Challenging Practice -
an approach to Cooperative Analysis

Preben Holst Mogensen

Table of Contents

Danish Summary (Dansk Resumé)

Denne afhandling undersøger muligheder for at finde et sidestykke til kooperativ design inden for området analyse i systemudvikling.

Baggrund

Afhandlingen placerer sig såvel teoretisk som empirisk inden for en skandinavisk tradition, der udspringer i projekter som NJMF, DEMOS, DUE og UTOPIA. Et af de senere bidrag er bogen 'Design at Work', som er skrevet af en række forskere fra eller med tilknytning til denne tradition. Heri gives en del bidrag til det, der i bogen formuleres som kooperativ *design*. Et af de centrale punkter i kooperativ design er aktiv brugerdeltagelse, dvs. aktiv medvirken i designprocessen af dem, der senere skal bruge edb-systemerne. Argumenterne for samarbejde spænder fra etiske overvejelser vedrørende respekt for gensidige kompetencer over mere politiske argumenter angående demokrati til de mere pragmatiske argumenter, at samarbejde fører til mere kvalitet i såvel proces som produkt.

Formål

Udgangspunktet i denne afhandling er, på den ene side, en accept af det frugtbare i aktiv brugerinvolvering og, på den anden side, en konstatering af, at når vi betragter området analyse, så er denne involvering kraftigt nedtonet. I såvel analysedelen af 'Design at Work' som mere generelt inden for analyse er der en tendens til at opfatte analyse som en proces, hvor brugerne er passive 'objekter', der bliver observeret, interviewet, filmet, osv.

Formålet med afhandlingen er derfor at undersøge hvad der kunne være et sidestykke til kooperativ design inden for området analyse - kooperativ analyse.

Metode

Undersøgelsen baserer sig på såvel teoretiske som empiriske studier. De teoretiske studier omhandler litteraturstudier af forskellige tilgange til analyse og design samt inddrager begrebsapparater fra psykologiske og filosofiske discipliner. De empiriske erfaringer er opnået gennem deltagelse i tre relativt store projekter: Esprit II projektet EuroCoOp (1991-93), Esprit III projektet EuroCODE (1993-95) og AT projektet mellem Arbejdstilsynet i Århus og forskere ved Aalborg Universitets Center og Aarhus Universitet (1990-93).

Resultater

Formålet er, som ovenfor nævnt, at finde et sidestykke til kooperativ design inden for området analyse. Med dette perspektiv diskuterer jeg seks alternative tilgange til analyse. Hovedtendensen i alle disse tilgange er, at analyse opfattes som en funktion eller aktivitet, hvis formål er at bibringe analytikerne en forståelse af det pågældende område for derefter at videregive denne forståelse til design, typisk i form af beskrivelser. Hovedbevægelsesretningen i systemudvikling opfattes altså som gående fra brugspraksis til analyse videre til design og derfra tilbage til brugspraksis i form af ændringer (nye edb-systemer).

Det primære resultat i denne afhandling er en formulering af kooperativ analyse, hvor kooperativ analyse og design fungerer parallelt og i et tæt samspil, hvor designresultater også bruges aktivt i analysen, og analyseresultater også bruges aktivt i brugspraksisen.

Brugen af og erfaringer med designresultater i form af prototyper og 'mock-ups' kan udover at være kvalificerede gæt på et kommende system også bruges til at rejse diskussioner af og ny indsigt i den nuværende brugspraksis.

Udover at bibringe analytikerne en forståelse af brugspraksis, kan analysen også påvirke brugspraksisen selv, både med henblik på, at praktikerne selv opnår nye indsigter i den, og med henblik på dag til dag ændringer i den pågældende praksis (den står jo ikke stille under en systemudviklingsproces).

Kooperativ analyse opfattes altså som en tilgang til at understøtte en forandringsproces snarere end eksempelvis beskrive det eksisterende. Den primære tilgang i kooperativ analyse er provokationen. Provokationen af den nuværende brugspraksis tjener tre formål:

- Fremprovokerer forhold i den nuværende praksis, som normalt bliver taget for givet.
- Udfordrer den nuværende praksis med henblik på at undersøge dens begrænsninger og potentialer i relation til muligheder for forandring. (Hvad kan/skal vi forandre og hvad skal bibeholdes?).
- Udfordrer den nuværende praksis for at få et indblik i hvilke forhold, der er relativt stabile, og hvilke der er relativt foranderlige. (Hvad kan vi bygge på?).

I afhandlingen gives der en analyse, baseret på en specifik prototypesession, af, hvordan artefakter kan fremprovokere nye indsigter i såvel som udfordre eksisterende praksis. Ligeledes gives der et konkret eksempel på et dilemma spil, hvor nuværende praksis udfordres igennem simulering af specifikke og problematiske scenarier.

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The empirical work was made possible through the cooperation by people from Great Belt A.S. and the Århus branch of the national labour inspection service in Denmark (AT).

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Chapter 1
Introduction

As the title of this dissertation indicates, this thesis is concerned with analysis in systems development. More specifically, its concern is to give ideas to, formulate concepts about, and provide practical examples from what could constitute a *cooperative analysis* in systems development.

The motivation for engagement in such an endeavour is twofold.

Firstly, in the field of design, user participation or cooperation between system developers and 'users' is emphasised more and more (Bødker & Grønbæk, 1991a; CACM, 1993; Greenbaum & Kyng, 1991; Grønbæk, 1991; Kuhn, Muller, & Meskill, 1992; Kyng, 1991; Schuler & Namioka , 1993) Strong cooperation between practitioners (the prospective users) and designers is encouraged in order to benefit from both the competencies of the practitioners and the designers - instead of approaches on the designers' terms, where they try to utilise the more or less articulated requirements from the practitioners - thereby enabling ends as improved product quality, democratisation, mutual learning, work practices, etc. In analysis, although usually seen as the activity in a development project involving users the most, the role of the practitioners (users) is often rather passive. Most analyses involve the developers interviewing, describing, observing, surveying, and the like, with the aim of transferring knowledge and understanding of the practice in question to the system developer. Often, the approaches to analysis have the system developers as active subjects setting the stage, and the practitioners and their practice as passive objects to be investigated.

Secondly, in the field of design, issues like experimentation and intervention are more and more seen as fundamental. Experimentation and intervention in the potential use-practices are emphasised due to the close relationship between technology and the embedding practice. Among other things, this close relationship means that the functioning of new computer systems is highly dependent on the practice into which it is

introduced. If the practice is somehow not suited for the system or vice versa, the system may technically be excellent but still fail. For that reason, experimentation and intervention regarding work procedures, organizational structures, competencies, etc., are necessary in addition to the more technical endeavours. The means brought to bear include prototyping, the use of mock-ups, future workshops, and organizational games. In contrast, analysis is usually conceived of as at best reflective experimenting (intellectual experimenting with different interpretations of the subject matter), usually there is no experimenting or intervention *in the analysed practice*.

If one is working within experimental cooperative design, it seems striking that in most literature on analysis, the ideas of cooperation and experimentation play a minor role, if they are not entirely absent. There seems to be a mismatch between the ideas of analysis as something done by the system developers and design done cooperatively; and between the idea of analysis as purely reflective and design as experimentation and action.

This mismatch is the point of departure for this dissertation, where I investigate what, in the field of analysis, could be the counterpart of cooperative design.

1.1 Background

For the last two decades, issues like democracy at work, 'user' involvement, and quality in work and products have been part of the core of systems development in Scandinavia. A historical overview can be found in (Bansler, 1987). The issue of democracy at work was in focus in the seventies in projects like NJMF in Norway, DEMOS in Sweden, and DUE in Denmark. The strategy to influence democracy (or lack of) at work was cooperation between researchers and (local) trade unions, and a negotiation model was developed (Ehn & Kyng, 1987). One of the problems encountered with this strategy was its rather 'reactive' character - it is a stronger argument to point at alternatives than to say no to existing proposals. This was one of the primary motivations behind the UTOPIA project (Denmark and Sweden) in the early eighties, in which alternatives to existing and proposed computer systems for the graphic industry were investigated. The focus had shifted from negotiation about potential

computer systems to development of alternative (and hopefully, from the given perspective, better) systems. One of the lessons learned from the UTOPIA project was the importance of close cooperation between people in the prospective use-practice and designers/researchers, and the importance of concrete experiences, hands-on, in this cooperation (Ehn, 1988; Kyng, 1988). Similar conclusions came out of the Norwegian Florence project (Bjerknes & Bratteteig, 1987; Bjerknes & Bratteteig, 1988), although the focus here was more on communication, whereas the UTOPIA project focused more on the tool aspects of computer systems. In the last half of the eighties much interest and work concentrated on the issues of cooperation in systems design. Some of this work is reported on in the book *Design at Work* (Greenbaum & Kyng, 1991), in which the so-called cooperative design is elaborated and conceptualised.

This thesis takes its departure in this tradition and in the conceived problems.

Three central activities in Design at Work are *analysis* which is the subject matter of the first part of the book, design which is the subject matter of the second part, and *use-practices* which is of primary concern for both analysis and design.

The relationship between the given use-practice and the design process is conceived of as cooperative and mutually informing. It is design visions that inform metaphorical design, organizational games, cooperative prototyping, etc. These are in turn conducted *in*, or as close as possible to, the practice in question. This affects and informs the practice, in that the practitioners experience it in alternative ways, and it affects and informs the design, in that the experiences from these sessions guide and inspire the design work.

Furthermore, the process of design is carried out cooperatively by the practitioners (the ones engaged in the practice in question) and the designers. The arguments for cooperation range from the ethical arguments about respect for mutual competencies, over more political ones about democracy, to pragmatic arguments concerning the practitioners as indispensable co-actors in design.

The first part of the book argues for the need for cooperative design processes to be founded in an understanding of the current practice, and it indicates the importance of an analysis that takes practice seriously. In contrast to the 'design-part' the primary concern of analysis is to

understand the practice in question, and to understand it in its own terms and from the point of view of its members. The approach is usually conceived of as an analysis from within. The basic argument is that in applying a predefined framework, a given theory, a specific design issue, etc., one will inevitably come to see practice in this light, which in turn easily leads to an analysis more influenced by the pre-understanding than the actual circumstances. Hence, the idea is to avoid a priori categories and frameworks, and instead to focus on the specifics.

The means brought to bear (observation, listening, watching, etc.) are, ideally, passive with respect to the practice investigated - the analysts are 'flies on the wall' they do not (directly) affect or inform this practice. The result of the analysis is conceived of as the analysts' reflections on the gathered material (interviews, videotapes, audio tapes, notes, observations, etc.) not changes in, or informing of, the practice in question.

Throughout the book, many examples and arguments are given as to how analysis can and should found the basis for design. Design, however, does not explicitly play a role in informing analysis. One of the arguments is that coming to the field of analysis with a specific design in mind, will inevitably affect the analysis and probably result in a technology-driven analysis. (To a baby with a hammer, everything looks like a nail.)

The relationships between the three central activities or practices, with respect to which *informs or affects* which, is summarised in Figure 1.1.

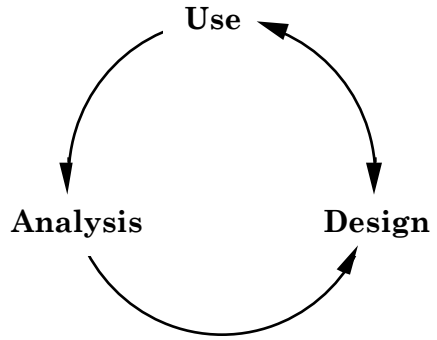

Figure 1.1: The relationship between the three practices of use, analysis, and design in Design at Work

The unidirectional arrow from use to analysis is meant to highlight that the purpose of analysis is to 'extract' a reflective understanding from use-practice, not to affect it. The unidirectional arrow from analysis to design indicates that analysis informs and affects design, but not vice versa. Finally, the bi-directional arrow between design and practice shows that

these processes are conceived of as mutually informing and affecting. The arrows do not represent causality or a time dependence, the processes are mostly seen as being undertaken in parallel.

What will be argued in this thesis is that analysis, design, as well as the practice in question in many situations can benefit from 'reversing the arrows': design can be used as an active informant of analysis and so can analysis of the analysed practice. The result is a close interaction between all three practices as depicted in Figure 1.2.

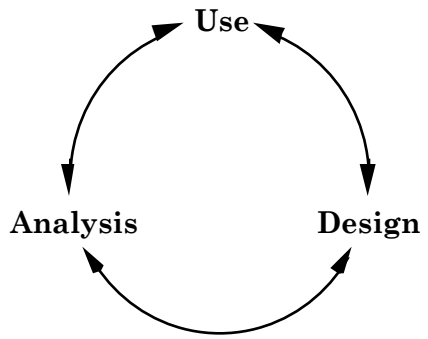

Figure 1.2: The relationship between the three practices of use, analysis, and design as investigated in this thesis

Furthermore, it will be argued that this mutual informing and affecting can be accomplished through a *cooperative* analysis.

In the words of the editors of Design at Work:

> Reflections on work practice, we believe, are critically important for ongoing design, not as laboratory experiments that measure the statistical significance of a user's interaction with a system (Chapter 2), but for daily or routine project work. However, a lot of work remains. The analytical approaches [in Design at Work], with their emphasis on observation, listening, and watching, have to be developed further to suit a cooperative design process where the 'objects of analysis' stop being objects and instead become active participants. (Greenbaum & Kyng, 1991) p. 271.

1.2 Cooperative analysis

Cooperative analysis is primarily seen as *facilitating taking action in order to bring about change* and it addresses primarily three issues:

- calling forth some of the taken-for-grantedness in current practice

- investigating current constraints and potentials with respect to possibilities for change
- exposing current problems and discrepancies to avoid basing a design on structures likely to change.

The primary approach is one of provoking through concrete experience. Provocation serves the purpose of calling forth hitherto taken-for-granted issues as well as it challenges the existing practice to investigate its dynamics and open up for new possibilities.

As two specific means to this end I introduce the possibility of using artifacts (e.g. commercially available products, prototypes, and mock-ups) to trigger new understandings of current practice and I introduce dilemma games to challenge current practice by exposing it to some of its inherent dilemmas.

A fundamental characteristic of cooperative analysis is that it is neither analysing from without (e.g. describing current practice in a pre-specified framework), nor is it analysing from within (e.g. describing current practice in its own terms and from the members point of view), rather it is *coming from without intervening within*. It is coming from without in the sense that it takes seriously that the overall concern is a systems development process, thus bringing in the competencies of the analysts, and it is intervening taking seriously that the overall concern of is change, i.e. it analyses the inherent dynamics.

Before I present the outline of the investigation I will briefly explain some of the concepts used.

1.3 Notes on vocabulary

The concept of analysis has been and is used with a number of different meanings: understanding of use-practice, modelling the relevant parts of a use-practice, specification of what services a prospective system should provide, and many more. Webster's II New Riverside University Dictionary offer the following explanation:

> **analysis** () [New Latin < Greek *analusis*, a dissolving < *analuein*, to undo: *ana*, throughout + *luein*, to loosen.] **1**. Separation of an intellectual or substantial whole into its constituent parts for individual study. **2**. *Chem*. … **3**. *Math*. …

As can be seen, the word analysis originates in the Greek *analusis*, a dissolving, which again comes from *analuein*, to undo. This captures rather precisely what is meant by analysis in this thesis, and how it is distinguished from design. Analysis is conceived of as directed towards *dis-solving* (disintegrating) *current* practice and design towards *solving* for *future* practice. Analysis is thus seen as directed more towards problem raising ('destructing') whereas design is seen as directed more towards problem solving ('constructing').

The systems development process seen from the perspective of cooperative analysis is conceived of as consisting of three practices:

- the practice being analysed, which is the practice into which a potential computer system may be introduced,
- the systems development practice, which is the practice(s) from which the system developers originate (analysts and designers), and
- the project practice, which is the common practice established during a systems development project consisting of both practitioners and system developers.

The project practice is seen as consisting of two primary functions:[1] analysis and design. The motivation for conceptualising these as functions and not, for example, as activities or processes, is that activities or processes have to be carried out by certain people in a specific point in time and space. By conceptualising analysis and design as functions, the emphasis is on the respective purposes. The point is that specific activities may contribute to either analysis, design, or both. The practices discussed are depicted in Figure 1.3.

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[1] For a [illegible] of the concept of function see (Mathiassen 1994)

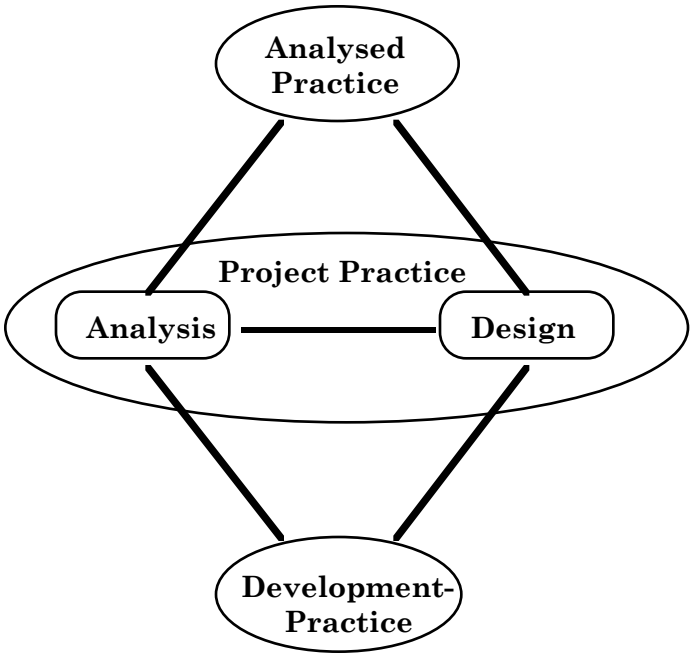

Figure 1.3: Components of systems development as seen from the perspective of cooperative analysis.

The above conceptualisation of the systems development process is certainly not the only one possible, and for capturing the totality of such a process it is inadequate. However, it has the advantage of being simple and at the same time capture the relevant parts of a systems development process *as seen from the point of cooperative analysis*.

