Introduction

Social and human sciences most often look at technology as something to be analysed and even criticised. In particular in the 70s many attempts were made to study "consequences", as if technology is something deterministic, the shaping of which is to be taken for granted. As the opposite approach, computer science and engineering has been known to create technical "solutions" to be placed in organisations without real consideration for why the technology is needed or the impacts on work.

The problems of both of these approaches have long been recognised, and e.g. the sociotechnical tradition has tried to unite the two sides. This is done by analysing both, and hoping to better build technology to suit the organisational needs. However, this approach has been widely criticised, both for being potentially manipulative (Ehn & Kyng, 1987), and, more important here, because the *separate analyses* of the two components can not be brought together as easily as assumed by the method. Furthermore, because the approach is not iterative, the experiences from technical design are not easily "fed back" to the social side, and *vice versa*.

In Scandinavia, the participation of users in computer system development dates back to 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 technological alternatives and focus on skill. (Ehn & Kyng 1987, Ehn 1988, Kyng 1991). The tradition has developed, continuously confronting itself with the above problems. The Scandinavian tradition, often called the collective resource approach has come to focus on development of computer technology in the context of work. At present, it is characterised by two main principles, which are nicely summarised in Fig. 1, showing two researchers exploring new and conventional technology:
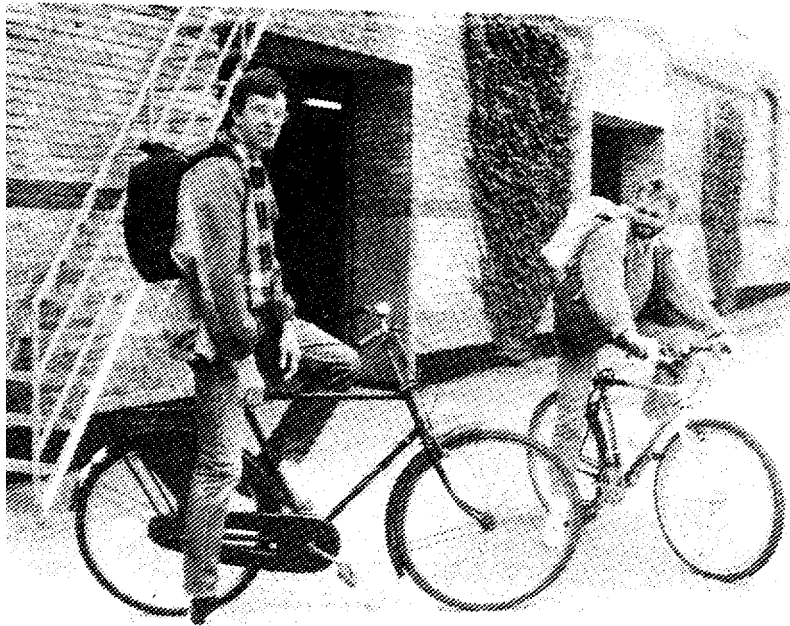
Figure 1. Researchers in action

1. Action research. The researchers need to involve themselves, they cannot study the world from the "side line". This implies that one cannot enter an organisation to study work, without changing it. Similar with technology. This also means that the researchers get something out of the process but they also affect the lives of people. In general we feel that this may just as well be turned around to something positive: that we should ask ourselves what we give back to people, what kinds of changes we cause, and use this in ways that are politically and ethically positive.

2. An experimental approach is needed when changing work using computer technology. I. e. an experimental approach to analysis and design of computer technology, as well as to changing the work activity, is needed. This process is all along viewed as a learning process for the involved parties.

With these principles in mind, how do we on the one hand, devise qualitatively new computer technology, and on the other hand, take the work practice of the users seriously and ensure the usability of the technology when brought into a given practice? This question has been the starting point of the NLIS project, which will be presented below. Many experiences from previous projects were certainly our anchor points. Yet **we** wanted, too, to change our working practices. Inspiration for such change primarily came from two sources: a theoretical understanding of work based in activity theory, in particular work development research as described by Yrjö Engeström (1987 and 1990), and studies of work from an ethnomethodological perspective, in particular the work of Lucy Suchman, Gitti Jordan et al. (see e.g. several contributions to the

Second International Congress on Research in Activity Theory, Lahti 1990).

What I will try to show in the following is how an reciprocal teaching)es organisational analysis and design, and to discuss how this practice has been inspired by activity theory and ethno-methodology.

The National Labour Inspection Service

My ideas will be discussed and exemplified by a project conducted in collaboration with workers at the Aarhus branch of the National Labour Inspection Service (NLIS).

The purpose of the project seen from the point of view of NLIS managers and workers is to design a number of computer applications for the branch and to develop a long-term strategy for decentralised development and maintenance. This is as opposed to the existing situation where all NLIS offices subscribe to centralised computer applications. Furthermore, the branch office is in the middle of a major restructuring process where technology is only one component.

