The collaboration between AU and AT started. Meetings were held with AT's instructors ("super-users") from the local branch and technology developers from central headquarters in Copenhagen. We learned that AT intended to increase the use of computers at the local branches, and to decentralize obligations concerning current computer systems.

We agreed on a collaborative project between AU and AT to include co-development of prototypes, and we obtained permission for AU researchers to interview and observe workers at the AT.

Fall 1990

AU researchers began participating in meetings of the local AT computer committee. Researchers accompanied inspectors on daily inspections and observed AT work in the office and at meetings. Administrative work at AT was studied primarily through interviews and investigations of their files and other materials. This **fieldwork** resulted in descriptions of their work and the computer systems in use. We also gathered a variety of AT artifacts, primarily documents and forms.

During this period, we developed a, primarily horizontal, **prototype** for a case-handling system in HyperCard on the Macintosh, with the intention that it should one day be ported to a UNIX-Oracle platform. The primary purpose of this prototype was to explore the integration of the various isolated computer systems in use at the AT.

AU researchers put out the first issue of "**Sidste Nyt**," a newsletter meant to keep AT workers appraised of the latest project news. The first issue served primarily to introduce the project and the AU researchers.

We decided to hold a seminar at the end of October with members of AT. In preparation for this, a **future workshop** was held for all members of the Århus AT except managers. The idea was to spark a discussion of technology-related issues and inform the upcoming seminar. We were also interested in revealing the tight coupling between organizational and technological issues.

The "Ry" seminar was held over three days from October 30 to November 1. (Ry is a town about 30 km west of Århus.) Ten people from Århus-AT and 6 AU researchers attended. The seminar included an extended **organizational game** and work with mock-ups and **prototypes** of future technologies. A month after the seminar, the prototypes were installed for two days at the AT so that those who had not attended the seminar could have a chance to try them. We also distributed the second issue of "Sidste Nyt" which included reviews of the seminar by AT and AU attendees.

Spring 1991

We conducted a "field trip" for AT workers to "**Told & Skat**", a governmental department handling tax collection. The AT and "Told & Skat" are similar in certain ways (for example, in how tax collectors and inspectors do their jobs). In addition, "Told & Skat" had recently introduced portable computers on inspection which we felt might be of interest to AT workers.

We held meetings with the computer technology committee at AT. This led to our writing a technology proposal on behalf of the Århus-AT which included the idea of replacing their mainframe and terminals with personal workstations and a network.

Later, AT headquarters reached a decision to buy PCs for the Århus branch as a first step toward new technology for the entire organization. Hearing this, we held a meeting which turned out to be a milestone for the project. We nicknamed this "the lawn-meeting," since it took place outdoors on a lawn near where most of the research group had attended a week-long course on organizational learning.

At the lawn meeting, we considered abandoning the project since the opportunity to do prototyping research in the way we wanted seemed to have slipped away. After intense discussion, we decided to continue the project; we were after all committed to an action research way of thinking, and therefore wanted to see that both parties got as much as possible out of the situation. In particular, we decided to embark on a consultant-style relationship. That is, we agreed to be subject to the technological and organizational contingencies at Århus-AT. This moved the project direction from our research goals, to the practical necessities of helping the AT in their current situation. Toward this end, we bought a PC compatible with the ones to be installed at AT, and began to move our prototyping work off the Mac. The consulting relationship formed one level of our **two-level strategy**.

Our discussions during the Ry seminar covered the proposed changes to the organizational structure at Århus-AT. The new organization was to consist of groups organized according to the types of companies to inspect, and not according to the inspectors' profession. What was formerly centralized administrative work would now be distributed across groups. For example, secretaries who had worked in a pool would now be assigned to specific groups. During the latter part of this period, Århus-AT began to implement the group-based organization.

Fall 1991

Upon adoption of the new group organization at AT, we decided to focus our project on two of the groups, "Group 3" and "Group 4". Group 3 was to receive new PCs; our focus there was on the technology learning and adaptation processes. For Group 4, we concentrated on their use of the existing mainframe-based technology.

Our work with Group 3 included meetings at Århus-AT where we collaboratively developed the ideas embodied in the Ry prototypes and mock-ups. We worked most closely with two inspectors and two secretaries. At the same time, we continued the work of moving our prototypes to the PC platform. However, this work was given lower priority due to uncertainty as to whether a functional integration of the various mainframe applications would ever be possible.

Meanwhile, we conducted interviews with selected members of Group 4 on their use of the existing mainframe based software. We also held "round table" meetings with the entire group.

Our role as technology consultants during this period included advising on hardware and software purchases. In addition, we argued in favor of a local "action" plan covering projected changes in technology and in the organization. At the end of 1991, we presented a draft of such a plan which included an analysis of the potential for various forms of software like integrated text processing, electronic mail, computerized calendars, and project planning. The draft also discussed technology support for the work of inspectors and raised issues in documentation and training.