Concerning the people involved, first of all, I find the widespread use of the word *users* to denote the people in the practice being analysed misleading. They are much more than users of a potential computer system. One of the central points in cooperative or participatory systems development is that we always have to regard the computer systems and their use in their respective organizational contexts, and that we have to take the given practice seriously. This is not the sort of connotations brought forward via the word user. Furthermore, when we are concerned with analysis, users of what? Users of something that we yet do not know what is (the purpose of analysis is, among others, to find out), and which they probably will be able to use within a two year time frame. Therefore, when writing about analysis in general, I will use the term *practitioners* to denote the people engaged in the practice being analysed, the *analysed practice*. In the specific contexts of a given practice, I will use the terms originating from that practice, e.g. inspectors, secretaries, instructors, etc. Likewise, I use the terms analysts and designers to denote people from the development practice that contribute to analysis and design, respectively.

An individual, hence, may be both an analyst and a designer as well as analysts and designers are characterised by what they are doing, and not, for example, by their organisational or educational backgrounds.

1.4 Progression of this thesis

As mentioned above, the aim of this thesis is to explore what could be the counterpart in the area of analysis to experimental and cooperative design. This aim is approached through the following progression.

In Chapter 2 I will present the two empirical projects from which ideas explored in the present thesis have arisen and in which many of them have been tried out: the AT-project (1990-1993) and the ongoing Esprit II/III project EuroCoop/EuroCODE (1991-1995). The presentations serve the twofold purpose of providing a basis for the subsequent examples in the thesis as well as exemplifying the empirical part of the research employed in the work.

Subsequently, in chapter 3 I present six different approaches to analysis ranging from Yourdon's structured analysis to cultural anthropological inspired approaches. The presentation is intended as both providing a basis on which to build as well as exemplifying some of the conceived problems in current approaches. These problems are elaborated and ideas to alternatives are given. It is argued that current approaches tend either to focus on analysing *practice* de-emphasising the important question of change, or they tend to highlight that the main outcome of systems development is *changed* or new technologies de-emphasising an analysis of actual practice. It is argued that both practice and change have to be taken seriously in analysis in systems development. Furthermore, analysis is in general conceived as '*observing*', leaving the analysed practice unchanged. It is argued that sometimes the question is more of *challenging* practice than observing and describing practice which can be accomplished through an analysis more directed towards *experiments and intervention* within the analysed practice.

In Chapter 4 I elaborate the concepts of practice and chance. Through a presentation of ideas originating in the philosophies of Heidegger and Wittgenstein I highlight two important aspects of practice: meaning as use and taken-for-grantedness. Regarding change, I try to highlight two issues important for cooperative analysis. The one is that the overall purpose of

cooperative analysis is to change a practice, and hence an important purpose for cooperative analysis is to challenge the established. The other issue is that the overall purpose is to change changing practices. The world is not 'frozen' in the period of a system development project. Another aim of cooperative analysis is thus to expose current problems and discrepancies to avoid basing a design on structures too likely to change.

The aim of taking practice as well as change seriously and to analyse through experimentation and intervention are brought together in Chapter 5, in the notion of *provocation through concrete experience*. The point of departure is the question of tradition vs. transcendence. On the one hand, it is our personal and collective history, tradition, that enables us to act competently and meaningfully in the present. On the other hand, sometimes we have to transcend the tradition in order to solve our problems. The means offered to transcend current practice while still retaining valuable parts of it is to provoke in the sense of challenging and calling forth the tradition through actual experimentation with alternatives.

These ideas are concretised through the presentation of examples from practice in Chapter 6. First, through an analysis of two cooperative design sessions (cooperative prototyping and organizational games) with the perspective put forward in this thesis, it is shown how the use of artifacts (prototypes and situation cards) may trigger new understandings concerning current practice. That is, how artifacts can provoke current established traditions and norms via concrete experimentation, and thereby provide new insight to the analysis. Secondly, it gives an example on a session deliberately aimed at challenging established practice, dilemma games, in which the participants acted through a number of dilemmas from current practice.

In chapter 7 these experiences are discussed with respect to the issue of change. It is argued that the purpose of systems development as a whole is change, organizational as well as technical. Therefore, when analysis is viewed as a means to the end of accomplishing changes, one of the key objectives of analysis must be an analysis of constraints and potentials for change within current practice. One thing is to describe current practice as it is, another is to understand its inherent dynamics and inertia. The primary purpose of analysis is thus seen as *facilitating taking action in order to bring about change*, rather than explaining how the practice is. It is argued that one cannot analyse inherent constraints and potentials for

change in general. What are constraints and potentials are highly dependent on what future possibilities are under consideration, and what are realistic possibilities in the given situation are highly dependent on current constraints and potentials. Furthermore, the dialectic interplay between building up alternatives and provoking current practice is reflected on. For an alternative possibility to provoke, it must matter within the practice, it must be 'constructed' as a possibility for the practice in question. On the other hand, it is the provoking of current practice that casts light on which general possibilities are possibilities in the specific practice being analysed.

Chapter 8 elaborates some of the issues regarding *cooperative* analysis. The first issue is the issue of pre-understanding: that each of the participants come to the cooperative analysis with certain goals, conceptualisations, and perspectives originating from their respective practices. Pre-understanding is seen as inevitable, necessary, and problematic. It is inevitable in the sense that when we enter a practice it is always partly understood, conceptualised, motivated, etc. beforehand. It is necessary in the sense that an analysis starting entirely from scratch is practically impossible. Finally, it is problematic because most likely the pre-understandings are different, partly implicit, and partly wrong. It is argued in favour of an approach neither to ignore the issue of pre-understanding nor to try to avoid it, but instead to confront the pre-understandings actively. Finally, I discuss different roles in cooperative analysis: expert, facilitator, and provocateur.

In Chapter 9 I return to the question of the overall development process. As tentative formulations as well as starting points for future work two issues are considered. The first one is the relationship between cooperative analysis and cooperative design in situations in which the aim is to develop applications for one practice. The relationship is conceptualised as a two-level dialectical interplay between cooperative design envisioning and constructing possibilities based on current practice, and cooperative analysis investigating, challenging and changing constraints and potentials within current practice in relation to relevant possibilities. The second issue regards situations in which the concern is to develop application(s) for many practices (a market). It is argued that one might 'reverse the roles', i.e. use current use-practices to challenge the underlying pre suppositions in the given designs. Finally, I try to sum up the results.

Chapter 2
Empirical background

In this chapter I will present two empirical projects. It is from these two projects many of the ideas explored in the thesis originate, and in which many of them have been tried out. The presentations serve both the purpose of providing a basis for the subsequent examples in the thesis, as well as the purpose of exemplifying the empirical part of the research employed in the work. One of the underlying characteristics of both empirical projects is that they are neither surveys nor descriptive case studies, but rather a kind of action research: in both projects (although to different extents) the researchers were active participants in the ongoing change processes in the respective practices. The interests in both projects (and in this thesis) were more directed towards what *could* be done rather than towards what *was* done. In this case experimentation and practical experiences with the various techniques, tools, and approaches become vital. In the latter case surveys and descriptive case studies may have been the appropriate means.

In this respect, there is a close resemblance between the research method employed in these projects and the approach to analysis in systems development being advocated. Both are concerned with potential changes (in systems development practice and analysed practice, respectively), and both emphasise the importance of concrete experimentation with alternatives in the given practices.

The two projects are the EuroCoOp/EuroCODE and the AT projects. The EuroCoOp/EuroCODE are large EEC Esprit II/III projects involving research institutions as well as industrial partners. EuroCoOp took place in 1991 and 1992, and EuroCODE, as a continuation of much of the work from EuroCoOp, started summer 1992 and is planned to end in the summer of 1995. The aim is to develop generic CSCW applications, using the organization supervising the construction of the fixed link across the Great Belt in Denmark as a test site.

The AT-project[2] was a comparatively much smaller project involving primarily the local branch of the national labour inspection service in Denmark (about 50 people) and six researchers. The project began in 1990 and is in the process of ending now (1993). The aim was to explore a diversity of approaches to cooperative design and analysis in the same context. This was accomplished through a consultant-like relationship between the researchers and the local branch, exploring long time visions concerning organizational and technological changes as well as shorter term consulting concerning day to day problems.

Apart from the differences in size, the two projects diverse in a number of respects, thus complementing each other as an empirical background for this thesis:

- The AT-project focused on the development of *dedicated applications* to the local branch, whereas EuroCoOp/EuroCODE focuses on the development of *generic CSCW applications*.
- The AT-project was explicitly an *explorative* endeavour, whereas EuroCoOp/EuroCODE conforms much more to a *traditional waterfall* approach to systems development.
- The AT-project was concerned with technological as well as *organizational* changes, whereas the EuroCoOp/EuroCODE are primarily concerned with *technical* changes.
- The focus in the AT-project was on exploring cooperative *processes* in one context, whereas the focus in EuroCoOp/EuroCODE is on developing *products*.

Apart from all the differences, both projects emphasised strong cooperation between developers and practitioners from the local branch of the national labour inspection service and Great Belt A.S., respectively.

The focus in this thesis is on techniques and approaches to accomplish cooperative analysis. Thus, the focus in the presentation of the projects will concentrate on those issues.

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[2] AT is the Danish acronym for national labour inspection service.

2.1 The AT-project

The AT-project involved primarily the local branch in Aarhus of the national labour inspection service in Denmark and six researchers from the universities of Aarhus and Aalborg. The project started in the spring of 1990 and is ending now (1993).

Some of the characteristics of the project were:

- The focus was on the development of *dedicated applications* to the local branch in Aarhus.
- It concerned *technological as well as organizational* changes.
- It took on an *explorative* approach to systems development and organizational consulting.
- Its aim was to explore *cooperative techniques* in one context - the local branch in Aarhus.
- Strong *cooperation between researchers and practitioners* from the local branch was at the core of the project.

Participants

The national labour inspection service (AT)

AT is the Danish acronym for the national labour inspection service in Denmark. Its basic objective is to ensure (some degree of) workers' safety.

Objectives and Organization

Markussen (1992) provides a historical account of the AT, its objectives, organization, and the interwoven development of the work environment laws,

Until about 1975, AT was primarily dealing with the inspection of physical work environment in factories, i.e. workers' safety primarily concerning working hours and use of machines. The inspectors were mostly machinists by education, there was little bureaucracy around the activity, and basically each inspector was responsible for selecting and inspecting the factories that he found appropriate. With the work environment act of

1975, the objectives were widened to include also non-factory work, and a more holistic approach to work environment.

The act implied two major changes

- more bureaucratic organization of work due to obligations concerning the accountability of work to government, companies, and the public in general,
- prevention became a central issue and the professional profile of the organization changed: therapists and psychologists were employed.

Markussen identifies three historically developed 'roles' in relation to these changes in objectives:

- the sheriff, which encapsulates the notion of the inspector going out in the field 'policing';
- the therapist, which focuses more on prevention instead of post-hoc detection of faults; and finally
- the bureaucrat, which is more concerned with proper appliance to the rules and procedures than with 'results' on the work-places (this position is, for example, often held by office workers working remote from the field).

In the late 80s, on the one hand, there was a tendency towards further decentralisation due to client orientation and, on the other hand, a tendency towards centralisation due to further obligations concerning quality assurance and accounting "upwards" in the bureaucracy for what had been achieved locally. Furthermore, more and more work was put into cooperative and structured activities, e.g. campaigns where all inspectors, usually in pairs, visit a large amount of pre-specified companies with a common aim of investigating a specific issue (e.g. young people in work places, security on construction sites, poisonous chemicals used by painters, etc.).

The overall organization of AT is depicted in Figure 2.1.

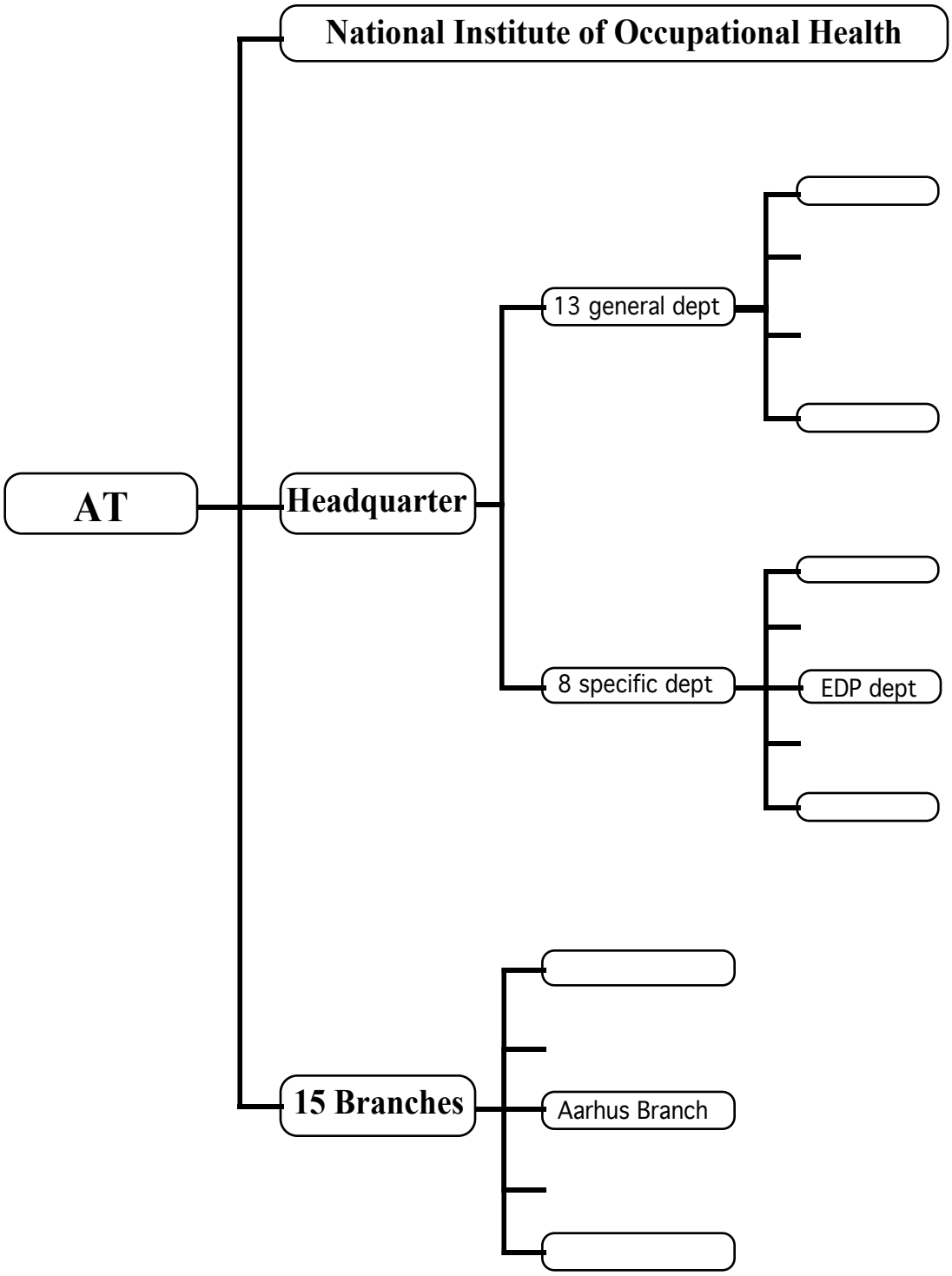

Figure 2.1: The organization of AT

The AT is organised with headquarters in Copenhagen, a National Institute of Occupational Health also in Copenhagen, and fifteen local branches situated throughout the country. The headquarters consist of thirteen general departments and eight departments taking care of either specialised or crossing functions. The EDP department is one of these and

supports all departments and branches regarding use and development of computer applications.

The Aarhus branch of AT, which is the one taking part in the AT project, is constituted by about 45 people (ca 30 inspectors, 10 secretaries, 5 others) - the actual numbers have changed throughout the project. When the project began, the Aarhus branch was organised with one manager and two deputy managers taking care of staff (all the secretaries) and inspection (all the inspectors), respectively. The inspectors were further organised in groups according to their respective trade: a health group, a construction group, a 'generic' group (mostly machinists and engineers), etc.

Computer support

In the beginning of the project - 1990 - the hardware configuration in the AT consisted of a central mini-VAX, a number of remote terminals (one per secretary and manager and two for the inspectors to share), and three printers.

The three major computer applications used were a word processing program, an accounting system in which the employees report on a weekly basis on their work done, and the company database (VIRK). The latter is most relevant in the context of this thesis[3].

VIRK was designed based on a company database shared with other authorities dealing with company inspection and counselling. It is a menu-based system running on the central mini-VAX. VIRK has been used in the organization for several years.

VIRK was created to help various groups of people, primarily management, to get an overview of the many cases and documents which came into play when the organization grew and diversified. Furthermore, management needed to make sure that all incoming requests were handled according to the law, and according to the same practice independent of the person who undertook the case.

We can identify the different activities in which VIRK is applied since there are many different use activities going on simultaneously, and VIRK has several roles in this web of activities:

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[3] For a more detailed description of VIRK see (Bødker, 1992; Bødker & Mogensen, 1993)

- VIRK is the instrument of management of AT to make sure, that the people who contact AT get a reply in due time, and get equal treatment. Correspondence lists and lists with deadlines are maintained in VIRK to support these issues.
- VIRK is used when following up on the work of the inspectors, and on the work of the whole branch office as such. Various statistics are important output. These statistics are used by management to control and plan the activity. Data entry for this is done primarily by inspectors, in VIRK and the accounting system.
- VIRK is used by the individual inspector and secretary to handle a certain case. The inspector "takes the travel card", he makes notes, he looks for correspondence of relevance to the present case, etc. The secretary pulls out information about a company for a campaign, she follows up on deadlines, etc. In particular, the sort of information that can be written down regarding a visit or a case is very limited, and in most cases very quantitative.
- Finally, VIRK is used by a secretary every time a document is registered in the system or a case is closed.

Generally, the objects that one can work on, in or through VIRK, have to do with recording the state of the overall activity. Descriptions and lists of documents, lists of cases, of deadlines, and various statistics are the objects *in* VIRK. The contents of the cases, which are the objects dealt with by inspectors and secretaries when handling a case, are almost absent in the system.