The project group works to shape new technology and new forms of collaboration and organisation in the Aarhus branch of NLIS. The people involved cover a broad spectrum of roles and skills and represent all groups at the NLIS branch (including local management).

At NLIS we used pieces of technology in the change process in several ways to let the users experience possible changes. In the following I shall present some examples of activities where technology was brought directly into play. In the total process these activities were carried out together with organisational games, future workshops, interviews, historical analysis and other activities (see Bødker et al. 1991, Ehn et al. 1990, Mogensen & Trigg 1992, Markussen, 1992).

Provotyping and prototyping

Prototypes in systems design normally stands for mock-ups or running computer programs used to illustrate certain aspects of a future computer application. We have developed an approach that we call *cooperative prototyping.* This approach stresses that proto-typing can be a cooperative activity between users and designers rather than an activity of designers utilising users' more or less articulated requirements. To facilitate such a process, the designers must somehow let the users experience a fluent work-like situation with a future computer application, i.e. 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)

At NLIS a prototype to illustrate the integration of the various manual and computer files was built early in the process. The reason for this prototype was that the NLIS workers did a lot of double and triple registration of information in the various files. An initial version of the prototype was built based on the current (paper) forms. This was given to the users to work with at a seminar, and several adjustments were made to the prototype throughout the session. Furthermore, a version of the prototype was placed at the NLIS office for a couple of days for interested workers to try out. In both types of sessions, the designers were present to introduce the prototype, the discuss and to make minor changes on the spot. Two kinds of discussions were central around the prototype: how would one work when the information was integrated?, and how should the information be presented on the screen?

In one further case the investigations dealt with the possibility of shifting from the text-based word processor to a graphical one. A new word processor was bought 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 doing it in alternative ways, what Mogensen (1992) calls "provotyping". Both of the above situations occurred during longer lasting working meetings for a larger group of people, where important parts of these meetings

were to follow up on the discussions in the provotyping sessions, e.g. in plenary discussions.

Mogensen, 1992, and Mogensen and Trigg, 1992, brings prototyping and provotyping together with the following example: "In a prototyping session involving a researcher and three people from NLIS, 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 and trying out 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 a question of economy and control. It turned out that in the present way of registering the inspector's travel it was not possible to check where they had been when, but it would be possible according to the new proposal." (Mogensen, 1992)

Based on our previous experiences we have been bringing in the collective in analysis, as opposed to e.g. Engeström who works a lot with individual interviews in the early stages of a change process.

Figure 2. Demonstrating a prototype

We have worked with future workshops and organisational games as described elsewhere (Kensing & Madsen, 1991, Ehn et al., 1990, and Mogensen & Trigg, 1992), and lately also with dilemma games in which the participants together face some of the dilemmas and conflicts of the situation that they are in. Comparing our approach to what we have done previously, and to most of the above mentioned work by others, we have this time worked in a setting where conflicting interests were predominant in particular due to the participation of management in the project. The challenge seems to be to utilise the differences and conflicts in the group in con-

structive ways. This means to bring the participants together outside of their normal situations where power and conflicts are in play, and yet respect their conflicting interests and be aware of the differences in power and resources.

In our studies of what happened in specific situations, whether design activities or use, interaction analysis has been a source of inspiration. We have found it important to use interaction analysis in investigating the richness of concrete activities, and we see a useful method in continuously "diving" into more details about what we did not understand (see e.g. Mogensen & Trigg, 1992, Bødker, in preparation). I find it problematic, though, to try to analyse the situations without making use of a pre-understanding of them. Furthermore, what is bothering me is to make interaction analysis in a non-participatory way. This far we have primarily used the technique to understand and improve our own practice. Insofar as the technique is also extended to be used to study the practice of the involved users, I feel that the method should be participatory too, something that we have not yet managed to do, primarily because of the enormous resource investment this would be for the participating users.

The technology of other organisations

One further approach is to visit other workplaces (see also e.g. Kyng 1989) similar to the one in question. At NLIS, letters to companies are written in the office and not in the field. We started to explore the possibilities of using portable computers by a visit to a local tax office. The tax inspectors use portables in their inspection including an expert system for case-handling. The visit provided concrete experience with potential use of portables in inspection service in general, and it raised new questions about the quality of current work: How important is the possibility to check with colleagues and source materials, give it one more thought, ask a secretary to proof read, etc.?