At the end of 1991 the Aarhus branch experienced two management changes: a new top-level manager and the disappearance of the deputy manager level (one of our primary points of contact). This led to further organizational changes, as well as a totally different management style.

Spring 1992

Following installation of the new PCs in Group 3 and as part of our continuing consulting role, we conducted training sessions for Group 3 members covering Microsoft Windows and WordPerfect text editing and tailoring. We also put out the third issue of "Sidste Nyt" which included short articles on various software and hardware-related topics.

Later in the Spring, we conducted a two-day seminar for members of Group 3. Like the Ry seminar, it was held away from their workplace in a town called **Odder**. And like the Ry seminar, the agenda included

organizational as well as technological issues. We used mock-ups and **simulations** to explain the essentials of networks and e-mail. We also conducted a "**dilemma game**" in order to spark concrete discussion of their current and future work practices.

Finally, we continued our work with Group 4 which included meetings and an analysis of their use of the **VIRK mainframe-based case-handling system**.

Fall 1992

Our consulting activity with Group 3 during this period included helping them customize Windows and WordPerfect. They learned, for example, how to write macros to support document creation following standard AT formats. We also began a study of the **use and tailoring activity** taking place within Group 3.

Our work observing and helping Group 4 continued, and included holding a **training session in VIRK**.

Finally, we learned that programmers at AT headquarters had been laid off as a first step toward an organization-wide move from the old mainframes to networked workstations. This continuing decentralization further supported the argument for a prototype demonstrating the functional integration of today's mainframe programs.

2 Key activities

2.1 Fieldwork

In order to get a first impression of work at the AT and to generate ideas about the potential for computer applications, we conducted interviews and a limited form of participant observation. At the same time, we gathered materials from the workplace including: annual reports, legislation, legal notices and orders, formal descriptions of the organization, job qualifications, and the like. We also focused on the status of the AT as a government agency.

We followed different categories of workers in order to understand their competencies, how they cooperate and the different perspectives present in the organization. The inspectors, for example, make up the largest group and come from a variety of professional backgrounds: engineering, carpentry, psychology, and nursing, among others. We accompanied inspectors on their visits to 'the field', and interviewed them about their work. Playing a role as "apprentices" gave us the opportunity to watch and listen not only for the discursive, but also the practical awareness and competencies involved in

their work. We were especially interested in the reflective practice of inspectors (Schön, 1983). We also interviewed other employees at the local branch, including secretaries, lawyers and local management.

We learned a great deal from this participation that helped us understand the work at a theoretical level, and plan subsequent activities like the organizational game. By listening carefully to the workers' narratives about their work with an ear for ambiguities and dilemmas, we composed "situations" for the organizational game. Being in contact with different groups in the organization gave us an opportunity to study communication and cooperation in their daily work, as well as to consider possible computer applications.

2.2 Sidste Nyt

As one channel of communication between researchers and AT workers, we produced and distributed pamphlets under the title "Sidste Nyt" (Latest News) to which both researchers and AT workers contributed. Since many AT workers had only peripheral contact with the project, "Sidste Nyt" could make the activities and results of the project known and available for discussion in a wider forum. It was also used to set the stage for meetings and seminars in which some or all AT workers were invited to participate. Topics raised in Sidste Nyt have included: presentation of the researchers, descriptions and impressions of the future workshop and organizational game, and short tutorials on relevant technical topics.

2.3 Future workshop

The Future Workshop method was developed by Robert Jungk (Jungk & Müllert, 1981) to support resource-weak groups of citizens who want to influence decision-making in planning processes (e.g. child care, energy politics, environmental design, and traffic problems). The method highlights a shared problematic situation, generates visions of the future, and supports discussions of how these visions can be realized. The role of the designer during the workshop is to introduce the method and guide participants through the three phases of the workshop: *critique*, *fantasy* and *implementation* (see e.g. Kensing & Madsen, 1991).

During recent years future workshops have been used in group work on "utopian futures," and in the design process to support organizational and technical change. Here it is typically conducted in a shorter version that emphasizes the critique phase. The future work-

shop then acts as a "democratic brainstorm process" in conjunction with other methods supporting design and implementation.

At the AT a future workshop was used in this way. Based on earlier interviews and workplace visits, we chose the theme, "new technology and work organization." Most of the employees participated during this half-day workshop, held at the time of their monthly staff meeting. Considering the short time and the number of participants (40), the four designers leading the process exerted more control than usual. For example, as critique statements were formulated during the critique phase, two designers grouped them into the themes: "Technology," "Management," "Work Organization," "Customers," "Resources," and "Talk & Action". After voting on the suggestions for themes, the participants were divided into four groups each of which worked on a positive vision of one of the four chosen critique themes. The results of these discussions were presented to all participants at the end of the workshop. Because time was limited and the workshop was part of a much longer design process, there was no implementation phase. On the other hand, the workshop served as an important source of input for the design of the organizational game, the next activity in the process.