There are some objects of normal daily activity present in VIRK:

- travel cards that the inspectors take (print out and mark in VIRK as "taken") before leaving for an inspection. They contain information about the company, but they are also meant to prevent several inspectors from going to the same company by coincidence, at the same time.
- various lists and overviews, such as companies sorted by street name, and correspondence with respect to individual companies.
- lists and overviews of cases held by the individual inspector.

Researchers

The project group consisted of Susanne Bødker, Ellen Christiansen, Pelle Ehn, Preben Mogensen, Randi Markussen, and Randy Trigg and was thus a conglomerate of people with experience of cooperative design, organizational conflicts, close up studies of work, communication, historical analyses, etc.

Our background were primarily in a Scandinavian tradition. In Scandinavia the concept of user participation as an integral part of computer systems 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 (Ehn & Kyng, 1987; Ehn & Sandberg, 1979; Kyng & Mathiassen, 1982). In the early 1980s, the focus was broadened to include skill (Bødker, Ehn, Kammersgaard, Kyng, & Sundblad, 1987; Ehn, 1988; Kyng, 1988). Throughout this development the tradition has emphasised a process oriented approach to systems development, i.e. the outcome of a systems development process is as much the process, e.g. the learning that takes place as it is the product, e.g. the computer application.

The above background supplemented with inspiration from activity theory (Bødker, 1987b; Christiansen, 1988), so-called work development research (Bisgaard, Mogensen, Nørby, & Thomsen, 1989b; Engeström, 1987; Engeström, 1990b) together with the insights from *Design at Work* (Greenbaum & Kyng, 1991) founded the theoretical starting point for the AT-project.

Starting point and aims

At the time of the project start, the local branch and the AT as such were in the process of major changes - on the one hand much work and authority were to be decentralised and, on the other hand, the obligations regarding accounting to the headquarters for the work performed were increasing.

The purpose of the project seen from the point of view of AT managers and workers was to make overall designs for a number of computer applications for the branch, to develop a long-term strategy for decentralised development and maintenance, and to support the organizational change process through technology.

As indicated above, the purpose as seen from the researchers was primarily to bring the diversity of approaches developed during the last decade to bear in one project and thereby to get experiences with respect to their interrelationships and respective strengths and weaknesses. Furthermore, it was an objective to achieve one or more "good" designs for the area in question, i.e. inspection and office work.

The agreed goal of the project was thus to produce a number of (long term) visions regarding technology as well as organizational change. The branch would get a selection of possibilities to strive at (or avoid), and the researchers would gain experience concerning the effectiveness and suitability of the diversity of techniques in different situations and areas.

Project history

As mentioned above the goal was to create a set of long term visions for the local branch in Aarhus regarding technology and organizational change. To achieve these ends we conducted a range of activities. Below I present a brief description of some of these activities in the period from summer 1990 to summer 1991. Only the activities in which I have taken part are included. For a more elaborate description and discussion, see (Bødker, Christiansen, Ehn, Markussen, Mogensen, & Trigg, 1991; Bødker, Christiansen, Ehn, Markussen, Mogensen, & Trigg, 1993a).

- **Initial analysis**. In order to get a first grasp of what was actually going on in the AT we interviewed people (Kvale, 1983), we were participant observers in the office, and we followed inspectors in the field. Some of these sessions were videotaped for subsequent analysis (Suchman & Trigg, 1991; Trigg, Bødker, & Grønbæk, 1991). Playing the "role as apprentices" gave us the opportunity to watch and listen for not only the espoused theories, but also for the theories-in-use in the daily work (Argyris & Schön, 1978), especially the reflective practitioning of the inspectors (Schön, 1983).

- Design of primarily horizontal **prototypes** (Floyd, 1984). The prototypes were meant to explore the possibilities opened up by going from a 'glass TTY', text based, to a graphical interface, and to explore the possibilities for integrating the current segregated systems: word processing, accounting system, and VIRK which again consists of three separate systems (one system for data entry, one for producing reports, and one for non-trivial search and retrieval). To a large extent, the prototypes were developed cooperatively (Bødker & Grønbæk, 1989; Bødker, Grønbæk, & Kyng, 1993b; Grønbæk, 1990) by the researchers and the people from the AT: at the university where one of the inspectors joined the designers, at the local branch where the prototypes were placed for a period of time, and at two seminars (described below).
- **Visit** to a tax collecting department (Dilschmann & Ehn, 1983; Kyng, 1988) We (six people from the AT and four researchers) conducted a "field trip" to a governmental department handling tax collection. The organizations share some resemblances in that, for example, both are going out to companies checking. In addition, the tax collection department had recently introduced a new system based on portable computers to use 'in the field' on inspection. We were in the midst of investigating corresponding possibilities.
- **Future workshop** (Jungk & Müllert, 1987; Kensing, 1987) for all members of the Århus AT except the managers. The idea was to generate ideas for the upcoming seminar (next item). The focus was on issues related to the interplay between the organizational and technological changes.
- The **Ry seminar**. Eleven people from the AT and six researchers participated in this seminar in a town called Ry. The main activities on the seminar were elaboration on the **prototypes** (described above), envisioning more advanced types of technological use via mock-ups (Ehn & Kyng, 1991; Kyng, 1988; Kyng, 1991), and an extended **organizational game** (Ehn, Mölleryd, & Sjögren, 1990; Ehn & Sjögren, 1991).

- **Action Plans**. As a follow up to the Ry seminar we held a half day workshop with the AT, at which an action plan for short and long term organizational changes were accomplished. As part of the plan was the idea of introducing semi-autonomous groups organised according to the companies which the AT should inspect contrary to the current organization according to the trade of the inspectors. Later, a technology proposal were written including the idea of replacing the current hardware architecture based on one central computer and a number of terminals with networked personal computers/workstations.

In the spring of 1991 the project changed character. It was decided in the local branch to change the internal organization into four semi-autonomous groups, typically consisting of 1 or 2 secretaries, 1 or 2 inspectors from the former health group (nurses, psychologists, ergonomists, etc.), and 4 to 7 inspectors from the former 'generic' group. Each group was responsible for the inspection of a certain subset of companies with related problems.

Furthermore, it was decided centrally (EDP department, see Figure 2.1) that the future hardware architecture in the AT should consist of networked PC's with the old central computers as servers and MS-DOS as the operating system.

The situation, constraints, potentials and possibilities at the AT were thus changed considerably. Naturally, the focus was no longer on long term visions, but rather on short term issues as to make the new groups and new technology function at all. Obviously, this shift of focus and needs had impact on the project. We decided to continue the project, but in a different role and with different objectives. The role shifted from a researcher investigating future possibilities to a consultant addressing current constraints and potentials.

In many ways this was a considerable change:

- the project moved from being one that was shaped by us, where the activities were 'under our control', to being one where we would try to do whatever was necessary to help the AT in the current situation.
- we bought a PC and began to develop on this platform instead of the Mac.

- besides envisioning future technology, the focus was now also on the introduction of existing technology.
- we now conceived ourselves as pursuing a two-level strategy, in which we, on the one hand, kept developing long term possibilities (visions) to inform and guide the day to day consulting and, on the other hand, spent a considerable effort in affecting current constraints and potentials.

Hereafter, the work in the project concentrated on two groups. One was to receive new technology, whereas the other was to stick to the old technology for a while. The author of this thesis was mainly involved in the work concerning the group receiving new technology. Some of the work concerning the other group is reported on in (Bødker, in preparation). In the group receiving new technology the work concentrated on the following activities:

- **Technical consulting** addressing issues as to what hardware to buy (brand, amount of RAM, size of hard disks, type of video cards, etc.) and what software to equip it with. One of the results of these activities was that the group in question was allowed to use Microsoft-Windows and applications to this platform in contrast to the rest of AT running DOS based applications, and the group was equipped with hardware suitable for handling a graphical contrary to a text based interface.
- **Training sessions** in using, primarily, Microsoft-Windows and WordPerfect for Windows
- **Tailoring** the purchased applications (Bødker & Trigg, in preparation). During the whole period we have acted as consultants regarding the set-up and tailoring of the purchased software, primarily Microsoft-Windows and WordPerfect, e.g. configuring the network, templates for 'standard letters', macros, etc.
- Developing **prototypes**. The prototypes developed on the Mac platform were partly moved to the new platform, as well as new development was undertaken. The new prototypes were designed during sessions at the AT with primarily two inspectors and two secretaries. The implementation of the old prototypes was given a low priority due to uncertainty as to whether it would be possible to integrate with VIRK running on the central mini-VAX.

- The **Odder seminar**. In the spring of 1992 we conducted a two day seminar in a town called Odder. The rationale for the seminar was a growing frustration in the AT: the PC's were installed but rarely used, the network was installed but few could find their bearings among the multitude of available drives, the new groups were formally constituted but did not function as such in practice, etc. Among the activities at this seminar were:
  - explanations of networks and e-mail using mock-ups and **simulations** (Eriksson, Hellman, & Nurminen, 1988; Hellman, 1989),
  - a **dilemma game** used to challenge current practice and spark discussions.
  - Discussion on future technology based on a **prototype** concerning case handling.
  - Discussion on **organization of group work**, particularly the division of labour between inspectors and secretaries.

Figure 2.2 tries to convey an overview of the activities described above.

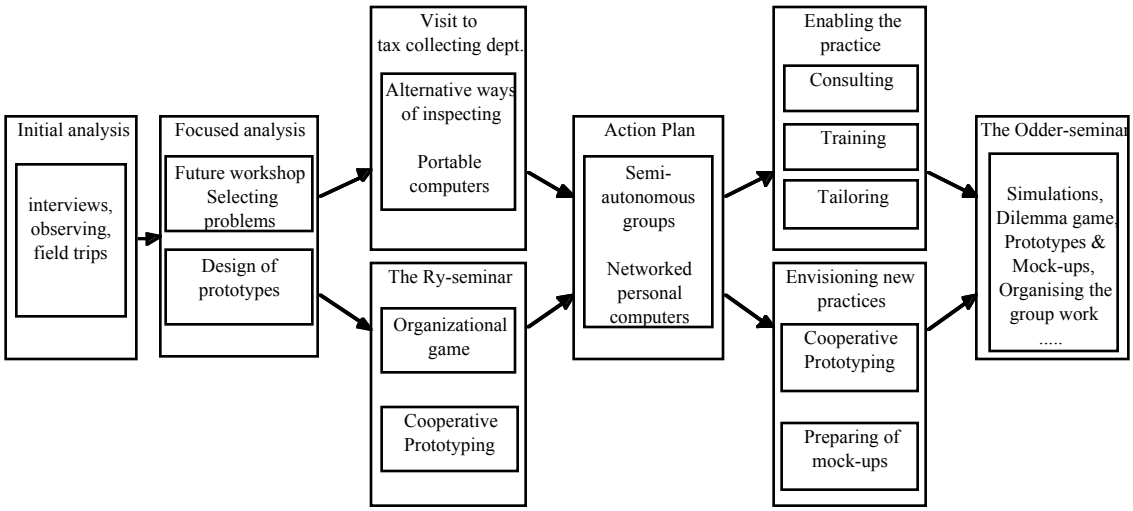

Figure 2.2: Some of the activities carried out in the AT-project

2.2 The EuroCoOp and EuroCODE projects

The EuroCoOp and EuroCODE projects are large EEC Esprit II and III projects involving research institutions as well as industrial partners. EuroCoOp took place in 1991 and 1992, and EuroCODE, as a continuation

of much of the work from EuroCoOp, started summer 1992 and are planned to end in the summer of 1995.

Among the characteristics of EuroCoOp and EuroCODE are:

- The focus on the development of *generic CSCW applications*.
- Formally, they conform to an approach resembling a *traditional waterfall* approach to systems development. In practice, though, analysis and design have been carried out in parallel and the process has been more iterative than suggested by the formal context.
- A concern primarily with *technical* development.
- A focus on developing *products* rather than exploring processes.
- Emphasis on strong *cooperation between developers and practitioners* from the Great Belt A.S.

The presentation of the projects concentrates on the issues relevant for this thesis, i.e. the activities relating to analysis conducted at the Great Belt A.S and the elaboration on proposed technical solutions. These issues are dealt with in greater detail in the project reports (Braa, Sørgaard, Holmes, Mogensen, Kyng, Thüring, et al., 1993; Grønbæk, Kyng, & Mogensen, 1991; Kyng & Mogensen, 1992) and in the more publicly available paper (Grønbæk, Kyng, & Mogensen, 1993).

Participants

Researchers

The work at the Great Belt A.S (GB) has been part of the work in the multinational ESPRIT projects 5303, EuroCoOp, and 6155, EuroCODE. EuroCoOp began January 1991 and was finished January 1993. EuroCODE began formally in July 1992, but in practice for those involved in EuroCoOp it began in January 1993 and is expected to last until September 1995.

EuroCoOp was organised around two activities aiming at eliciting requirements and activities pertaining to develop primarily five products:

- Specific requirements for the products derived from an analysis of GB
- General requirements for the products
- Tool manager

- Personal information manager
- Enterprise information system
- Synchronous conferencing tool
- Hypermedia tool

The members of EuroCoOp were: TA Triumph-Adler AG, Aarhus University, Empirica, GMD, Great Belt A.S., Jydsk Telefon A.S., STC Technology Ltd/Bell Northern Research, Xtel Services Ltd.

EuroCODE is organised around the development of

- a CSCW framework and requirements
- a CSCW shell for the design of CSCW applications
- a High Road[4] Demonstrator supporting collaboration and interaction via live video
- a Middle Road Demonstrator supporting distributed work mainly via a global window
- a Low Road Demonstrator supporting the use of mobile computers
- Application services and network infrastructure

The members of EuroCODE are: CAP debis/Dornier, Aarhus University, Empirica, GMD, Great Belt A.S., ICL, Jydsk Telefon, Nexor, Norsk Regnecentral, and Rank Xerox.

In both projects the main objective has been to develop generic products. To that end, the GB was selected as a 'test' site for these systems. The aim was a development of generic CSCW products, tested and informed by the introduction of them to the GB, it was not a development of systems to the GB in particular.

The work in these project which is most relevant for this thesis and the work in which the author has been mostly engaged is the work regarding the user site, the Great Belt A.S. Therefore, the description and discussion relating to these two projects will be restrained to concern activities regarding the user site.

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[4]High, middle, and low road respectively signifies the bandwidth supported in the

The Great Belt A.S. (GB)

The application domain of the EuroCoOp project was the management and supervision of one of Europe's largest technical projects: the construction of the fixed link across the Great Belt in Denmark.

Objectives and Overall Organization

Great Belt A. S. (GB) is an organization established by the Danish State in 1987. GB is a 100% state owned company. It is to be responsible for the design, construction, and operation of the Great Belt fixed link connecting Zealand and Funen (see Figure 2.3).

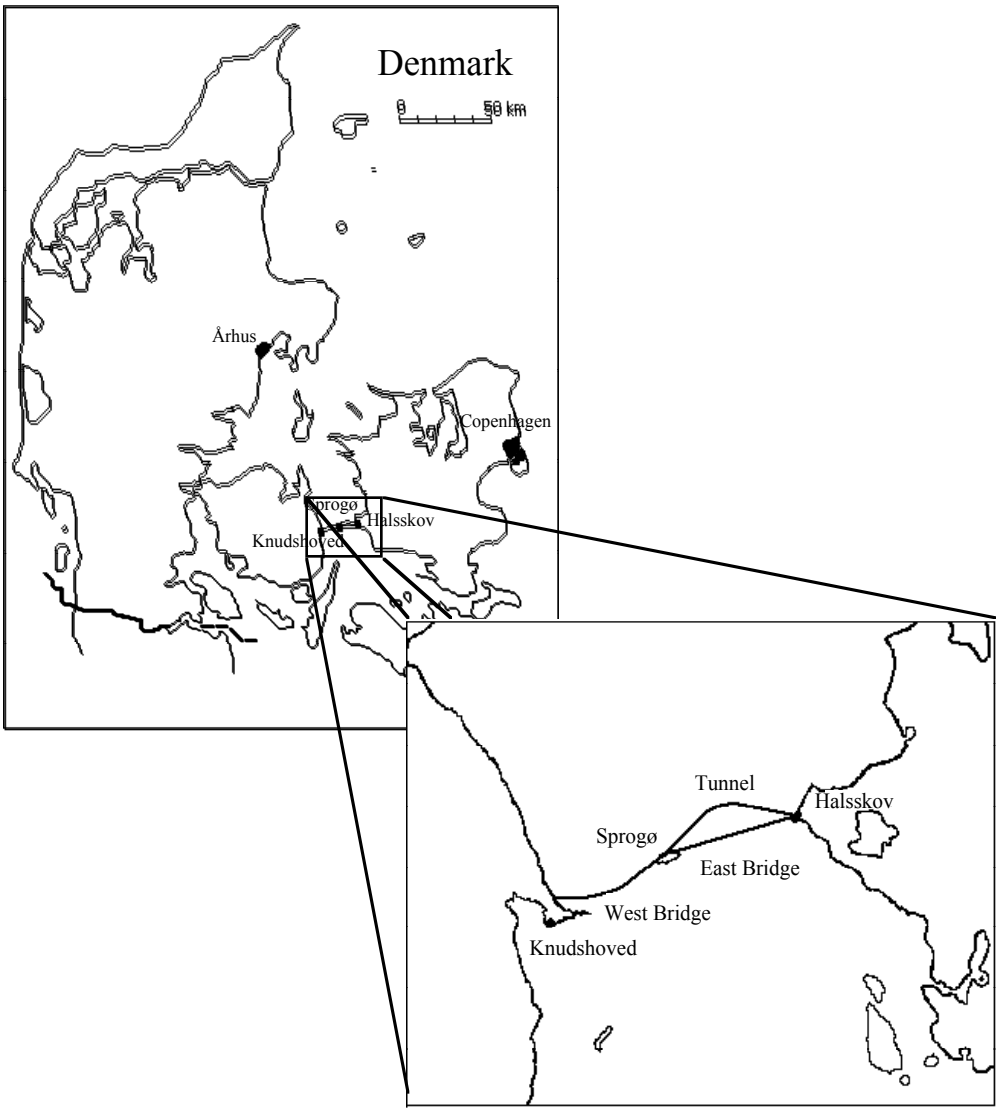

Figure 2.3: The locations of the Great Belt fixed link. GB has offices in Copenhagen, Halsskov, Knudshoved and Sprogø.