This experience became a reference point for further discussions, in particular with respect to the use of portable computers. Generally I find such visits of vital importance to project groups, because they allow the participants to study technological alternatives and work organisation in a very specific setting, they provide the participants with a shared case for discussions, and they allow the participants to conduct their own investigation of the technology because they can discuss the technology with the involved users at the place visited. (see also Kyng, 1989)

Figure 3. Provotyping

Reshaping existing technology

Today most organisations already have technology in place, and often some problems of this technology are well recognised. Yet, a debate about the problems and how, perhaps the organisation may work around the problems is rare. At the NLIS, a centralised system (VIRK) is applied to record the interaction of the NLIS with companies in the geographical area covered by the local branch. Visits to work sites as well as correspondence with companies are recorded, and various lists can be extracted, ranging from lists of a specific kind of companies within a geographical zone to lists of which recommendations and demands the NLIS has put on a specific company. Also lists of cases under investigation by a single NLIS inspector can be extracted.

From interviews and prototyping sessions, the project group came to realise that much of the functionality of this system was unknown to the majority of users, and the question arose how the use of a current system could be reshaped to better fulfil the needs of the users *in spe.* With this in mind we have set up a process where we, together with the users, try to uncover more about the system and its possibilities. We had the system demonstrated by several frequent users, and we had round-table conversations with a group, who would be the core group in this "experiment". Together with the super users, we have set up education for these users, consisting of a full day of work in pairs, and some follow-up sessions stretched over six months' time. It is our hope that this education can shape some changed work practices around VIRK once the users are getting more acquainted with the technology. We are yet in the midst of this process and the actual outcome is to early to tell.

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Bringing it together: A two-level strategy

Early in the process a decision was made to aim for standard PCs at NLIS. At the same time the organisation reorganised to work in groups of inspectors and secretaries. After negotiations one group was selected to become users of the first PCs. This strategy was chosen rather than one where the computers were spread all over the office. The idea was that the experiences from this core group, as well as technical and organisational solutions encountered in this group should later expand to the rest of the organisation.

Research-wise it was a very open question how to introduce PC technology into an organisation in a concernful way: we wanted people to get started and gain experiences, and yet we wanted to develop the technology to fit the needs of the specific organisation and group. And also we wanted to develop the vision in the group of a use of the technology that was not readily available in the standard systems. In other words we wanted to avoid the blindness that is often introduced together with a certain way of doing things.

We decided to try out a two-level strategy. At one level, a technical and educational minimal platform was established: very few programs for the most needed things such as text processing. The users were taught how to use these programs and slowly they are being used more and more in the daily work. At the same time we kept on doing prototyping to explore some of the more advanced uses of technology, for which there was no standard programs available. It is not fair to say that we expected these two to meet, at the end. Rather we see the bottom level reaching out for a moving target, as hopefully the ideas and visions keep moving as experiences consolidate.
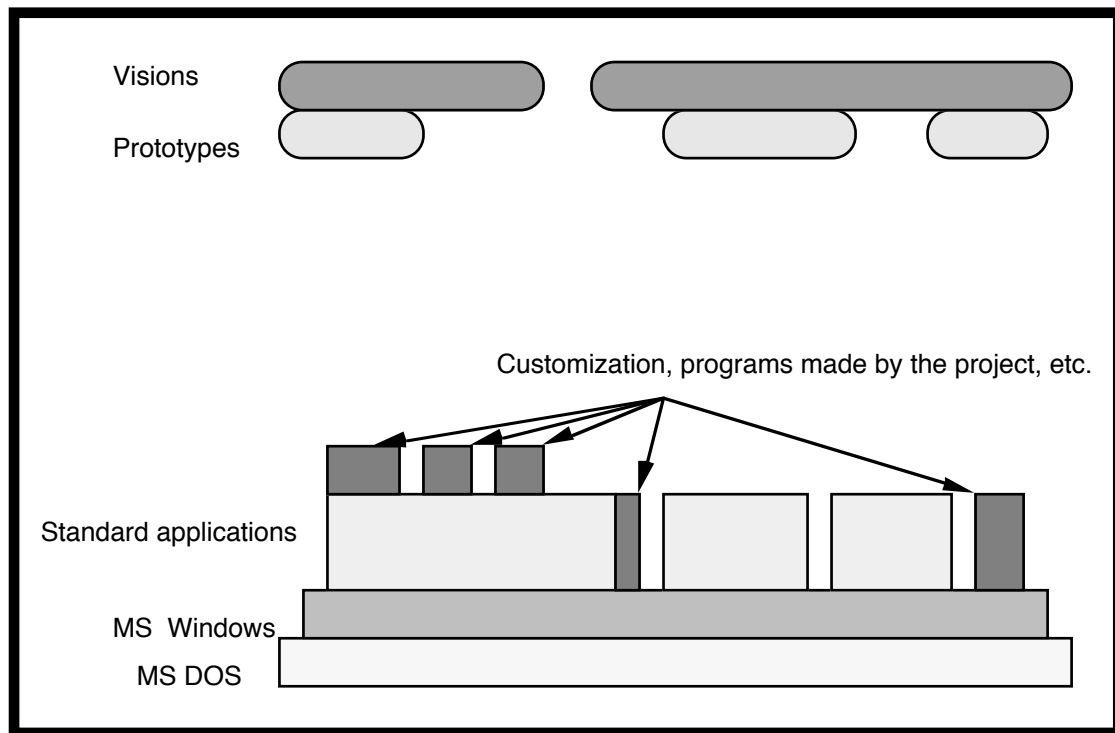
Figure 4. The two-level strategy

At the moment, we are watching how the users themselves are starting to reshape the technology, as they experience its potential and problems. This far, they have mainly started by making various standard documents. Furthermore we are helping them with collective and individual solutions all along.