As it turned out, we were able to conduct a meaningful future workshop in only half a day, with the results feeding directly into the ongoing design process. However, there were problems. Forty participants was too many for a really effective workshop. The fact that critique statements were grouped into themes by two of the designers rather than as an extended dialogue among participants sped up the work, but made it less democratic. There was also too little time for the groups to have a chance to work creatively on "utopian futures." As often happens during the critique phase, normally tacit frustrations were laid bare, and it was not always clear whether and how much to encourage the ensuing discussions.

An interesting aspect of this future workshop was the fact that management agreed not to participate. This decision was not based on mistrust between management and the designers. Rather, our experience had been that future workshop participants are reluctant to criticize when management participates, and hence ideas for improvement sometimes get lost. Management found this to be a valid argument for not participating.

2.4 Workshop I - the Ry seminar

The Ry seminar lasted three days and involved five participants from Aarhus University and eleven from AT. The latter were chosen to

represent the three main groups in the work organization: inspectors, secretaries, and managers. This "mix" of participants had been discussed between unions and management in the cooperation committee (sam-arbejdsudvalget) at the AT, although the suggestion came originally from the researchers.

The seminar was held five months into the project in the town of Ry, outside Århus and away from the participants' everyday work environments. The goal of the seminar was to encourage discussion of current and future work practices as well as possible computer support, in the context of the decentralization directives that were coming from AT headquarters.

2.5 Organizational game

The seminar was structured in part as an Organizational Game (Ehn et al 1990). As its inventors explain,

> For all participants in a design group [the organizational game] serves as a means to create a common language, to discuss existing reality, to investigate future visions, and to make requirement specifications on aspects of work organization, technology, and education. (Ehn & Sjögren 1991, p. 252)

In short, an organizational game is a kind of role play in which the participants take part in action-oriented simulations of alternative and future work situations. The idea is to learn to improve cooperation and communication in the work process, change and develop new work roles, and use new technology.

This is done in the context of a dramatic game based on the participants' everyday work, in which they play their ordinary work roles. Every organizational game is unique since its design is based on the specific conditions, visions and problems that characterize the given organization. There is a basic pattern and terminology, however, that has been used in several design projects (Ehn & Sjögren, 1991). The *playground* is a negotiated interpretation of the work organization in question. *Professional roles* are represented by both professional ambitions and organizational requirements. *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 organizational game at Ry was conducted by a "play master" and two assistants from the group of researchers; the other researchers acted as observers and videotaped the game.

The interviews and the future workshop had given us the basic ideas for the playground, situation cards and roles, although we unfortunately did not have time to negotiate these with the AT people beforehand.

Each situation card contained a few sentences describing a realistic, problematic situation that could arise at the AT workplace. The idea was that these discussions should lead to concrete proposals for and commitments to changed practice by participants. At the seminar, we used approximately 40 situation cards, some designed by us ahead of time and others by the participants during the seminar. For example, situation card #8 (SC8) read as follows:[2]

> SC8: An inspector has begun work on a case regarding a chemical factory. The case started because of an accident and is still not concluded. A call comes from the police: There's a new accident at the company. The inspector is on vacation. Where is the material?

The situation cards and attached commitments were posted on the playground, a bulletin board, according to the participants' opinions of where they belonged according to a classifications in the 6 groups of criticism from the future workshop. The idea of this classification was to support a discussion of how the various situations were associated with basic problem areas, and to create a shared visualization of the network of problematic situations and commitments.

In the first "act" of the play the participants discussed some fifty situation cards formulated by the designer group. Subsequently, the participants wrote and discussed twenty situation cards of their own.

Occurring between the first and second "acts" was a session in which the participants had a chance to get hands-on experience with relevant technologies, prototypes and mock-ups we had developed as part of the design process. The second act followed with technology-oriented situation cards.

In the third "act" situations and commitments from the playground were transformed into *action possibilities* in the group's *plan for action*. The plan for action was a new playground where actions were arranged according to whether they "can be carried out here and now," "require new resources," or "are good candidates for cooperation with the researchers in the design group."

The organizational game raised a wealth of issues for us as researchers in cooperative design. We briefly describe some of these in

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[2]The text of the situation card is translated from Danish. The original texts are available from the authors on request.

what follows; see Mogensen & Trigg (1992) for a more detailed discussion.