The Fixed Link consists of a railway tunnel and a roadway bridge from Halsskov to Sprogø and a combined bridge from Sprogø to Knudshoved. In the period until 1996 an important role of GB is that of an employer – supervising the work of the contractors building the bridges and the tunnel. After 1996, when the fixed Link is completed, GB will be responsible for its operation and maintenance.

The construction work is divided into four projects:

1. West Bridge (Sprogø – Knudshoved, Funen) - combined bridge
2. East Bridge (Halsskov, Zealand – Sprogø) - roadway bridge
3. East Tunnel (Halsskov, Zealand – Sprogø) - railway tunnel
4. Land Works (train stations, highway extensions, etc.).

All projects are carried out by international consortia. With currently 430 employees and consultants, GB has four projects involving approximately 4500 persons. The headquarters are in Copenhagen, while the three major site offices supervising the construction of the West Bridge and the East Tunnel and Bridge are placed in Knudshoved and Halsskov, respectively. In addition, smaller units are placed on Sprogø (See Figure 2.3), Sines in Portugal, and Livorno in Italy.

The objectives of the company imply that, besides the construction work itself, important work activities pertain to one of the following activities:

- quality assurance
- time planning
- economy management

In traditional inspection in the construction business, the inspector - on site - checks the delivered products in order to ensure that these products meet the standards formulated in the contract. Due to the huge complexity in building the tunnel and the two bridges, GB has chosen to do otherwise. Following the ISO 9000 series (especially ISO 9001) what is specified in the contract is, apart from the requirements to the products, requirements to the process of ensuring the quality. In the contract a quality assurance (QA) system is specified which the contractor has to follow. The basic idea in this system is that the contractors themselves have to assure the quality through plans for what they will do, and how and when they will do it. Subsequently, they must provide documentation showing that the plans were followed and the specified requirements adhered to. In the

construction process, GB receives a huge amount of documentation from contractors, which the supervisors at GB check with regard to the contract and the plans for the documentation process. Where the role of a traditional inspector is that of inspecting the products, the role of the supervisors at GB is more that of inspecting documentation from the inspectors of the contractor, combined though, with some spot checking of procedures and products.

GB reviews the contractors' workplans and monitors the progress of the construction activities in order to ensure the completion of the bridge within the required time limits.

Furthermore, GB manages all the economic transactions with the contractors. All prices are specified in the contracts between GB and the contractors, but the rates being paid to the contractors are dependent on the quality and status of the deliverables. Payments are calculated on a monthly basis.

Objectives and organization at the West Bridge

In the following the focus is on GB in the role of supervising the construction of the Fixed Link, primarily the West Bridge.

One of the major tasks of the GB organization in Knudshoved is to supervise the construction of the West Bridge. The objective of this task is to make sure that the Fixed Link is built/constructed according to the requirements laid down in the contract between GB and the contractor.

The construction of the West Bridge is done by the international consortia European Storebælt Group (ESG).

Figure 2.4 gives an overview of the organizational structure of the site-office in Knudshoved.

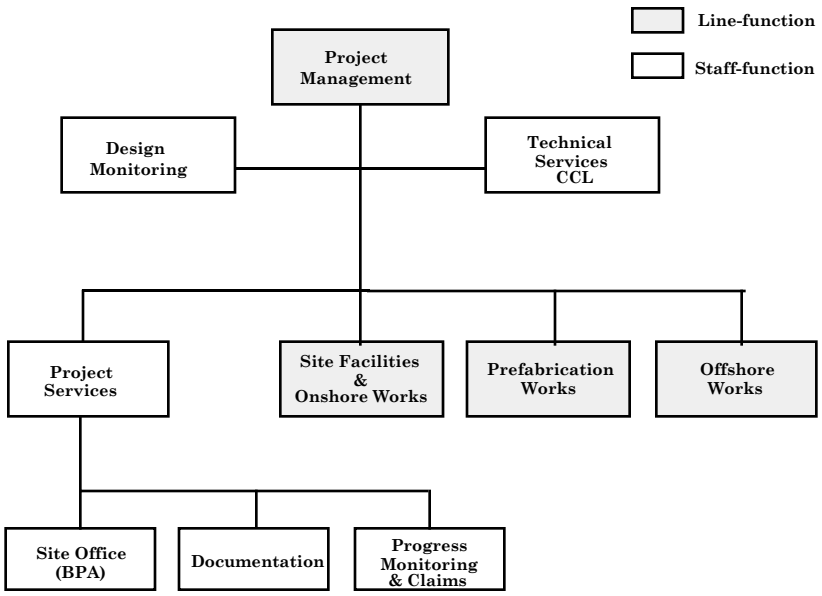

Figure 2.4: The organizational structure of the supervision at the West Bridge.

The supervision in Knudshoved is divided into three technical sections:

On-shore Works inspects the construction of all the land works around Knudshoved, Sprogø, and Lindholm.

Prefabrication Works (Prefab) supervises the prefabrication of the elements to the West bridge made on shore. The prefabrication process takes place at the construction site Lindholm situated near Knudshoved.

Off-shore *Works* is responsible for the supervision of the works at sea including, for example, the placing of bridge elements.

CCL is a consulting engineer firm hired to give GB advice in complicated technical situations. **Technical service** consists of engineers employed by CCL working as advisers in Knudshoved. Besides the role of advisers in complicated technical questions, CCL is responsible for the general design of the bridge. **Design Monitoring** keeps track of changes in the design.

Project Services is the main staff function, which, among other things, takes care of the documentation delivered from the contractor. Project Services is split up into three sections:

Site Office takes care of the journalising and distribution of incoming mail (mainly from ESG), as well as cars, the boat, computer coordination, and administration.

Documentation: registers and handles the documentation from ESG (drawings, quality assurance documents, change requests, etc.).

Progress Monitoring & Claims: monitors the progress against the time schedules of ESG and processes monthly payments and claims. Partly due to the confidentiality about claims it was not elaborated in the project.

The focus was on the two sections monitoring the work that Prefab supervises (Documentation and Progress Monitoring). Progress Monitoring and Documentation distribute the documentation from the contractor to the supervision sections. The supervisors inspect the documentation and return their evaluation to Progress Monitoring and Documentation. Progress Monitoring is divided into two functions: **Time Planning** and **Economy**.

Management and the results of the evaluations are, for example, used by these two functions in the process of progress reporting.

Computer Support

GB has a comprehensive computer installation based on local area networks with 2 Mb connections between Copenhagen, Halsskov and Knudshoved and a satellite connection to Sprogø. Approximately 80% of the personnel have their own PC. In the following, some of the most important computer systems in Knudshoved are described.

SØS. The main computer support in **Economy** Management consists of the financial management system, SØS - a Danish acronym for GB's Economy System. SØS supports the monitoring of the financial status of the West Bridge project. There is a direct network connection to a central database in the Copenhagen headquarters. This database is updated twice a day.

Artemis. The computer support in **Time Planning** is mainly made up of the time planning systems Artemis 7000 and Artemis 9000. Artemis 7000 is a PC based system used to process data locally for the West Bridge. Artemis 9000 runs on a mainframe and processes data concerning the whole project. The data is kept in a central database which is updated once a month after the progress reporting process.

KIS. The main computer support in **Documentation** is the quality information system KIS. In connection with quality assurance the use of KIS should support many of the daily work procedures concerning the assessing of the documentation from the contractor, and it should support

the realisation of ISO 9001. Due to technical and contractual problems the system never functioned as intended on the West Bridge. The intention was that the system should function on a distributed basis. The supervising engineers at ESG as well as at GB should have their own PC with a local database containing the documents currently being processed.

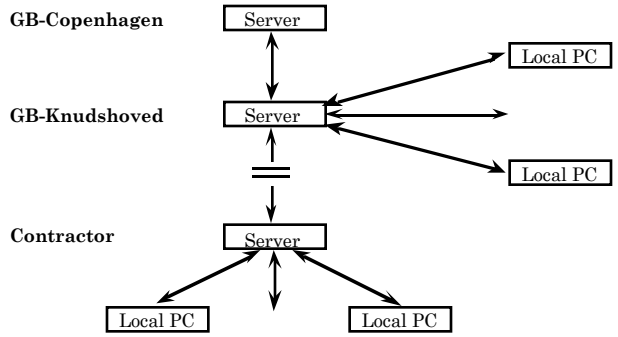

Figure 2.5: The configuration of KIS.

The supervising engineers at ESG should make the documents on site, transfer these to the central server at ESG. On a sample basis these should be transferred to GB on floppy disks (the lack of network connection between ESG and GB is due to security reasons). The documents should then be distributed to the individual supervisor at GB for evaluation. Subsequently, the documents should be transferred to a central database in Copenhagen. In practice, only the GB side of the system came into use - GB receives the quality documentation on paper forms and enters them in KIS manually.

DMS. In order to manage the large number of drawings - approximately 35,000 - GB has developed a computer based Drawings Management System, DMS. Essentially, the system is a database to which all relevant GB personnel has on-line access. The system provides the **supervisors** with the possibility of retrieving and plotting the drawings or viewing them on screen. Before plotting a drawing it is possible to make annotations to it (thus, the annotations appear on the plotted drawing, but not on the computerised one).

The functionality of these four systems can be summed up as indicated by Figure 2.6.

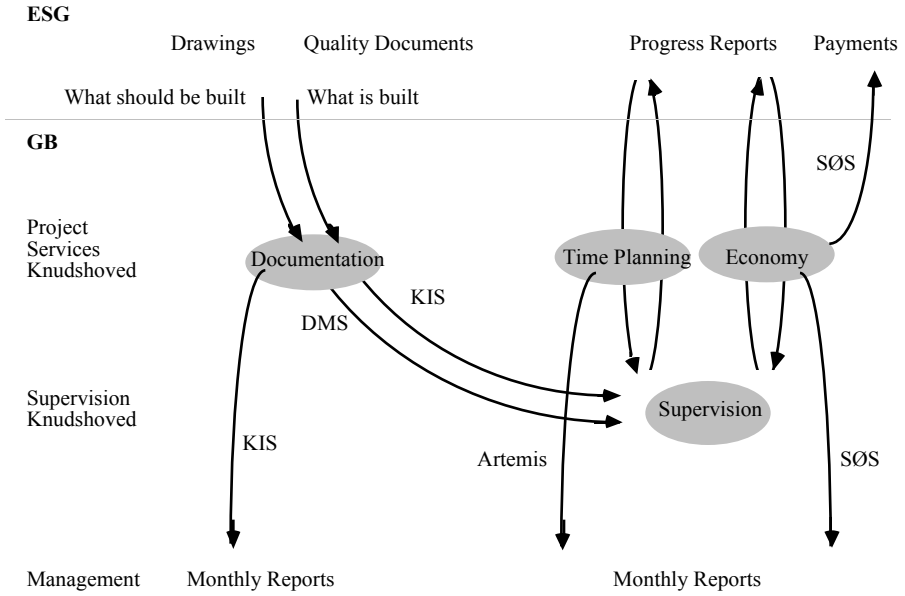

Figure 2.6: The main flows of information concerning supervision. The bold arrows indicate main information flows supported by the systems, and the plain arrows indicate main information flows not supported.

The design drawings are made by ESG in Holland. After acceptance by the GB they are sent to Documentation in Knudshoved in electronic form as well as on paper. Documentation checks that the paper and electronic drawings correspond. If so the drawings are registered and entered into the DMS system, and thereby made available to Supervision. This represents the main information flow regarding what should be built. After construction, ESG delivers quality documents which are sent to Documentation where they are entered into KIS for availability to the supervision. Supervision checks via primarily DMS, KIS, and on site inspection whether 'what is built' corresponds to 'what should be built'.

The plain arrows indicates the interaction regarding the monthly reporting: ESG sends its suggestions to Time Planning and Economy, respectively, where they are distributed to the appropriate supervisors, who comments on them and return them to Time Planning and Economy, respectively. In case of disagreement a negotiation between Time Planning, Economy, and ESG takes place. This procedure is only supported by computer systems to a very limited extent. The remaining bold arrows indicates the main output from KIS, Artemis, and SØS: reports to management, and in the case of SØS payments to ESG.

Lindholm Application. Early on in the construction project it turned out that many, especially managers, needed information concerning the status of the construction on Lindholm. A large number of inquiries were made by phone or directly to the supervisors in Prefab. Hence, they decided to develop an information system: the Lindholm application. This system monitors the production of bridge elements on the construction site Lindholm, including the states of specific elements and the date they were casted. The information is presented graphically. The application is independent of the Artemis system, even though the two systems, to a large extent, use the same data, but on two different levels of detail.

Journalising system. All incoming and outgoing letters and faxes are logged centrally in the computer based journal system SCAN-JOUR. The registration consists of an ID number, a category number, a date, sender/receiver and a short abstract for each letter/fax. The letters are sorted by date in the system. It is possible to search for the items in the registration and patterns from the abstracts. The category number is given by a matrix plan. In the journal archive, documents are sorted according to these category numbers, and for each category they are again sorted by date. The journal system is shared by all geographical sites within GB. In Knudshoved, SCAN-JOUR is only accessible for the two secretaries who take care of the central archiving of letters. If somebody else wants to find a particular letter s/he has to contact one of these secretaries to ask them to search for the letter.

Furthermore, GB has developed a Geological system and an Environmental system to keep track of changes in the subsoil and the ecology of the Great Belt respectively. Also a number of standard office software packages are used: e-mail, calendar, word processors, spread-sheets, database systems, etc.

Project history

Figure 2.7 summarises the main activities carried out in relation to the user site in EuroCoOp. The emphasis is on the activities carried out in the project, and furthermore on those activities relating to task management and hypermedia support in that they were the most elaborated in relation to the GB. Grønbæk, Kyng, and Mogensen (Grønbæk, et al., 1993) give a more elaborate discussion on the issues related to design raised in the project.

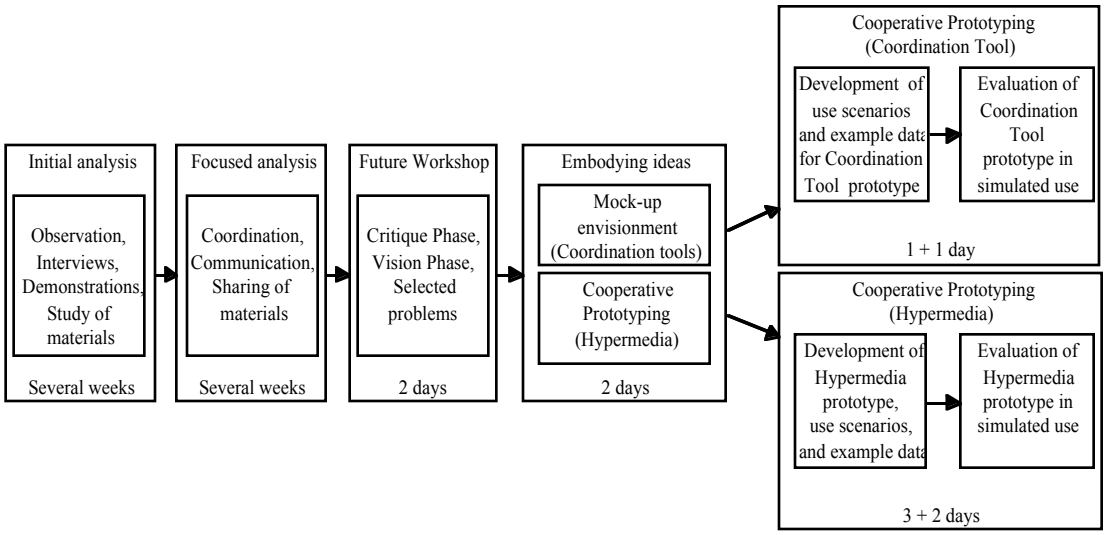

Figure 2.7: Overview of activities involving GB in EuroCoOp

In between the outlined main activities, analysts and designers were working on technical development activities, documentation, and several more informal contacts with the practitioners at the GB. The activities spread over a 2-year period, and approximately 15 analysts/designers and 20 users were involved.

The objective of the initial analysis was to get an overall picture of the Great Belt A.S, its objectives, organization, practices, object of work (bridge construction), etc. It was carried out through a number of visits to the headquarters in Copenhagen, the site office in Knudshoved, as well as the construction site at Lindholm (close to Knudshoved). To a large degree, the focus in the initial analysis was determined by the GB - they told, showed, and demonstrated what they considered to be relevant in relation to supervision.

The overall understanding of the GB as well as the obligations relating to the products being developed led to a more specific analysis, focusing on:[5]

- Coordination (Task manager and personal information manager)
- Communication (Enterprise information system and synchronous conferencing tool)

---

[5]Related distinctions can be found in (Sørgaard, 1987) who proposes a distinction between coordination as explicit communication or implicit through shared materials and (Schmidt, 1993; Schmidt & Bannon, 1992) who distinguish between 'real work' and

- Sharing materials (Cooperative design and authoring).

The analysis was a balance between coming from without with answers (the products being developed in the project) looking for problems to apply them to, and analysing from within looking for problems and bottlenecks as conceived by the people at GB.

With the aim of generating visions regarding the identified problems and bottlenecks we held a future workshop. In relation to the proposals of Jungk and Müllert (1984), we took on a much more active role in the workshop. The people at GB could hardly be said to be resource weak (as presumed by Jungk and Müllert); most of them are engineers and have used (and programmed) computers for years. Instead we used our previous analysis and technical knowledge to challenge current practices as well as suggest possible solutions. Instead of being facilitators only, we were also 'co-players'. One of the outcomes of this future workshop was the decision to elaborate the possibilities for hypermedia support in journalisation, supervision, and monthly reporting, as a reaction to current technology consisting of large non-integrated monolithic systems.