We see that the introduction of the PCs influences how the group look at more overall organisational problems in the office, e.g. whether it is a good idea to try to write letters to companies on the spot or not.

The notion of the zone of proximal development (ZPD), as introduced by Vygotsky, has been important to us. The videos of different uses of the system, the list of wishes that people had come up with at various occasions, and our own investigations of the system were used to look at the directions in which an improved teaching of the system should take us. More overall we faced some problems with the concept: The origin of concepts such as ZPD and its "cousin" LPP (Lave and Wenger, 1991) are situations where a praxis is rather well established (although changeable in a dialectical fashion). In systems development, there are no one praxis that constitutes a core, and it is not clear what to aim for (see below). In many ways the ZPD is a moving target.

Two-level strategy is one way in which we tried to work around this problem: The bottom level, the small, consolidated steps of change were all the time implemented to improve the immediate situation.

At the same time, the top level aim to keep on shedding light on thorough changes, thus working with possible expansions of praxis (Engeström, 1987). This does not remove the problem of the moving target but makes use of the fact.

Spreading it out: A two-step strategy

In the process we have worked with two groups of users, one of which has been introduced to PC technology and one which hasn't. In the latter one we are working with potential ways of reshaping work around the existing technology. Initially our idea (in line with Pape & Thoresen, 1987) was to let the next step be a move of the technology to this group. For various reasons this may not be possible, in particular since the current group structure may no longer exist.

Yet, much in the spirit of Engeström's micro-cosmos (Engeström, 1987) we find it important that the experiences created in the PC group are spread in the organisation at the same time as the PCs are starting to be spread. We have already seen a tension between the groups choice of PCs running MS Windows, and overall requirements in the organisation for cheaper equipment. Since the group viewed this requirement as a major failure it decided to "go public" with its experiences. This meant to support other users who wanted to start using MS Windows and other programs developed for the group. The initial result of this effort was that management decided to buy MS Windows for everybody.

Conclusions

In this paper I have not tried to describe activities in the project, only some of those which directly involved the use of computer technology. We have found an important starting point in the project in the study of the history of the organisation (its purpose and organisation of work), and in the devices applies by the organisation (this includes computer systems as well as e.g. paper based files).

It is our experience that people are so easily stuck in their present understanding of technology (see also Kyng 1989), and that this understanding pretty much shapes their understanding of how the organisation can be changed as such. Thus, I have given examples of how technology can literally be thrown at the problem: Work place visits and prototypes can be used to provoke understanding of the current praxis as well as possible changed ones. The prototypes, and in this case a few PC standard programs are used in an iterative

process of implementing and consolidating a changed work practice around the specific technology. At the same time this gives a very sound technical development process, because the changes are continuously tried out (See e.g. Floyd, 1987).

In our inspiration from ethnomethodology I find in particular the lack of action-orientedness to be a problem. Furthermore neither this approach nor the work development approach offer any real approach to cooperative analysis, something that I otherwise find much in line with the spirit of work development research. In a way none of the approaches offer any real alternative to the traditional analysis of systems development, where the outside observer is describing what goes on in the organisation (Mogensen, in preparation).

In one respect the extreme "ethno" approach of just entering a situation and seeing what happens is the exact opposite of a traditional systems development approach and of much social science, where one most often determines the glasses to look through before looking. I.e. one determines which description language or theory to use. We have not been accustomed to a theoretical starting point, and yet we have found it useful with some theoretical point of departure. At the same time, we seriously believe that the starting point must be the specific problems of the specific practice in question, so that one should not e.g. bring technology in unless there is a need for it. Are we trapped between a theoretical and an empirical stance? or are there ways of handling this?

This does have connections to the second trap that we are facing: trapped between hermeneutics and knowing better. On the one hand we do not believe in coming from the outside and telling people how to solve their problems. Yet we sometimes know e.g. the technology better, but what right do we have to lead people in a certain direction? what right do we have not to? on what grounds? In a certain way traditional Marxism has made the answer easy for activity theory, but what happens if there is no **one** culturally more advanced activity, one line of development?

Acknowledgements

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