1. When to cut off a discussion: It seemed that almost any situation card could lead to an extended discussion. Thus an ongoing question for us during the seminar was whether to cut off or constrain discussion in order to complete more situation cards.

2. The "role definition" phase: We noticed difficulties during this first phase of the game including communication breakdowns that could be traced to confusion among the participants over what was being asked of them. We hope in the future to better understand the proper "role" for role definition and if it should be included, how best to present it.

3. Problem definition vs. making commitments: A key component of the organizational game methodology is to encourage the adoption of commitments when discussing situation cards. We found little evidence that the participants were themselves interested in making commitments. Rather, the discussions took the form of problem definition. This could well be because of the more open-ended nature of the changes being considered for the AT branch at that time. Because it wasn't clear what direction the organization should move in, our focus on commitments may have been premature.

4. Openness of discussion: We were sometimes struck by the openness of the discussion and other times by its indirectness. Though the setting seemed to encourage a general frankness, we sometimes suspected that relevant topics (and absent individuals) were referred to indirectly if at all. This could be because representatives from all sectors of the branch (including, for example, management and secretaries) were present around the table. The procedural question of how to deal with the dampening effect of "power" relationships is one that we are struggling with.

5. Our role: More generally, we struggled with the question of how to define our own role at the seminar. Should we have spurred discussion at certain times, and acted to cut it off at others? If we were aware of an indirect reference to an area or individual (on the basis of our previous ethnographic work and interviews at the branch), should we have encouraged making the reference explicit? When should we have behaved like bystanders, like mediators, like provocateurs, like consultants?

6. Comparing situation cards and prototypes: Finally, we were struck by the commonalities between two sorts of catalyzing physical

artifacts at work at the seminar, situation cards and computer prototypes (see also discussion below). Both served to trigger or provoke discussion of current work practices, future possibilities for work organization, and the present and potential application of technology. We found that one measure of practical effectiveness of the artifact was the degree to which one or more participants demonstrated "ownership," for example, when the reader of a situation card rephrased or otherwise defended the card's formulation in the face of an offhand or simplistic proposed solution. The physical nature of the artifacts was also important. We saw, for example, that the original formulation on a situation card could be returned to as a way to recover a sidetracked discussion, or alternatively, in order to avoid tackling a sensitive, but appropriate, reformulation.

2.6 Prototyping and provotyping

The term *prototype* in systems design usually refers to a mock-up or running computer program used to illustrate certain aspects of a future computer application. Within participatory design the term *cooperative prototyping* suggests that prototyping can be a cooperative activity between users and designers rather than designers utilizing users' more or less articulated requirements. To facilitate such a process, designers need to help users experience a fluent work-like situation with a future computer application. In other words, users' current skills must be confronted with new technological possibilities. This can be done in a simulated future work situation or, even better, in a real use situation. (For general discussions of cooperative prototyping see Bødker & Grønbæk, 1991a and b; Trigg et al., 1991).

At AT a prototype was built early in the process to illustrate the possible integration of AT's various manual and computer files. We had learned that workers were frequently forced to register the same information several times in the various files. An initial version of the prototype meant to address this problem was based on their current (paper) forms and was tried out by users at the Ry seminar. Several modifications were made to the prototype at that time. In addition, a version of the prototype was left at the AT office for a couple of days for interested workers to try out. In both cases, the designers were present to introduce the prototype, engage in discussion and make minor changes on the spot. Two central questions were discussed around the prototype: how would one work differently with integrated information, and how should the information be presented on the screen?

In another case our investigations dealt with the possibility of shifting from the text-based word processor to a graphical one. A new word processor was purchased and tried out. According to Mogensen (1992), "The goal in part was to investigate how this word processor could support the work to be done. A critical aspect, however, became visible when people experienced the new possibilities. Formerly, the format of outgoing letters was taken as given, but in experiencing the ease of changing fonts, styles, and graphics, the format became a changeable, 'present-at-hand' object. This led to the issue of flexibility versus standardisation in the format of outgoing letters." In this example, the participants experienced and analysed their current practice by reenacting it in alternative ways, what Mogensen (1992) calls "provotyping".

Mogensen (1992) and Mogensen and Trigg (1992) bring prototyping and provotyping together with the following example taken from the Ry seminar: "In a prototyping session involving a researcher and three people from AT the researcher was demonstrating a part of the prototype concerning the registration of the inspectors' weekly travel, relating the current prototype to the existing practice. At one point, the researcher was interrupted by one of the participants: 'we don't do it that way.' After discussing how to fix the prototype, the question was turned around to become '*why* don't you do it that way?' A discussion between two inspectors made it clear that what was at stake was not a question of procedure, but of economy and control. It turned out that in the present way of registering the inspectors' travel it was not possible to check where they had been when, but it would be possible according to the new proposal." (Mogensen, 1992)

2.7 Visit to Told & Skat

One of the ideas of participatory design that has proven successful is to visit related workplaces (see also e.g. Kyng 1989). In order to explore the possibility of using portables at AT, we took several AT workers on a visit to a local tax office where auditors use portable computers in the field. (Currently at AT, letters and directives to companies are written in the office and not in the field.) Not only did the visit provide a concrete sense for the use of portables in general inspection work, it also raised new questions about the quality of current work (Mogensen, 1992). The use of portables (and a printer) to compose letters at the site raised issues regarding AT's current procedures. For example, how important is it to check back at the office with colleagues and source materials, work the letter over once more, ask a secretary to proof-read, etc.?