The first concrete ideas concerning the task manager were introduced to the GB in a seminar with a mock-up session. The mock-up consisted mainly of screen layouts with relevant data from the GB. The session was thus an attempt not only to present the task manager as such, but as a concrete possibility for the people at the GB. In the same seminar we conducted a mock-up session concerning the hypermedia. The mock-up consisted of a rather comprehensive HyperCard application showing some of the possibilities in supporting a network structure of the material instead of current structure with search via keywords.

In the period between the future workshop and the mock-up session regarding the hypermedia we (Aarhus University) changed focus: initially the focus was on supporting cooperative design and authoring, but the analyses at the GB combined with the ideas developed at the future workshop, turned the focus more towards the construction of a hypermedia tool for managing material used in supervision.

A prototype of the task manager was explored at a two day seminar at the GB (not all the time was spent on the task manager, though). The data in the task manager were taken from the GB, and known tasks in the GB were simulated in the prototype. The exploration was done by various practitioners from the GB actually trying to use the prototype in work like

situations. Some of the major impacts on the design from this session were:

- introduction of an edit mode for tasks or task groups
- introduction of a facility for moving groups of tasks
- introduction of facilities for filtering and searching.

Correspondingly, a seminar exploring the hypermedia was held some months later. To prepare for the seminar, three people from GB joined the designers in Aarhus for three sessions of one day each. In effect, the hypermedia tool was explored via a comprehensive 'GB-Hypermedia' interlinking about 60 Mbyte of material from GB. The hypermedia was explored by several people from GB and some of the major impacts were:

- Different user defined categories of links such as "comment"- or "see"-links
- The need to integrate with certain third party applications
- Development of browsers based on link types
- The need to support cooperation between different organizational units (e.g. time planning, economy, and supervision).

The mentioned activities delivered so-called pre-competitive prototypes of a Coordination Tool (Kreifelts, Hennessy, & Ehrlich, 1992; Kreifelts, Hinrichs, & Woetzel, forthcoming) and a Cooperative Hypermedia Tool (Grønbæk, Madsen, Møller, Nørgaard, & Sandvad, 1992; Grønbæk & Trigg, 1992). The work continues on both tools in EuroCODE, and they are intended to be developed into products by some of the industrial partners.

Chapter 3
Six approaches to analysis

Below, I present six different approaches to analysis. The first three, Yourdon, Jackson, and Coad & Yourdon, can be seen as examples on rather traditional approaches within systems development. All of them give their account on how to describe and model the present in order to support subsequent design and implementation. They differ, however, considerably in their respective approaches to modelling. The fourth, the MARS project, is an example of an understanding of systems development emphasising the importance of choosing methods according to the specific situations and stressing the dialectics of systems development. SSM, as the fifth, can be seen as a reaction to especially the first three mentioned approaches and their focus on 'objective' descriptions. SSM emphasises the importance of the subjective interpretations of the problematic situations and the participants respective 'Weltanschauungen'. Last, but not least, I present recent approaches within systems development, originating in cultural anthropology. These approaches stress the importance of studying actual practice as well as doing it in the terms from the studied practice.

The presentation is by no means intended as being exhaustive with respect to the area of analysis. The intention is to give examples on the rich variety of approaches in order to use these as sources of inspiration, to provide some context for the ideas presented in this thesis, and to exemplify some of the conceived problems in current approaches.

The presentation of the approaches is deliberately focused according to the aim in this thesis of investigating potential counterparts in analysis to cooperative design. This means that the presentations are focused on issues as 'how is the analysed practice conceived', 'how do the approaches relate to the issue of change', and 'how do they relate to cooperation and intervention'. Therefore, the presentation cannot give full justice to the respective approaches. My aim is not to discuss or assess the applicability of these approaches in general, all of them may be perfectly suitable in

certain situations, but instead to use and discuss them as approaches that may potentially inform an investigation of cooperative analysis.

3.1 Yourdon: Managing the System Life Cycle

Yourdon's *Managing the System Life Cycle* (Yourdon, 1982) is an example of an approach to systems development emphasising a functional top-down decomposition. The idea is that a system can be regarded as an overall function that can be successively decomposed into sub-functions until the level of system-provided functions is reached.

The early activities (three out of nine) survey, analysis, and design and their corresponding entities, users, operations, and management of the structured project life cycle are depicted in Figure 3.1.

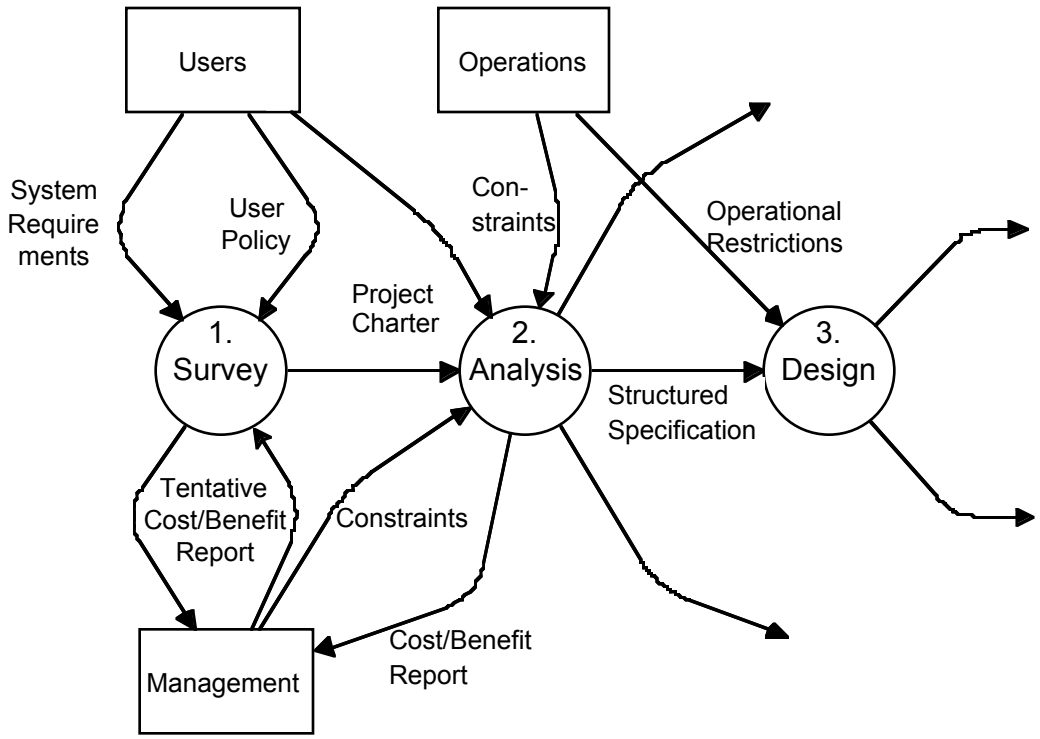

Figure 3.1: Parts of Yourdon's structured project life cycle (Yourdon, 1982).p. 43

The arrows indicate which activities informs which:

> It's important that you view [Figure 3.1] for what it is: a *data flow diagram*. It is *not* a flowchart: there is no implication that all of Activity N must finish before Activity N+1 commences. (Yourdon, 1982) p. 46.

Users denote three different types of users: the strategic user is one concerned about long term profitability of the new system and often head of an operational division; the tactical user supervises the day to day operation of a piece of the business; and the operational user is the one actually using the system. Management is the person or group that approves the funding of the project and may be identical to, for example, the strategic user. Operation is the person or group responsible for the day to day operation of computer hardware and software and may be identical to the users, especially regarding smaller systems.

The activities are described as follows (Yourdon, 1982) p. 45:

- *Activity 1: The Survey*. This activity is also known as the feasibility study or initial business study. Typically, it begins when a user requests that one or more portions of his business be automated. The major purpose of the survey activity is to identify current deficiencies in the user's environment; to establish new goals; to determine whether it is feasible to automate the business, and if so, to suggest some acceptable scenarios; and finally, to prepare a project charter that will be used to guide the remainder of the project.
- *Activity 2: Analysis*. The primary purpose of the analysis activity is to transform its two major inputs - user policy and project charter - into a structured specification. This involves modeling the user's present environment with data flow diagrams and the other tools described briefly in Chapter 2. Using this physical model as a basis, the user's *new* environment is modeled in logical terms.

The tools referred to are data flow diagrams, data dictionaries, data structure diagrams, and structured English. The design activity is mainly concerned with identifying modules and the interfaces between them.

3.2 Jackson: System Development

Jackson's JSD (Jackson, 1983a) is an example on a method that challenges the strategy of functional decomposition. At first the strategy in JSD is to model (selected aspects of) the real world, secondly to specify the functions the system should provide. The basic argument is that the model is more stable over time than the functional requirements. Regarding the idea of

modelling, JSD can be viewed as one of the first widely known object-oriented approaches to systems development, although the strategy of modelling entities (objects) from the real world is more directed towards the possibilities in parallel computing (one process per entity, described in a procedural language) than towards object-orientation as such (e.g. no inheritance).

The activities or steps regarding analysis and design in Jackson's system development procedure are shown in Figure 3.2. The procedure is described in the 'language' that Jackson proposes for analysis and design. The top level box is an entity and the bottom level boxes are actions performed or suffered by this entity. The boxes in between are abstractions grouping chunks of actions. The means to express how the actions are performed are:

- Sequentiality which is expressed as in the figure where, for example, the chunk 'describe reality abstractly' is performed by the two actions 'entity action step' and 'entity structure step' in sequence, and the chunk 'develop specification' is done by performing in sequence the five actions at the bottom.
- Option which corresponds to an if-statement in programming languages and which is expressed by placing a small circle in the upper right corner of the optional actions. A circle in the upper right corner of 'entity action step' and 'entity structure step' would mean that 'describe reality abstractly' should be performed by either 'entity action step' or 'entity structure step'.
- Iteration which corresponds to a while-statement in programming languages and which is expressed by an asterisk in the action to be repeated. An asterisk in the upper right corner of 'initial model step' would mean that 'define realized model' should be realised through a number of 'initial model steps'.

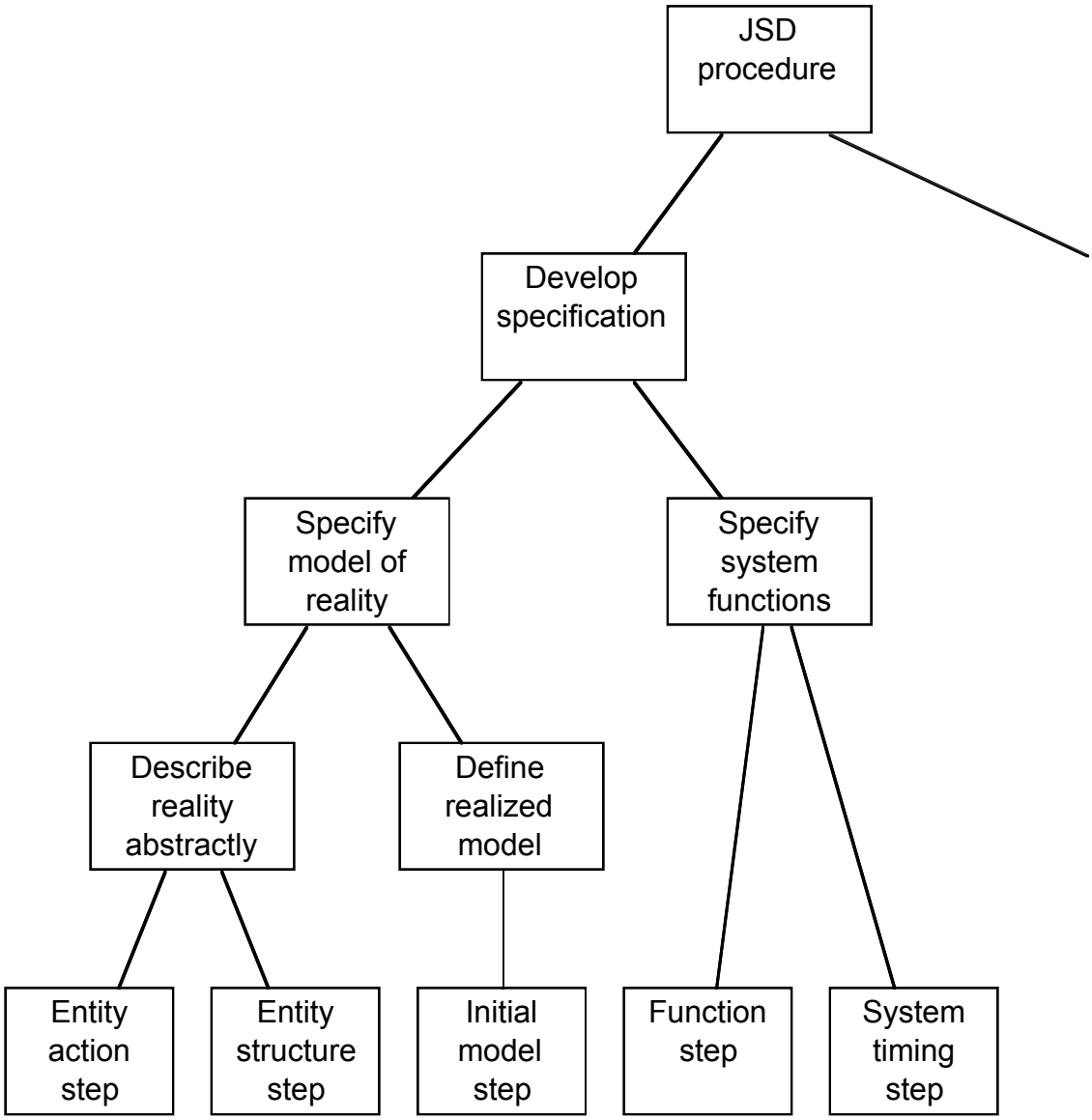

Figure 3.2: The parts of JSD development procedure concerning analysis and design. (Jackson, 1983a) p. 39.

The entity action step consists of a selection of entities (objects) and the actions they perform or suffer. The given criteria for selecting an entity are:

- It must perform of suffer actions in a significant time ordering.
- It must exist in the real world outside the system.
- It must be capable of being regarded as an individual.
- It must be relevant for the system under consideration, i.e. not Outside Model Boundary.

The entities within the model boundary are these entities that the system somehow must provide information about.

The criteria for the actions are:

- It must be regarded as taking place in a point in time rather than extending over a period of time.
- It must take place in the real world.
- It must be regarded as atomic, i.e. it cannot be decomposed.

Examples of entities relevant for an accounting system to a bank could be customer and account, respectively performing and suffering the actions invest, pay-in, withdraw, and terminate.

In the entity structure step the ordering of the actions belonging to the entities is accomplished by means of the expressions mentioned above: sequence, option, and iteration. The result is a diagram, like the one above, for each entity.

The subsequent steps concern the more design oriented parts. In the initial model step one specifies relations between each entity and its 'real world' counterpart and between the entities in the model. The function step is concerned with specifying the outputs the system should deliver, and in the system timing issues relating to time lacks are considered, i.e. the amount of time different parts of the model are allowed to lag behind the real world.

3.3 Coad & Yourdon: Object-Oriented Analysis

Coad & Yourdon's OOA (Coad & Yourdon, 1991) is an example of an approach explicitly trying to incorporate in analysis the advances within object-oriented programming and design. Like in JSD, the focus is on modelling selected aspects of the real world. In contrast to JSD the focus is on object-orientation (hierarchies of classes) instead of possibilities provided by parallel computing.

Coad & Yourdon define analysis as follows:

> To us, analysis is the study of a problem domain, leading to a specification of externally observable behavior; a complete, consistent, and feasible statement of what is needed; a coverage of both functional and quantified operational characteristics (e.g., reliability, availability, performance).
>
> Analysis means the process of extracting the "needs" of a system - *what* the system must do to satisfy the client, not *how* the system will be implemented. (Coad & Yourdon, 1991) p. 18f.

The overall approach to OOA consist of five major activities (not steps, they may be accomplished in parallel):

Finding Class-&-Objects. Finding classes and objects corresponds to finding entities in JSD described above. An object is "a person or thing to which action, thought, or feeling is directed. Anything visible or tangible; a material product or substance". Classes are groups of objects. The arguments for this activity are that it helps to gain and communicate problem domain understanding; that a model of problem domain classes and objects is more stable over time than functions; and that it may bridge the gab between analysis and design.

The proposed means for finding Class-&-Objects are: Observe first-hand; Actively listen to problem domain experts; Check previous OOA results; Read, read, read; Prototype.

Identifying Structures. The term structure expresses both generalisation-specialisation and whole-part structure. The arguments for finding structures are that it: focuses the attention on the complexity of multiple Class-&-Objects; pushes the edges of system's responsibilities; and inheritance applies. The means are a graphical notation for expressing aggregation and generalisation.

Identifying Subjects. Subjects are mechanisms to facilitate communication and avoid information overload. The basic idea is to group the Class-&-Objects and provide means for collapsing and expanding these.

Defining Attributes. The attributes to objects are some data for which each object in a class has its own value. The attributes of an account (mentioned above) could be balance, interest, owner, etc.

Defining Services. Services are specific behaviours which an object exhibits. Coad & Yourdon distinguish between three types of behaviour (Coad & Yourdon, 1991) p. 17:

> The section on human behavior was all too bewildering; however, we found a useful set of behavior categories, just a few pages later:
>
> (1) on the basis of immediate causation,
>
> (2) on similarity of evolutionary history [change over time], and
>
> (3) on the similarity of function.
>
> [Britannica, "Animal Behaviour," 1986]

Regarding the issues discussed in this thesis, the three approaches presented so far have certain similarities. Yourdon, Jackson, as well as Coad & Yourdon, presented in this section, focus on aspects of practice that are (ideally) objectively describable, and describable in terms very close to programming languages. They all conceive of change as technical change and they all conceive the current practice as given. Furthermore, analysis is seen as a purely descriptive activity in which the analysts gather information from the analysed practice.

3.4 MARS: Professional Systems Development

Another view on systems development processes can be found in the MARS project (Andersen, Kensing, Lassen, Lundin, Mathiassen, Munk-Madsen, et al., 1990; Mathiassen, 1984; Sørgaard, 1988). The MARS project investigated a number of Danish systems development projects in the early eighties. The MARS project declares 'death to standard methods' and seeks instead to provide an understanding of what is involved in systems development combined with a number of techniques to support different aspects of systems development processes.