2.8 Two-level strategy

When our project with the AT started, we were inclined to suggest that they move to Macintosh computers networked with the existing VAX system. We believed that the Macintosh platform supported potentially useful software for the AT, and that Macintosh was the best tool for prototyping. As it turned out, our interests ran counter to the Department's wishes; they eventually decided to purchase standard PCs. Though surprised by this decision, we decided to "stick it out" with the local branch. We made a commitment to work with them to make the best possible use of the PCs, in spite of the extra investment and learning required on our end.

At the same time, the branch reorganised into work groups of inspectors and secretaries. We saw this as an opportunity to start a more systematic effort of introducing PCs into the organization, instead of just spreading the available machines around the branch at random. After negotiations, one group was selected to become users of the first PCs. The idea was that their experience, as well as any technical and organisational solutions they arrived at, could later be reused in the rest of the organisation.

One problem with this initial approach was that neither AT workers nor AU researchers had experience with PC platforms or with the relevant software (e.g. text processing). A crucial choice had to be made between Windows and DOS/WordPerfect Office. In addition, the PCs had to be purchased, configured and hooked up to a network with the VAX computer. None of us had experience with prototyping environments and other development software for the PCs.

Although help could be obtained from vendors and other PC installations for some of the technical questions, our major research concern was how to devise a strategy for the introduction of PCs in an organization like the AT, including the work of adapting standard programs and developing new programs for particular situations. And just as important, how could the technology be introduced in a concerned way. Within systems development research there are almost no cases from PC network-based organizations. The state of the art in systems development still involves one-of-a-kind systems, developed "from scratch." What we were looking for was a strategy that would utilize the potential of the PC technology, including the wide range of standard programs available, without giving up the possibility of designing and adapting pieces of software to the AT setting. All in all, we didn't know much about where we were heading nor how we would get there.

In addition, since the PCs could be purchased almost immediately, we wanted people to get started and gain experience as soon as possible. Yet the technology needed to be developed to fit the needs of the specific organization and group. We wanted to develop a vision for the group that is rarely attainable with standard systems that are by nature, blind to alternative ways of conceptualizing people's use of technology.

Group 3 was our vehicle for getting started; with a limited group of people, problems were more easily handled than if the whole organization had been introduced to PCs simultaneously. Our approach was to pursue both visioning and concrete goals, to raise questions of meaning concurrently with practical issues arising in the daily use of computer applications. We called this our *two level strategy*.

The elaboration on long term visions informs the short term consulting and decisions regarding, for example, purchase of software and hardware; and the short term activities enables (or constrains) the longer term visions as well as they may give rise to new ideas.

As part of the two-level strategy, we initially established a technically and conceptually minimal platform consisting of a few programs supporting text processing, access to the VAX and the like. Workers at AT were taught how to use these programs which, over time, have become more and more a part of the daily work practice.

**Visions concretized
through prototypes**

Customizations

**Standard and specially
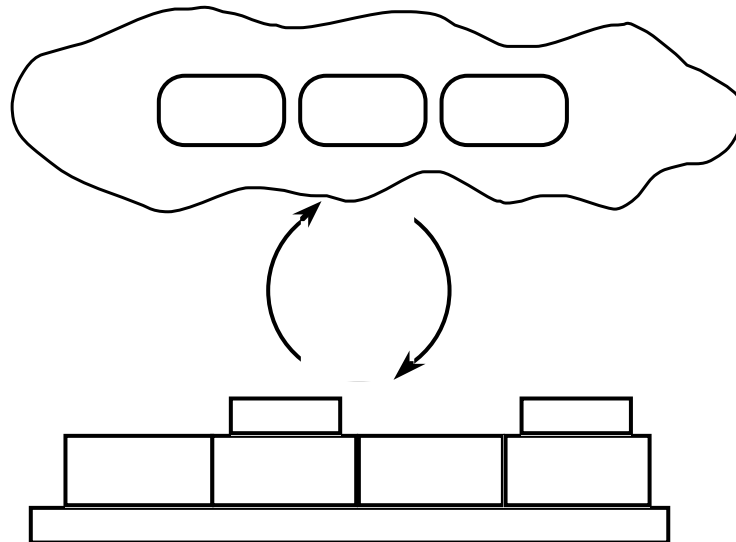developed applications**

MS DOS & Windows

Figure 1. The two-level strategy - the technology

2.9 Workshop II - The Odder seminar

We organized a two day seminar at which eight people from Group 3 at the AT and three researchers were present. One goal was to address the work required in the shift from old to new technology, including education in the use of the network and changes to the organization of work. A second goal was to raise problems normally hidden in the everyday "entanglement," and at the same time change their formulation from an abstract to a more concrete and understandable level.

There were two main characteristics of the workshop: (1) the fact that our recommendations were based on Group 3 participants' (as well as our) assessments of the importance of learning more about the technology, and (2) the need to discuss the future work organization in more detail. The situation in the group at that time was that new technology had been purchased and introduced and new work groups had been formally decided upon, but none of these really seamed to be used or function in practice.

Unlike the Ry seminar, this workshop was not meant to try out a specific method; rather, methods were used and invented in order to shed light on the problem of interrelating technology and work organization. This problem had also been addressed at Ry, but at Odder the participants had experience working together and with the technology. Here it was easier to trigger discussions just by hinting at a problem currently experienced by the participants. On the one hand, the seminar showed possibilities worth pursuing, and, on the other hand, it showed problems in current practice making the effort worthwhile.

2.10 Simulations

We used simulations to deal with pressing organizational problems and changes related to the use of the technology. For example,

- how do secretaries and inspectors exchange documents? What physical form does the exchange take (floppy disks, an agreed-upon location over the network, etc.)? And who does what, when, and how to communicate about these matters?

- how and where are shared documents stored, and under what names? This includes sharing among inspectors and between secretary and inspector, as well as general naming and filing conventions that could ease the job of retrieval.

Inspired by the Finnish Knowledge and Work project (Eriksson et al. 1988), our work on these issues involved simulation. We elaborated short scenarios to explore different ways of working together. We also used paper simulations to illustrate the problems of saving and finding versions of documents on different servers under the same or different names.

2.11 Dilemma Game

One of several activities carried out in this seminar was a *dilemma game* (Mogensen, in preparation). The dilemma game was designed to meet the seminar goal stated above: to raise problems normally hidden in the everyday "entanglement," and at the same time change their formulation from an abstract to a more concrete and understandable level.

The game consisted of two parts: the actual dilemma game (one hour) and a discussion of the topics raised during the game (one hour). Two facilitators or provocateurs provided concrete scenarios taken from everyday work at the AT, chosen to evoke particular dilemmas. The participants were asked to imagine that they were in these situations; their subsequent actions (encouraged by the provocateurs) led to new situations in which to act.

Members of Group 3 participating in the dilemma game included the group secretary and six inspectors, one of whom was also the group leader and two of whom were also computer instructors. Two researchers acted as concerned provocateurs, facilitating the process, but also pushing the participants to say what they *would* do rather than what they might or should do. This served to make the game more realistic; inspectors in the field cannot just contemplate, they have to act. And actions have consequences; imagining what one *might* do has far fewer.

To prepare for the game, the provocateurs wrote a *script* consisting of a high-level plan organized around different (presumed) dilemmas. These were highly flexible; for each dilemma, the script branched into several paths, depending on what the participants did. In addition, we were prepared to improvise.

In what follows, a 'transcript' of the first few minutes is presented to give a feel for how the game proceeded. (The transcript is based on memory and our notes; due to technical problems, the videotape records did not include sound.) Two of the dilemmas and the ensuing discussion are described.

In the transcript, P is one of the provocateurs, I1 an inspector, I2 an inspector who is also responsible for day-to-day tailoring and maintenance of the PCs, and S is the group secretary.

P: We are in the office of the Aarhus branch of AT one day in the Summer of 1992. The security steward from the plant nursery 'The Green Apple' calls and explains that half an hour ago an accident occurred; one of the gardeners fell down unconscious and was taken to the hospital. The plant nursery is usually the area of I2, but I2 is vacationing in the Alps, so the case is given to I1.

        I1! You know that I2 visited this very plant nursery just before he went on vacation. When he returned from the inspection, he mentioned pesticides they had started using, and also something he wanted to look up. Later, you saw I2 browsing in pesticides reference books and editing documents on the PC.

        OK, I1, what do you do?

I1:   Well, I think I should check out some of the material,

P: It is not, in this setting, a question of what you think, what do you do?

I1:   I should take a,

P: Not should, what do you do?

I1:   OK, I will check out the material.

P: How?

I: I would probably take a look on I2's machine.

P: Do you?

I1   Yes.

P: You cannot find it.