The MARS project conceptualises systems development in terms of different components and (dialectic) relations between them. One relation is between the product-oriented components, performance, and the process-oriented components, management. The conceptualisations regarding the product-oriented components are depicted in Figure 3.3 (The other half, management, is not relevant for the discussion here). Although the main direction in systems development is conceptualised as a movement from analysis via design to realisation, the components are seen as mutually informing each other. The Figure depicts one half of the conceptualisations, i.e. the product-oriented components.

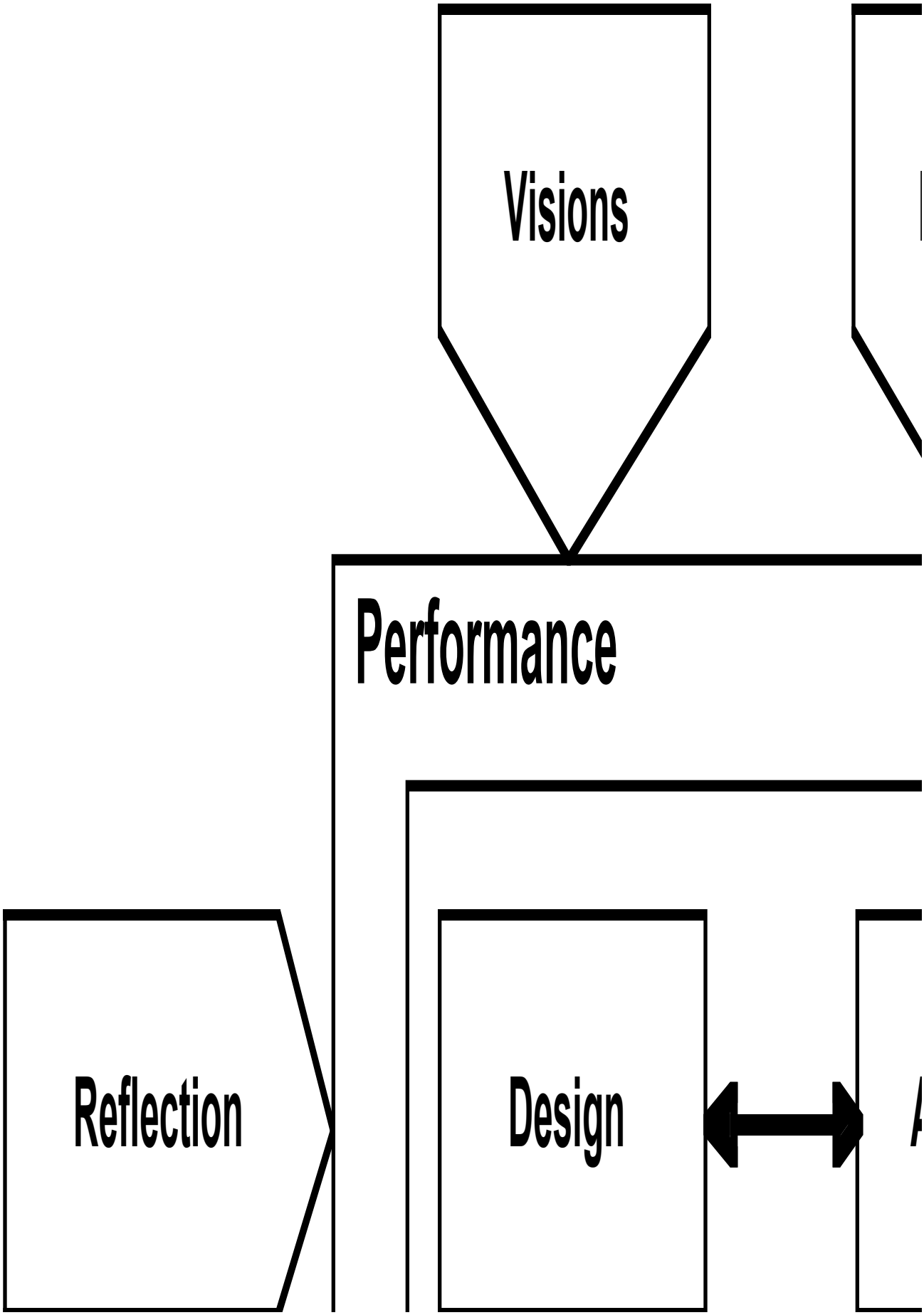
Visions
Performance
Reflection
Design

Figure 3.3: The product-oriented components of the conceptualisations from the MARS project (Andersen, et al., 1990) p. 7.

Analysis is reflective and directed towards the existing practice, technical possibilities, and design suggestions. The intended results of analysis are descriptions of the user organization, descriptions and evaluation of technical possibilities, and evaluation of design proposals (Andersen, et al., 1990) p. 49.

Analysis is mainly accomplished through (1990) p. 45:

- interviewing users on their current practice
- describing working processes,
- describing data flow,
- visiting other organizations to study similar systems,
- describing technical options,
- and evaluating design proposals.

Design is directed towards future technical and organizational possibilities. It results in overall-, functional-, and technical design (1990) p. 49. It is mainly accomplished through (1990) p. 46:

- meetings where ideas are generated,
- working out tenders,
- describing functions,
- description of module structure,
- overall description of modules,
- determining system architecture,
- and describing working processes.

Realisation is directed towards the computer system and the user organization. The result is running programs and systems and in changed work procedures, qualifications, and attitudes in the user organization (1990) p. 49. It is typically accomplished through (1990) p. 46:

- coding programs,
- integrating and testing programs,
- implementing new or modified computer systems,
- changing work organization,
- training users,
- and conversion.

Analysis is a necessary precondition for design, and visions from design are necessary in delineating the area of analysis as well as providing criteria regarding what is relevant. Analysis is achieved through reflecting on existing practice, technical possibilities, and design suggestions. Design

is conducted through reflecting on the future computer system and its functions. Analysis and design are seen as purely reflective, whereas change is accomplished through realisation. Analysis and design are necessary preconditions for realisation, and actual realisations may lead to new analyses and designs. In short, analysis means reflecting on present organization and technical possibilities, design means reflecting on future visions, and realisation means accomplishing change.

The focus regarding practice is broadened compared to the approaches presented above to include organizational issues. As in the above approaches, the focus is on descriptions (which may be accomplished by analysts in cooperation with practitioners). Change is conceived as technological changes as well as changes in the organizational context. Finally, analysis is conceived as solely reflective, i.e. the primary aim of analysis is to understand not to affect the practice being analysed.

3.5 Checkland: Systems Thinking, Systems Practice

In his book Systems Thinking, Systems Practice (Checkland, 1981), Checkland challenges the view in the more traditional approaches ('hard' system thinking) that the objective of analysis is to describe the problems in the existing organization objectively using predefined models and vocabularies. His alternative, Soft Systems Methodology, consists of seven cyclical arranged stages (see Figure 3.4).

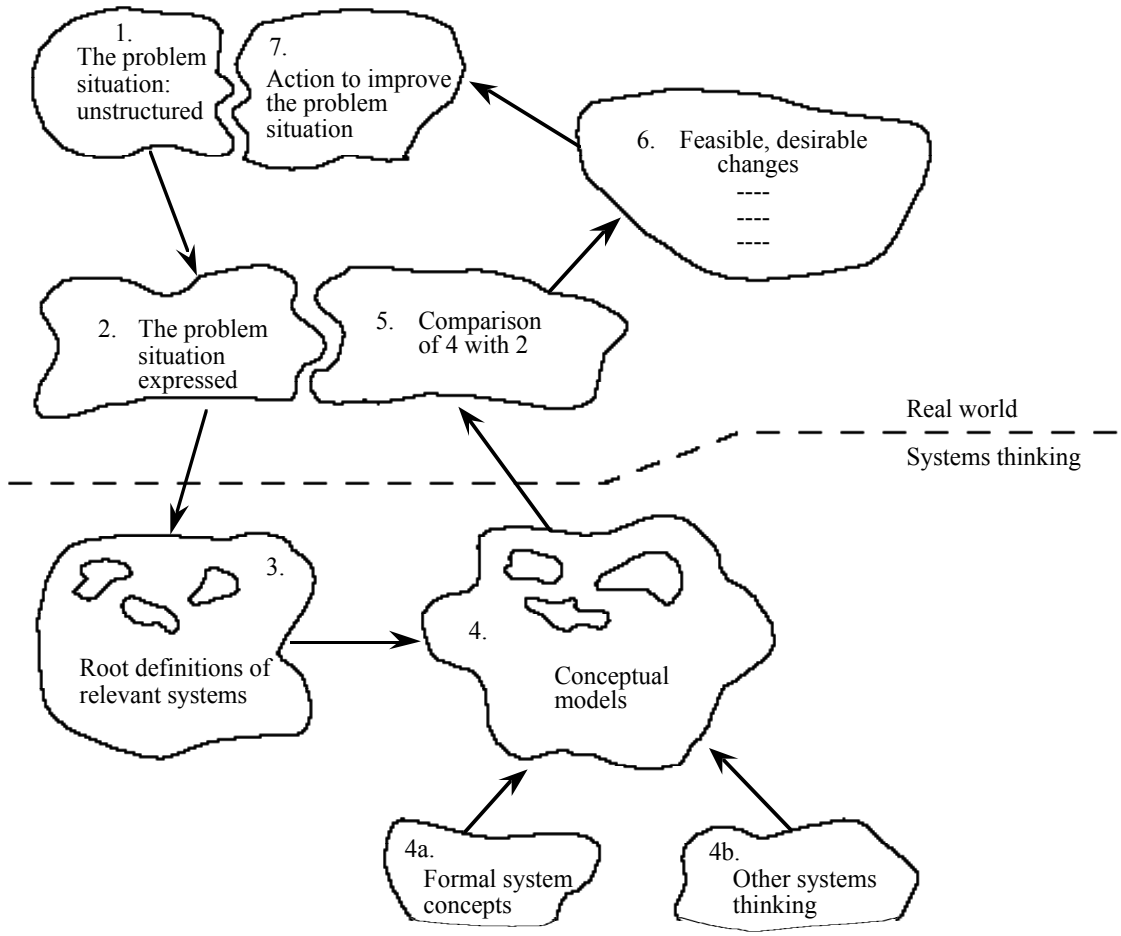

Figure 3.4: Soft Systems Methodology, after (Checkland, 1981) p.163.

SSM takes its point of departure an unstructured problematic situation (stage 1) that is being expressed (stage 2) by building up a rich picture of the situation. The importance, in these stages, is not to impose a particular structure on the situations, but to build up the richest possible picture including different interpretations of the problem situation.

> The function of stages 1 and 2 is *to display the situation so that a range of possible and, hopefully, relevant choices can be revealed*, and that is the only function of those stages. (Checkland, 1981) p.166.

In stage 3 relevant systems are chosen and defined in terms of root definitions. The elements covered in a root definition should be the CATWOE: Customers, Actors, Transformation process, Weltanschauung, Ownership, and Environmental constraints. Each root definition reflects a certain way of looking at the problem situation, a certain *Weltanschauung*. The root definitions are turned into conceptual models in stage 4. These

models are ‘ideal types’, they do not describe reality but each of the;m present one particular view on the situation.

> Root definitions (…) have the status of hypotheses concerning the eventual improvement of the problem situation by means of implemented changes which seem to both systems analyst and problem owners to be likely to be both ‘feasible and desirable’. To propose a particular definition is to assert that, in the view of the analyst, taking *this* to be a relevant system, making a conceptual model of the system, and comparing it with present realities is likely to lead to illumination of the problems and hence to their solution or alleviation. (Checkland, 1981) p. 167.

In contrast to the two first stages, stage 3 and 4 make use of a pre-given vocabulary - systems thinking. In stage 5 the conceptual models from stage 4 are compared to ‘the real world’, i.e. stage 2, with the purpose of opening up a debate about change, which is used in stage 6 to define possible changes, effectuated in stage 7 (action to improve the problem situation), which may cause new problems and a new round in the cycle.

SSM is an explicit attempt to address the more subjective aspects of the analysed practice. Furthermore, it conceives analysis (to some extent) as an intervening and not only descriptive activity. Regarding change it seems almost to take the opposite stance than the three approaches first mentioned: change is conceived almost entirely as change in peoples' conceptions.

3.6 Cultural anthropology

In recent years approaches, originating in what could be called cultural anthropology have emerged within the discipline of systems development, particularly in areas as participatory design and CSCW (Heath & Luff, 1992; Hughes, Randall, & Shapiro, 1993; Hughes, Randall, & Shapiro, 1992; Jirotka, Gilbert, & Luff, 1992; Suchman & Trigg, 1991; Wynn, 1991). Blomberg, Giacomi, Mosher, and Swenton-Wall (1993a) gives an introduction to the field of ethnography as well as preliminary ideas as to its potential relationship to design.

These approaches try to avoid the use of a priori (to the analysis) constructs in the analysis (e.g. data-flow, entities and actions, objects & classes, systems thinking, etc.). The basic argument is that in applying a

predefined framework or 'language', as in the approaches mentioned above, one will inevitably come to see the practice in this light, which in turn easily leads to an analysis more influenced by the pre-understanding than the actual circumstances. Hence, the attempt is to avoid utilising a priori categories and frameworks and instead focus on:

- An analysis from within, an analysis from the "member's point of view" (Blomberg, et al., 1993a), meaning among other things that the attempt is to accomplish the analysis in the terms from the practice being analysed, i.e. to use the conceptualisations from the analysed practice instead of conceptualisations derived from the outside as for example programming languages.
- Subjective accounts of what people themselves consider to be relevant and important aspects of their practice, instead of what might be relevant and important as seen from outside perspectives (automation, modelling, CATWOE, etc.).
- Specifics in the practice. The focus on detailed analysis of specifics in the daily practice serves (at least) two purposes: it tries to enable an analysis of what 'actually' happens (regularities as well as what happen in cases of mistakes or emergencies) in contrast to what, according to someone, should happen, as well as it serves constructing the analysis as an interplay between emerging general observations and the specific circumstances.

Suchman & Trigg (1991) p. 75 explain their approach as follows:

> Informed by these perspectives, our work makes use of two related methods for research: ethnography and interaction analysis. Ethnography, the traditional method of social and cultural anthropology, involves the careful study of activities and relations between them in a complex setting. Such studies require extended participant observation of the internal life of a setting, in order to understand what participants themselves take to be relevant aspects of their activity. Importantly, this may include things that are so familiar to them as to be unremarkable (and therefore missing from their accounts of how they work), although being evident in what they can actually be seen to do.

In contrast to the five approaches presented above the focus is primarily (Suchman & Trigg is partly an exception) on understanding and describing

what is, the purpose is not, at least explicitly, to change the practice in question.

The primary strategy is involvement or participation, as an observer, by the analyst into the practice being analysed: participatory observation, being a fly on the wall, video recording, etc.

The relationship between design and these approaches to analysis, naturally, varies. Hughes, Randall, and Shapiro (1993) see their role as a bridge between the users and the designers, 'proxies' as Kyng (forthcoming) characterises this role. Heath & Luff (1992) can be seen as an example of an ethnographic study of existing technology (which can serve as 'evaluation' of designs). Blomberg (Blomberg, Suchman, & Trigg, 1993b) argues for ethnographic work as an embedded component in design - a cycling between field studies of work, design, and user experience with new technologies. Wynn (1991) sees the role of ethnography more as one of influencing the way designers *are* than what they should *do* in the specific circumstances (e.g. by showing the richness of practice through ethnographic studies).

The cultural anthropological approaches have understanding of the analysed practice as their primary objectives (in contrast to the first three that have design as the primary objective of analysis). In contrast to all the above mentioned approaches change is not a key issue. The focus is on describing what is, and is primarily seen as passive with respect to the analysed practice.

3.7 Issues for cooperative analysis

As stated, the purpose in this thesis is to investigate what could be an analysis counterpart to cooperative design. From this perspective that the aim of cooperative analysis is to inform (and be informed by) a cooperative design process, at least three issues become important:

- what is analysed: *practices*. Cooperative design emphasises the close relationship between practice and the designed artifacts. Cooperative analysis should therefore include an analysis of the given practices, i.e. how work is actually accomplished and how artifacts are actually used;
- objectives of analysis: *change*. The overall objective of a cooperative analysis and design process is the accomplishment of changes in the designed artifacts and/or the given practice. In consequence, a cooperative analysis has to include an analysis for change, i.e. an analysis of constraints and potentials for change within the given practice;
- how analysis is accomplished: *intervention*. As stated in the introduction, cooperative design emphasises a cooperative design process, i.e. a process in which the considered changes are evaluated and (re)designed cooperatively in the given practice. In consequence, it is suggested that cooperative analysis should also be accomplished via cooperation and intervention, both because it supports a cooperative design process and because it may enhance the analysis as such.

Below, I will discuss these issues in relation to the six approaches presented above.

Analysis of practices

The analyses in Yourdon, Jackson, and Coad & Yourdon all focus on supporting the implementation of the systems in the respective programming languages. They focus less on understanding how work is actually accomplished. They all take it for granted that the analysis should support a subsequent design and implementation process. This pre-understanding leads largely to a view of practice as seen from the

computer and its capabilities, and practice is largely understood in a language close to programming languages.[6]

Yourdon suggests data flow diagrams, data dictionaries, data structure diagrams, and structured English. Jackson proposes, as means for expressing the relationship between actions, a language capable of expressing sequentiality, option (if-statement), and iteration (while-statement) - the three basic constructs in any procedural programming language. Coad & Yourdon uses a language taken from object-oriented programming, where the fundamental constructs include classes and objects (instances) and the means of expressing their relationships: generalisation-specialisation (inheritance) and whole-part (aggregation, an object may consist of a number of other objects as its parts). As Coad & Yourdon formulates it:

> Object-oriented programming was first discussed in the late 1960s by those working with the SIMULA language. By the 1970s, it was an important part of the Smalltalk language developed at Xerox PARC. Meanwhile, the rest of the world bumbled along with languages like COBOL and FORTRAN, and used functional decomposition methods (...) to address problems of design and implementation. Little, if any, discussion focused on object-oriented *design*, and virtually none on object-oriented *analysis*. (Coad & Yourdon, 1991) p. 5.