I1   Then I will ask his secretary to help find the document.

P: She is sitting right there, you can ask her.

I1:   S, could you help me find the material on I2's machine?

S: Yes, I know where he keeps his stuff, I can help you.

P: The security steward from 'The Green Apple' calls. They are rather nervous out there - some talk about halting work. They're wondering where AT is.

I1:   I'll be there in a moment, but first we'll check I2's machine.

P: OK, you find the document. It looks like the start of a request to the company explaining that the new pesticide is rather dangerous with prolonged use. It may infect the central nervous system.

I1:   I will phone I2 and ask about it.

P: You cannot reach him. He is out hiking.

I1:   OK, I will drive to the company.

The dilemma game continued and raised several issues as well as it provided a platform for further discussion and investigation. Two of the dilemmas raised are presented below.

1. Privacy of electronic material

We anticipated that the privacy issue would be important. Based on our own experience and experience with similar situations in other companies we expected problems to surface when we confronted the participants with issues concerning 'private' PCs interconnected in a 'public' network. In short, to what extent do people have the right to see the materials of others?

The problematic situation was provoked by placing I1 in a scenario where he lacked knowledge, though he knew that I2 (who was not present) had potentially relevant material.

It turned out, however, that this issue was not as controversial as we expected. In the AT, all material received and produced is filed in the central paper archive, and the production of most material involves at least two people (an inspector and a secretary). The branch's history of openness, collaborative writing, and lack of 'ownership' of produced documents, further explains why privacy issues rarely arise.

2. Status/validity of electronic material

The privacy issue led directly to another dilemma, this time between the desire and potential for utilizing existing knowledge and material in the organization, and uncertainty regarding its status.

The situation was provoked shortly after the one described above. I1 found the material that I2 had been working on and felt that it indeed raised concerns about the new pesticide. He thus closed down

the nursery until further examinations could show whether the pesticide was dangerous. As it turned out (or rather as P made it turn out) the gardener had a gastric infection (his wife became ill as well). Furthermore, I2 had found out before going on vacation that the pesticide was harmless, but had not deleted the file. (There was no need to; he knew his original suspicion was wrong and in any case, he had not sent a directive to the company.)

In this case there was a mismatch between the possibility of further utilizing existing knowledge (here in the form of written material) and current practice. Using a paper archive in combination with a computer indexing system, material is usually first publicly archived when it is completed and sent out. Over time, procedures have evolved to handle this organizational 'shared memory', but there are neither formal procedures nor actual practices to assess the status of unachieved material.

In the dilemma game a small utility was made by one of the tailors which supported storing, searching for, and retrieving documents on the network. This led to the next dilemma, and more issues were raised.

2.12 VIRK studies

At the AT, a centralized computer system (VIRK) is used to record interactions with companies in the geographical area covered by each local branch. Visits to work sites as well as correspondence with the companies are recorded. Various information can also be extracted, ranging from the kinds of companies found within a particular geographical zone to the recommendations and demands AT has directed to a specific company. Finally, lists of cases under investigation by a single AT inspector can be extracted.

In our initial investigations we found that people used VIRK differently, and that some wanted facilities that already existed in the system. Few people knew the full functionality supported by VIRK. Thus we set out to investigate how to help the secretaries and inspectors make better use of the system (see Bødker, in preparation a and b).

VIRK's design was based on a company database meant for governmental authorities dealing with company inspection and counselling. It is a menu-based system running on terminals and has been used in the AT for several years.

VIRK was created to help various groups of people, primarily management, get an overview of the increasingly many cases and docu-

ments resulting from AT's growth and diversification. In addition, management needed to ensure that incoming requests were handled according to the law. Historically, VIRK replaced a number of paper based lists, which had provided overviews of files on companies and inspections. With the growth of the organization these lists had become inadequate. Though VIRK has generally made retrieval from these files easier, there are cases where the paper-based lists are still maintained. For example, lists of expiration dates, sorted according to expiration month are still kept, because VIRK offers little support for extracting such lists.

Though VIRK appeared rather late in the historical development of work at the AT, it has not been designed to reflect this development. This has led to lack of support for individual and group case handling.

VIRK does support the original desired functionality of distributing cases and collecting statistics for "upwards" accountability. It also supports the work of secretaries entering data about single documents and cases. On the other hand, the historically recent work of case handling at the branch level, by teams within branch offices, and by individual inspectors is supported only through add-ons to the original system that are hard for users to access. This despite the fact that VIRK was built after most of these work changes had taken place. It is therefore no coincidence that secretaries and inspectors ask for computer support that can be characterized as media or tools, whereas management asks for a system. VIRK embodies a traditional quantitative perspective combined with management planning and control, not the holistic, qualitative perspective that underlies the work of contemporary labor inspection and the information kept on companies. Clashes between these views are seen throughout the use of VIRK.