The most explicit (and striking) example is probably Coad & Yourdon's proposal for describing behaviour (Coad & Yourdon, 1991) p. 17:

> The section on human behavior was all too bewildering; however, we found a useful set of behavior categories, just a few pages later:
>
> (1) on the basis of immediate causation,
>
> (2) on similarity of evolutionary history [change over time], and
>
> (3) on the similarity of function.
>
> [Britannica, "Animal Behaviour," 1986]

The approach taken in the MARS project is a more pragmatic one. It refuses, for example, to adhere to any standard methods. Instead it

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[6]Comprehensive discussions on the general approach of modelling can be found in, for

suggests to choose approaches that fit the actual situations, i.e modelling in system's terms is one option, but not the only one. Analysis is conceived as a reflective endeavour directed towards (detached) understanding and with various descriptions as the main means of bringing about and communicate understanding. The descriptions may be made by the analysts, practitioners, or both. In this respect SSM and MARS are alike, SSM also focuses on descriptive accounts made by practitioners (rich pictures), analysts (root definitions and conceptual models), or both.

The problem, as seen from the perspective of cooperative analysis, is that descriptions tend to be abstract, tend to focus more on what *should* be done than on what *is actually* done, and finally one can only describe what one is aware of, i.e. issues as tacit knowledge, taken-for-grantedness of current practice, unraised problems, etc., tend to be neglected.

In contrast, the cultural anthropological approaches focus on detailed studies of how artifacts are actually used and work actually accomplished, i.e. the issue of practice is at the very core of these approaches. Seen from the point of cooperative analysis, they provide much insight regarding, and means to investigate, practices, from which cooperative analysis may benefit.

Analysis for change

Yourdon, Jackson, and Coad & Yourdon all conceive analysis as a means to accomplish changes. The focus, however, is primarily on technical changes, development of computer systems, i.e. constraints and potentials for changes in the embedding practices are not considered.

Yourdon takes his point of departure in the "user requests that one or more portions of his business be automated", tries to "to identify current deficiencies in the user's environment" (Yourdon, 1982) p. 45, and models the user's present environment with data flow diagrams, data dictionaries, data structure diagrams, and structured English.

In Jackson's JSD, the approach is to start out with modelling the current 'real world' in terms of entities and the actions they perform or suffer. The 'real world' is regarded as given:

> In JSD the real world is regarded as given, a fixed starting point. This view reflects the exclusion from JSD of specific application knowledge; … Our concern in JSD is to ensure that the system

> correctly reflects the real world as it is, and to provide the functions requested by the user, to a specification in which the user has the determining voice. (Jackson, 1983a) p. *x*.

Coad & Yourdon take their point of departure in a "study of a problem domain, leading to a specification of externally observable behaviour; a complete, consistent, and feasible statement of what is needed" (Coad & Yourdon, 1991) p. 18, and the purpose of analysis is "the process of extracting the "needs" of a system - *what* the system must do to satisfy the client".

The analysis in the framework of the MARS project is carried out through interviews, visits to other companies, assessment of design proposals, and descriptions of work processes, data flow and technical possibilities. Although the focus primarily is on (descriptions of) current practice, possibilities for change are explicitly considered, for example, in the activities of visits to other companies and descriptions of technical possibilities. The focus, however, is clearly on external (to the practice in question) and primarily technical possibilities. The focus is not on potentials, or constraints, for change *within* current practice (internal resources, current competencies, the degree to which people are willing to change their positions, the degree to which norms are persistent or rather a matter of temporary 'fashion', etc.).

Analysis in SSM is explicitly addressing constraints and potentials for change within the analysed practice. SSM can be seen as an attempt to facilitate a negotiation process concerning organizational changes (Checkland, 1982). In stage 5, for example, Checkland explicitly considers "the system models to open up debate about change" (Checkland, 1981) p. 178. As will be discussed in the next chapter, though, the focus in SSM on debate and consensus probably limits the degree of changes actually accomplished via SSM.

The cultural anthropological approaches are primarily focused on understanding current practice as it is. Issues like constraints and potentials for change play a minor role in these approaches.

Analysis as intervention

In the three approaches first presented, the interplay between the analysed practice, analysis, and design is conceived of as a rather one-way relationship of the practice informing analysis that in turn informs design.

In Yourdon's data flow diagram, the survey gets 'input' from users and management and delivers 'output to analysis and management (cost/benefit report), and analysis gets 'input' from management, users, operation, and survey, and it delivers 'output' to, among others, design and management (cost/benefit report), but neither to users nor survey. There is no data or information flow from design to users, management, analysis or survey.

In JSD the entity action step, entity structure step, initial model step, function step, system timing step, etc. are conceived of as *steps* performed in sequence.

In OOA the conception is similar

> To us, analysis is the study of a problem domain, leading to a specification of externally observable behavior; a complete, consistent, and feasible statement of what is needed; a coverage of both functional and quantified operational characteristics (e.g., reliability, availability, performance). (Coad & Yourdon, 1991) p. 18f.

The positions are characterised rather aptly in the words of DeMarco "Analysis is the study of a problem, prior to taking some action" (1978) p. 4. In all three approaches, though, it is acknowledged that some iteration between analysis and design may be necessary or desirable, e.g. (Coad & Yourdon, 1991) p. 179.

In the MARS project, the purpose of analysis is seen as a reflective one of understanding the area of analysis, and it is carried out primarily through interviews to serve as a basis for realisation - change. It is stressed that the relationship between the reflective components (analysis and design) and the changing component (realisation) is a dialectical one. The activities through which change are accomplished, however, suggest a considerable amount of time before the realisation actually informs analysis.

The anthropological approaches share the characteristics of *observing* a given practice, in the sense that the means brought to bear (participant observing, being a 'fly on the wall', video-recording, interviewing, etc.) ideally are meant to be passive with respect to the practice analysed.

In all the above mentioned approaches, the intention is to describe current state of affairs and leave the analysed practice unchanged - in the analysis, that is. SSM is, partly, an exception to this tendency, in that it sees part of the outcome of systems thinking as actually informing the practice being analysed.

Cooperative analysis

On the one hand, the more traditional approaches to systems development take seriously that the endeavour of analysis is part of an overall process of systems development - change, but, on the other hand, they tend to neglect that what they describe are (also) human beings in their respective practices.

Through the cultural anthropological approaches one gets a thorough understanding of the practice in question, but an understanding that is difficult to 'operationalize' in design. There may be a considerable gab, for example, between a careful and detailed description of current practice and the implications for the prospective system and the changed work procedures: between descriptive statements about the present and normative statements about the future. In the case of the more traditional approaches one gets an 'operationalizable' understanding (e.g. by being expressed in languages close to programming languages), but an understanding that may be quite far from an understanding of the actual practice.

It is acknowledged that the cultural anthropological approaches are well suited to analyse existing practices, understanding the social world as it is, and how it is maintained. It is seen as necessary, though, to complement such approaches with views and techniques focusing more on the change aspects when the concern is about cooperative analysis.

When we are concerned about systems development and not, for example, a pure sociological analysis, research oriented activities, or programming an application for the mere fun of it, the ultimate criteria for success must be concerned with the quality of the changes accomplished in the systems

development process. Whether we are concerned about organizational consulting, in-house development of a specific application to a specific practice, or product development of more generic applications to the market, what ultimately counts is the effectuated changes: the proposed organizational changes, the use of the new system in the practice or the education given, the sales numbers for the product, etc.
What is argued here is that, although important, it is not enough

- to describe the existing system (computerised or not), without investigating issues like: what in the existing system must/can be kept and what can/must be removed or replaced; what are the resources and the internal EDP-department's willingness to changes, what are the current competencies and possibilities for education of prospective users.
- to know the different interpretations and perspectives on current practice, it is also necessary to find out to which degree people are willing to change their positions
- to find out that, for example, a certain unarticulated norm is effective, one also has to find out whether it is persistent or a matter of temporary 'fashion', and to which degree it can or should be changed.

In other words, the suggestion is to complement the analyses focusing on describing and understanding the practice as it is with a focus on the constraints and potentials for change within the practice.

From this perspective, both analysis and design are means to the end of accomplishing changes.

The primary purpose of analysis is thus seen as *facilitating taking action in order to bring about change*, rather than explaining how the practice is. This challenges the view which tends to underlie most of the approaches inspired by cultural anthropology.

On the other hand, taking seriously that what ultimately count are the changes accomplished in the practice in question challenges the view underlying the more design oriented approaches (e.g. Yourdon, Jackson, and Coad & Yourdon). The purpose of analysis is from this perspective not (only) to produce a requirement contract to be signed off by the customer, or a description or model of what to automate. If it is accepted that the ultimate purpose is changes in the practice, it necessarily follows that the

analysis must include obtaining a thorough understanding of that practice - considerably changing something which one does not understand often leads to quite unexpected and undesirable consequences.

Cooperative analysis, as explored in this thesis, tries to take seriously both that we are dealing with practices of human beings and that the overall purpose is to change these practices. Cooperative analysis is thus, as mentioned, conceived as *facilitating taking action in order to bring about change*. This means that the focus in cooperative analysis is on constraints and potentials for change within the given practices, i.e. the dynamics, rather than describing practices as they are.

Although there is a great similarity between *what is in focus* in the anthropological approaches and the approach taken up in this thesis, the *means* brought to bear are, thus, very different. The anthropological approaches are *observing within*, whereas the approach investigated in this thesis is more concerned with *coming from without intervening within*. It is coming from without in the sense that it takes seriously that the overall concern is a systems development process, thus bringing in the (technical) competencies of the analysts, and it is intervening taking seriously that the overall concern of a systems development process is change, i.e. an analysis of the inherent dynamics.

Thus, in the following Chapter 4 I will elaborate the two important aims in cooperative analysis of investigating *practices* with respect to *changes*. Subsequently, in Chapter 5 I will try to bring these aims together by introducing an approach of provoking (challenging) current practice by exposing it to possible changes. In contrast to the above presented approaches, partly with SSM as an exception, this means that analysis is conceived as intervening and cooperative instead of 'observing' leaving the analysed practice unchanged.

Chapter 4
Practice and change

As argued in the previous chapter practice and change are important issues when cooperative analysis is the concern. In this chapter I will elaborate on these two issues. Practice is approached through a presentation of ideas originating in the philosophies of Heidegger and Wittgenstein, respectively, in which the issue of everyday practice is a key notion. The presentation serves to point at two issues important for cooperative analysis: the meaning of artifacts and language is heavily tight to their specific usage, and the taken-for-grantedness and unarticulatedness of everyday practice.

Change is approached through a discussion from literature concerning the notion of change in SSM. This discussion is taken as point of departure both because the issue of change is important as such and because SSM, methodologically, is the one among the six presented closest to the ideas here. The discussion leads to two considerations: change in materials or change in conceptions, and the degree to which the established is or should be challenged.

4.1 Practice

The issue of practice is discussed through a presentation of thoughts regarding the use of equipment (artifacts) and language in everyday practice from the philosophies of Heidegger and Wittgenstein, respectively. The point is not to enter a debate about their respective objectives within the area of philosophy. It is a relevant and interesting discussion, but not in this context. The point is that some of their respective arguments and examples are useful for understanding issues important to cooperative analysis. Artifacts or equipment is a key issue in cooperative analysis in that the reason for analysing in the first place is assumed to considerations of new or changed computer artifacts.

Language is one of the primary means (if not the primary means) by which the practice understands itself as well as a primary means regarding interaction between an analysed practice and an analysing practice.

Equipment

In his main early work 'Being and Time' (Heidegger, 1979; Heidegger, 1988a), Heidegger attempts a new and thorough analysis of the sense of Being[7], initially claiming that all previous ontology has made an ontological leap by taking Being for granted. Consider, for example, Descartes' famous argument, 'cogito ergo sum'. In his attempt to remove any presumptions and uncertainties in his attempt to reach absolute certainty Descartes concludes that he can be certain that he thinks and therefore he exists. Here he takes 'sum' for granted; that he can be certain what it means to exist. Thus, Heidegger's question is the obvious yet obscure one of what is really meant and taken for granted with the word 'is' in everyday practice.

This fundamental question leads Heidegger to analyse the character of being not in an 'objective' world independent of us, nor in a 'subjective' world solely determined by our thoughts, but in a life world - "that '*wherein*' a factical Dasein as such can be said to 'live'."[8]

Heidegger's quest is of an ontological nature and is as such not within the scope of this thesis, but his analysis of Being and time contains many intermediate steps and central concepts that are useful in the present context.

As mentioned, Heidegger is striving to make a new analysis of the sense of Being, taking his starting point in an analysis of Dasein - us, the being that asks to what the other being is - and its relation to other beings. Here the focus is on his treatment of Dasein's relation to other entities, especially those entities we use as equipment or gear (e.g. fishing-gear) -

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[7] When writing Being (Sein) with a capital B it signifies the state of having existence, and thus distinguished from being in the sense of that which is (das Seiende).

[8] A thorough discussion of Heidegger's notion of world can be found in (Heidegger, 1988a)

‘Zeug’[9] In his analysis Heidegger shows a profound difference between equipment encountered in purposeful and involved[10] engagement and the equipment encountered in detached reflection.

The point is that in order for equipment to contribute in the work, that is, to function as (to be) equipment, it must withdraw (‘zurückzuziehen’) itself. When we use equipment in purposeful and involved engagement, what we are concerned about is not the equipment in itself, but the work to be done. The equipment is, so to speak, subordinated to an ‘in order to…’, a purpose, the equipment is *ready-to-hand*. This is not ‘by accident’, it is necessary for us in accomplishing a task using a tool to concentrate on the task and not the tool - imagine the outcome of trying to hammer a nail in a piece of wood while concentrating on the hammer. The important characteristics of equipment, when used ready-to-hand as equipment, include issues as serviceability, usability, manipulability, handiness, conductiveness, ‘contributory-ness’, fitness, etc.

When we encounter equipment detached and reflective, we cannot ‘see’ these characteristics. No matter how hard and careful we ‘look’ we cannot ‘see’ the ready-to-hand characteristics of the equipment. What we can see are the ‘outward characteristics’ like substantiality, materiality, size, side-by-side-ness, shape, etc. When encountered detached and reflective, the equipment is *present-at-hand*.

A shift from using an equipment in involved and purposeful engagement to reflecting detached upon it (for example when it somehow becomes unsuitable for my purpose by, for example, breaking) is what Winograd & Flores (1986) has termed *breakdown*.

To Heidegger the above is a step towards a characterisation of the ontological status of Being. This is not the issue here. Rather I will point at the difference between how aspects of the world are experienced depending on whether you are in engaged involvement with them, or you

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[9]Heidegger's original account can be found in (Heidegger, 1988a) ¶ 15. Accounts of the same issues used in the context of design can be found in (Ehn, 1988; Winograd & Flores, 1986). An account relating issues from Activity Theory and Being and Time to systems development can be found in (Mogensen & Thomsen, 1990).

[10]Heidegger uses the term interested, which in its original etymological sense, the Latin

perceive them in a detached manner. When an analyst, for example, interviewing a practitioner asks how she performs her job, this is an example illustrating this difference. Usually the practitioner in daily work encounters the equipment used as ready-to-hand, and what count are ready-to-hand aspects (usability, manipulability, handiness, conductiveness, fitness, etc.). Asked to reflect, detached, on the same equipment means a shift from encountering the equipment as ready-to-hand used in the work to something present-at-hand 'looked' upon detached, a breakdown, and what is seen is, in a sense, something different (the difference between a detached object 'lying there', and an equipment in active use for something). Thus the answers given tend to be in terms of the present-at-hand characteristics of size, shape, materialness, formal purpose, etc. - *what* the equipment is - instead of the ready-to-hand characteristics - *how* it is used. The problem is that what the analyst wants to be informed about are often the ready-to-hand aspects. Likewise, we may observe the practitioners, but we only see the present-at-hand aspects of the observed (shape, colour, size, etc.), we cannot see the usefulness or handiness, the ready-to-hand aspects. We may speculate about these aspects, but we cannot experience them by observing.

Dreyfus & Dreyfus (1986) use the above distinction which in their terms is a distinction between *knowing how* and *knowing what* (the knowledge or skill related to ready-to-hand and present-at-hand experiences, respectively). This distinction plays an important part in their identification of five steps in expertise from novice to expert. Their point is that the expertise, or rather lack of expertise, of the novice is characterised by detached and context-free rules, knowing what, whereas the expertise of the expert is characterised by involved and situational knowledge, knowing how. When an expert practitioner is asked to reflect upon his or her practice, for example in order to explain it to an analyst, this means a shift from involved action to detached reflection, which has consequences for the answers that the practitioner might give. Most of us are experts in keeping the balance on a bicycle, shifting gear in a stick-shift car, using a pencil to write our signature, or the like, but it is very hard to give a reflective account for it. Reflecting on how to perform these actions while doing them will most likely result in degradation in performance, and the answers we can give to the analyst asking will most likely reflect our

‘degradation’ to if not novice then at least non-expert level that we, temporarily, find ourselves on.

Language

The philosophical work of Ludwig Wittgenstein concentrated on a critique of language through a thorough analysis of the nature and limits of it. His first major work was *Tractatus Logico-philosophicus* (Wittgenstein, 1984b) in which he via symbolic logic investigated the limits of formal language and thereby separated the world of “facts” and the world of “values”, “representational” and “poetic” knowledge, and what can be directly stated and what can only be indirectly shown. The strategy chosen for this critique was a strategy of critique that could explain the nature and limits of language *from within*. It was a reaction to previous attempts (e.g. Mauthner) to form a critique of language by making theories *about* language, thus necessarily ending up in some degree of circularity. Wittgenstein’s idea was to “expound the nature and limits of language in terms of its own structure; the limits of language could be made evident and did not have to be stated explicitly.” (Janik & Toulmin, 1973) p. 182. The account of Tractatus given here is based on a reading of Tractatus (Wittgenstein, 1984b) but it also draws on the interpretations given by (Janik & Toulmin, 1973; Mcguinness, 1988).

Wittgenstein starts out with the claim that

(1)[11] The world is everything that is the case.