2.13 Group 4- educated use of VIRK

In order to better understand VIRK and how it might be improved, we organized and videotaped three activities: (1) two secretaries discussing their daily activities, including documentation and information retrieval in VIRK; (2) a secretary demonstrating VIRK and answering our questions; and (3) a "super user" secretary using VIRK. The first two sessions showed us that even those who use VIRK every day have problems understanding the system and how best to use it. Thus in the last session, we directed our questions again to the super user and had her repeat procedures we had seen in the previous sessions. In all we have more than four hours of videotape of VIRK

use. In addition, we organized a round table discussion with all of Group 4 to discuss the need for more extensive use of VIRK.

Based on these activities we organized a day of training in which Group 4 was to work with VIRK. The day started with an hour-long introduction to a practical VIRK use model (Ehn & Kyng 1984, Kammersgaard, 1985). Group 4 members then worked in peer pairs on exercises we provided. The workshop ended by summarizing the problems and experiences that arose during the day.

In the end, Group 4 members wanted to continue working on VIRK exercises in the months to come. We agreed and further suggested that the groups generate exercises for each other. Due to the heavy workload at AT and another round of reorganization, this never happened. Instead we had a short meeting much later where we discussed VIRK as well as the general situation.

2.14 Group 3 - using Word perfect

Word Perfect for Windows was chosen for text processing primarily because Word Perfect (under DOS) had been used previously by individuals in the organization. Also the general feeling locally and at AT headquarters seemed to be that WP is *the* text processing program. Group 3's training in the software required several rounds of teaching. In the first round, researchers introduced the basic functionality to all of Group 3. We learned quickly that group members had very different levels of experience. Thus, a later round conducted by a computer supplier let Group 3 members choose between three levels of expertise. At present, all Group 3 members use WP in their daily work.

Since then, we have been following Group 3's use of the PCs and software. For example, we have been studying the work practices and experiences of a Group 3 inspector who took on the (now formalized) role of WP tailor, answering colleagues' questions and providing macros and standard forms (Bødker & Trigg, in preparation). This inspector is also one of those responsible for the computer equipment at AT. We have also been monitoring the ongoing organizational changes at AT and their effects on the use of technology. For example, groups no longer have their own secretaries, forcing inspectors to take responsibility for writing and filing their own letters.

The group has also encountered problems creating and sharing standard documents. These can be set up in a variety of ways, each with its accompanying flexibility trade-offs. The Group 3 experience

shows that the competence required to set up these forms differs significantly from that required for normal use.

3 Wrapping up

In this report we have tried to give an overview of the AT project. Some of our work and the activities we organized were based on techniques we had used before (prototyping, future workshops, organizational games), applied in a new setting. Others were based on techniques new to us, or "invented" for the situation.

One of our successes was the idea of initially introducing PCs in Group 3 rather than throughout the organization. Now, a year later, every employee works with a PC. By confronting problems with printers, standards, definitions of technology-related roles, and the like, early on in the small group, we avoided what could have been chaotic situations for the organization as a whole. Furthermore, it was possible to draw on the experience of a fairly large group of people (group 3) in the general introduction of the technology.

On the other hand, we started several activities that were never completed, either because they were of little interest to AT workers, or because AT had insufficient resources to pursue them. When we insisted on pushing through an activity, the result was sometimes less successful as in the case of Group 4's VIRK training. This illustrates a dilemma for researchers who decide to enter into a relationship like we have had with AT. On the one hand it is important to respond to the needs and interests of the organization when setting up activities. However, one occasionally needs to introduce new activities that may be at odds with the organization, say, if one believes that the organization will benefit in the long run, or that the activity has inherent research interest. In general, it is difficult (and often unhelpful) to judge these decisions as successful or unsuccessful. What we learned as a project group is that doing participatory design means really participating; our learning as well as theirs is limited by the degree to which one is willing to take responsibility and take action.

These days at the AT, life is as turbulent as ever. The situation with respect to technology is still very open, because there may now be a chance of eliminating the mainframe. This has led to a decision to resume work with the prototypes we had used to explore integration issues. Meanwhile, AT is facing yet another reorganization. The group structure is partly being abandoned in favor of a more specialist-oriented work organization. The effect of this decision remains to be seen, though we hope that through our project, people at AT will be better able to cope with and take control of the change process.

We see our project as proof that work settings are not passively waiting for computer systems to be developed, as assumed by many systems development methods. Indeed, had we gone off in 1990 to make a requirements specification and come back two years later with the solution, there would almost certainly not have been a fit. It has only been through continous interaction with the AT, both day-to-day consulting and long-term envisioning, that our technical solutions have kept up with the frequent organizational and managerial changes.

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