(1.1) The world is the totality of facts, not of things

The world is not seen as, for example, a collection of things of which the meaning can be more or less known to us (c.f. for example Kant’s separation of ‘das Ding an sich’, the thing in itself, which we cannot know, and ‘das Ding als Erscheinung’, as it appears to an observer), but a world seen as constituted by certain *arrangements* of things, facts. A fact is thus one out of a number of conceivable possibilities (the fact that I am inside the building is one out of the conceivable possibilities that I may be inside or outside). A certain fact, a certain state of affairs, is only conceivable if

[11]The numbering here and below refers to Wittgenstein’s numbering in Tractatus, and the citations are from the newer translation by Pears and McGuinness (Wittgenstein, 1974)

we can somehow grasp the potential states. This is done through picturing. Pictures ('Bilder') are models, i.e. deliberately constructed verbal representations of certain aspects. Pictures are thus logical constructs rather than sensory experiences.

Through the notion of signs (names) that corresponds to objects of thought ((Wittgenstein, 1974) § 3.2) and the pictures, Wittgenstein thus establishes a logical structure of language where propositions (statements about the world) are conceived as determining a specific place in the logical space.

And only that can be thought, expressed in language that satisfies the criteria for propositions, stating one among a number of conceivable possibilities in the world.

In this way Wittgenstein constructs language as a "model" of reality relying on at least two basic premises.

- That there exists a direct relationship between concepts (names) and objects, e.g. by ostensive demonstration (e.g. *that* is a chair, pointing at a chair is an ostensive demonstration of the concept chair).
- That a proper "move" in either the world or language corresponds to a proper "move" in the other, i.e. the logical possibilities correspond to actual possibilities and vice versa, that reality and language share the same logic.

Wittgenstein, thus, shows what (formal) language is capable of expressing and probably more important what it cannot express. This is the issue of the last part of Tractatus.

> There is no fact that makes an action or a life or the world good or bad: yet they can be seen or experienced as such. (Mcguinness, 1988) p. 312.

What language is capable of, at least as it is constructed in Tractatus, is to express facts. Issues like ethics are not issues about facts and thus cannot be expressed in language. In this way, Wittgenstein constructs a sharp borderline between the "world of facts" and the "world of values", and between what can be directly stated and what can only be indirectly shown.

(7) What we cannot speak about we must pass over in silence.

The question is what he separates from what. The Vienna Circle, for example, interpreted it as separating metaphysics from what we can speak about meaningfully, logic. Janik & Toulmin (1973) and Mcguinness (1988) both make the opposite interpretation that Wittgenstein wanted to separate logic from what really matters, ethics. Anyhow, Wittgenstein left philosophy for almost a decade in order to become a school teacher (to do what really matters?).

Almost a decade later Wittgenstein returned to (professional) philosophy. His main objectives were still a critique of the nature and limits of language, but from an entirely different perspective. As he tells in a conversation with Waismann:

> In the *Tractatus*, I was unclear about "logical analysis" and ostensive demonstration [Erklärung]. I used to think that there was a direct link [Verbindung] between Language and Reality. (Janik & Toulmin, 1973) p. 222.

The basic assumption in Tractatus that there is a more or less directly connection between things in the world and the concepts we use about them are now called into question. The beginning of Wittgenstein's second major work *Philosophical Investigations* (Wittgenstein, 1958; Wittgenstein, 1984a) is devoted to a critique of the idea of ostensive demonstrations or rather ostensive demonstration used as definitions, showing that although such a language, consisting mainly of nouns, could be a meaningful language, it would be extremely limited and not capturing what we usually conceive as language. The question is now:

> By what procedures do men *establish* the rule-governed links they do between language, on the one hand, and the real world, on the other? (Janik & Toulmin, 1973) p. 223.

And further:

> The expressions in our language acquire their specific *meanings* from the procedures by which we give them definite *uses* in our practical dealings with one another and with the world, not from their inner articulation alone, nor from any essentially "pictorial" character in the utterances themselves. (Janik & Toulmin, 1973) p. 223.

Thus, for the later (after the return to philosophy) Wittgenstein, the meaning of any utterance is characterised by its use in a specific context. He uses the metaphor of *language games* to bring into prominence certain aspects of our ordinary use of language.[12]

As in games we follow explicit or implicit social rules. We cannot just play the game 'our way' unless we are prepared to take the consequences of being left out. Likewise, in the use of language we have to use it in certain explicitly or implicitly given ways in order to be accepted in the given community or understood at all.

> … To obey a rule, to make a report, to give an order, to play a game of chess, are *customs* (uses, institutions).
>
> To understand a sentence means to understand a language. To understand a language means to master a technique. (Wittgenstein, 1958) Last part of § 199.
>
> And hence also 'obeying a rule' is a practice. And to *think* one is obeying a rule is not to obey a rule. Hence it is not possible to obey a rule 'privately': otherwise thinking one was obeying a rule would be the same thing as obeying it. (Wittgenstein, 1958) § 202.

We do not recognise what counts as a game by an explicit definition, but we recognise it via our previous experiences in playing. Likewise we recognise the language game used by, for example, another practice

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[12]For an account of language games in the context of design, see (Ehn, 1988). For an account of implications of the philosophy of the later Wittgenstein in areas as sociology,

through our familiarity with other language games - the different language games have a *family resemblance*.[13]

Although language games do not have one thing in common, they are not "arbitrary". Our language is rooted in our forms of life. As Hanna Pitkin in *Wittgenstein and Justice* formulates it:

> Because they are patterns, regularities, configurations, Wittgenstein calls them forms; and because they are patterns in the fabric of human existence and activity on earth, he calls them forms of life. (Quoted from (Gier, 1981) p. 19).

Forms of life are based on the traditions, culture, religion, type of production, social organization, etc. which characterise a group of people.[14] Wittgenstein's point is that language is not some free floating phenomenon but is deeply rooted in our daily practice. To understand a language is to understand a practice, a form of life.

That language is founded in our practice (forms of life) also means that it is founded in what is closest to us - our everyday lives with all its customs, traditions, institutions, etc.

> The aspects of things that are most important for us are hidden because of their simplicity and familiarity. (One is unable to notice something—because it is always before one's eyes.) The real foundations of his enquiry do not strike man at all. Unless *that* fact has at some time struck him.—And this means: we fail to be struck by what, once seen, is most striking and most powerful. (Wittgenstein, 1958) § 129.

And further:

> What has to be accepted, the given, is—so one could say—*forms of life*. (Wittgenstein, 1958) p. 226.

In the book *On Certainty* (Wittgenstein, 1969; Wittgenstein, 1989) Wittgenstein investigates, among others, the issues of being certain of something and believe something. He shows that in ordinary language the

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[13]See, for example, (Wittgenstein, 1958) § 65-67 for a discussion of family resemblance.

[14]Actually, there is not one interpretation of forms of life. Gier (1981) p. 19 mentions four possibilities: as identical with language games, as formalised behaviour, as cultural-historically grounded, or as natural-historically grounded. It is the third interpretation

use of expressions as ‘to be certain of something’ or ‘to know something’ means that we open up for the possibility that we might be wrong. Stating that I *know* that this is the case implies that I am prepared to defend my view, in contrast to the statement that I *believe* such and such is the case. When someone says that he *knows* that this is his hand (showing his hand) or that he has spent his life on or close to the surface of the earth, in most situations this is a meaningless statement, because in most situations it is meaningless to doubt. (Of course, one could imagine situations in which it would be meaningful; he might have suffered an accident and major surgery or have been an astronaut.) The point is that every practice are grounded in such traditions of taken-for-granted beliefs that are not questioned (see, for example, (Wittgenstein, 1989) § 91ff.). These taken-for-granted beliefs, we could say, are part of a *knowing why* (c.f. the distinction from Dreyfus & Dreyfus between knowing how and knowing what). This knowing why is the rock bottom; where we end when we keep asking for reasons for something. It is not (always) by reflection that we ‘deduce’ what is good or bad, beautiful or ugly, reasonable or unreasonable, and so forth, it is rather by virtue of our participation in established practices in which we ‘take over’ (some of) the established values.[15]

In this way Wittgenstein breaks with the ideas from Tractatus in which our language consists of names with a direct correspondence to objects in the world and a common logical structure in reality and language. The meaning of utterances are found in their use, which furthermore implies that, to a large extent, it is hidden for us, taken-for-granted, because our forms of life, our practices, are something that is so fundamental to us that we seldom question it.

Articulation and use

The point of introducing some of the philosophies of Heidegger and Wittgenstein is not to suggest a Heideggerian and/or Wittgensteinian approach to analysis in systems development. Although different authors see the philosophies of Heidegger and Wittgenstein, despite all their divergences, as potentially complementing each other in a new pragmatic

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[15]Examples on these issues as well as a thorough account of learning as Legitimate

understanding (Ehn, 1988; Janik, 1989a; Rorty, 1989; Schanz, 1989), the question of whether this is a fruitful approach in philosophy or systems development in general is not important in the context of this thesis as such. What is of interest here, and what arguments from the two lines of thought are used for, is that in their respective philosophies Heidegger and Wittgenstein point to important issues for cooperative analysis.

The above presentation can help to clarify, regarding practice, some of the emphases in the approach of 'modelling'. Especially Yourdon, Jackson, and Coad & Yourdon focus on:

- the *articulated* aspects of a given practice. Their respective 'inputs' are accomplished via interviewing practitioners, reading existing documents, and observing the practice, and their respective outcomes are articulations (descriptions) of chosen aspects of the existing practice in their respective terms (data flow, entities and actions, and classes and objects). None of them refers to or tries to cope with unarticulated or unarticulable issues like, for example, knowledge acquired through experience or familiarity or reified concepts and understandings.
- a '*world of facts*' and de-emphasises a 'world of values'. All of them concentrate on 'objective' descriptions of current state of affairs (data that flows and entities with relations, entities with actions in pre-specified sequences, and classes & objects with structure and externally observable behaviour). None of them addresses questions of, or means to find out in the specific circumstances, whether the existing state of affairs is a desirable one, for whom, and according to what values.
- the given practice looked *detached* upon as present-at-hand entities. All of them describe *what* the respective data, processes, entities, actions, objects, classes, etc. are. There is much less emphasis on *how* these are used or performed.
- words standing for something, *modelling*. The focus in all the approaches is on those aspects and areas of practice where it is meaningful to conceive of words and real entities as standing in a one-to-one relationship (all of them emphasises the importance of the close, one-to-one, relationship between real world entities and concepts in the descriptions, the models). Aspects that are not so easily modelled, issues that we know not by 'definition' but by

experience or familiarity, for example issues as product quality, work culture, quality of work, how to handle exceptions, etc., are almost entirely absent in these approaches to analysis.

None of these focuses are irrelevant. In analysis it is often fruitful to address articulated aspects, facts, present at hand entities, and models. The point is that this is not the whole story. We also have to address the non-articulated issues, values, ready-to-hand aspects of artifacts, and issues not suited for modelling. Historically, in systems development literature the first set of issues has been subject to most attention. The focus in this thesis is how to approach the latter set of issues. The point in focusing on these issues is, thus, not that any 'proper' analysis should focus on, for example, unarticulated aspects of practice, but that a 'proper' analysis should *also* focus on the unarticulated aspects.

Taking that cooperative analysis should address these issues as a starting point, I will elaborate some of the topics originating from the presentation of Heidegger and Wittgenstein in order to find out how to address them. I will concentrate on two topics:

- the meanings of artifacts and language are heavily influenced by their respective uses,
- to a large extent, our uses of artifacts and language are taken-for-granted in our everyday practices.

Below, I will elaborate these issues as well as identify some of the implications for cooperative analysis.

Meaning as use

A key point in the presentation above, according to both Heidegger and Wittgenstein, is that we understand and attribute meaning to artifacts and language according to their respective usages. Heidegger stresses that in order to understand an artifact we have to understand its actual uses for specific aims (the 'in order to …'), we do not understand it primarily through its 'outwards' characteristics. Wittgenstein points to the same issue regarding language. If I utter the word water it may have different meanings depending on the specific situations and practices in which I and the one I am addressing are situated. It may be an attempt at ostensively explaining the word to a non-English speaking person (I point at water while uttering the word); it may be an attempt to show that I know the

word (e.g. in an English class); it may mean (almost) anything cold and drinkable (on a hot summer day); it may be an expression of disgust, meaning non-alcoholic (sitting in a bar expecting to get gin); it may express my need for anything fluid and not inflammable (in a situation of fire), and many more.

The point is that in analysis, when we enter a practice and try to understand its artifacts and language, we often find ourselves in situations like the above concerning water. We know the artifacts or words from our own practices, but their meanings seem to be different because they are used in another practice for different purposes.

At the point in the AT project when we made the first prototypes, we wanted to include the concept of a 'case'. Everybody seemed to use this word and it was known to us from own experiences and previous projects. We thought we knew its meaning but wanted to check our understanding. It turned out, though, that it had many meanings depending on who used it and in what situations. To management a 'case' was a task to be assigned to an inspector for handling, and it was identified as essentially one sheet of paper. A case was 'opened' when management assigned the task and completed when a decision had been made. To the inspectors, a case was a problem on a workplace which could involve a number of documents from previous visits to the same company, regulations, law, technical handbooks, etc. To them the 'opening' of a 'case' coincided more or less with the understanding of management, but for them it was not 'closed' before the problem had been solved. For the administrative staff a 'case' was connected to the archiving and retrieving of documents to and from the central archive. A 'case' was 'opened' when documents were retrieved and 'closed' when they came back.

The point is that when we, as analysts, enter new practices trying to understand some of the current artifacts and concepts we (also) have to address their specific usages.

Taken-for-grantedness

Both Heidegger and Wittgenstein point to the issue that in our everyday engagement in the world we take a lot of issues for granted, although the character of taken-for-grantedness in their respective notions is not entirely the same. Heidegger talks about the taken-for-grantedness resulting from knowledge or experience acquired through repetitive use of

equipment. This sort of knowledge or experience is very hard, if not impossible, to describe precisely. Wittgenstein talks about taken-for-grantedness in at least two senses. One is that we, in our respective practice, take something as given in that we employ certain categories about the world, which we in the course of time come to reify as “natural”, “universal”, and “unquestionable”. These issues are, at least in principle, describable if we take the effort. The other sense is the one of taken-for-grantedness of issues experienced through acquaintance or familiarity, for example the sound of a clarinet (I do know how it sounds, but cannot describe it) or beliefs founding the “bottom rock” of our language games and practices (many of these are taken over from the culture without, by the individual, having been an object for reflection). This sort of taken-for-grantedness is impossible to describe precisely.[16] We can thus distinguish between issues in a given practice that are articulated, unarticulated (but in principle articulable), and unarticulable. To avoid confusion, in the following when I use the term 'non-articulated' I do not distinguish between 'unarticulated' (but in principle articulable) and 'unarticulable'.

In our everyday practices it is usually not a problem that we do not articulate everything for ourselves or others. Rather, in everyday practice it is a necessity that we do not have to draw attention to all the details in our use of artifacts or all the questions concerning why we do the things we do. However, when the purpose is analysis, we have to address some of these issues. The question is how we 'ask' and what 'answers' we get.

Implications for cooperative analysis

> If a lion could talk, we could not understand him. (Wittgenstein, 1958) p. 223.

If a lion, somehow, was taught the words of the English language it would not help much. Because the meaning of the words is so closely tight to our use of them, i.e. our respective practices, we would still not be able to

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[16]For an elaboration of this distinction see Allan Janik (1989b), who distinguishes between unarticulated knowledge (such as issues kept secret for political or economic reasons, things we just never have got around to articulate, absolute presuppositions relative to the given practice) and unarticulable knowledge (such as knowledge by

understand the lion because the practice of a lion is so far from our practices. Wittgenstein's point is, of course, not just to state this observation, but rather to point to the problem that all of us are engaged in different practices and, thus, although we may use the same words the meanings are different.

Heidegger tells us (in the interpretation of Dreyfus & Dreyfus) that if we ask about the competencies of the practitioners, all we get will be the articulation of the knowing what of a 'degraded' competence. Wittgenstein tells us that, to a large extent, we (i.e. also practitioners) take a lot of the fundamental questions in our practices for granted and, furthermore, to the extent that we try to communicate through language, we are not able to understand one another because we are engaged in different practices.

Although the above is pushed a bit to the extremes and although the difference between the practices of practitioners and analysts is not as severe as in the case of the lion, the differences between practices are usually severe enough to represent problems regarding understanding one another in analysis. Taking as a given that we cannot fully understand one another we can pose two questions:

- Does it matter? And if so
- Are there other ways than through language or observation to approach actual use and taken-for-grantedness?

Naturally, in posing a second question dependent on the first, I am not going to argue for a no to the first question. Lack of understanding between the analysed and the analysing practice does represent a problem. On the other hand, I am not sure that one should argue for an unconditional yes, either. There are two reasons for this.

The first reason concerns the aim of analysis. In all the approaches, apart from SSM, presented in the previous chapter there is an underlying assumption that one of the primary purposes (for several and different reasons) of analysis is to 'extract' an (reflective) understanding from the analysed practice to the analysts. Naturally, in these cases lack of understanding is a problem. But is it necessary for the analysts to 'extract' an understanding of the analysed practice? If it is assumed that it is the analysts who, based on the analysis, make decisions about future changes, the answer must be yes. But does it have to be the analysts who make decisions about future changes? Not necessarily. If, as assumed in this

thesis, we are concerned with a cooperative development process the traditional role of analysis as something in between the analysed practice and the designers become obsolete. In this case it is more important for analysis to point at problematic areas in current practice, point to hitherto taken-for-granted issues, and to challenge the existing state of affairs. This way analysis may facilitate a learning process for the analysts as well as the practitioners, and thus support taking action to bring about change in that it becomes a counter player to cooperative design.

The second reason is dependent on the previous one. When the focus is turned towards problem raising and calling forth of the hitherto taken for granted, instead of describing what is, it may be a problem to obtain too much of a mutual understanding in that mutual understanding also implies mutual blindness, a mutual taken-for-grantedness.

In the next chapter I introduce the notion of 'provocation through concrete experience', which is proposed as a means to investigate (and challenge) actual use and taken-for-grantedness in current practices, i.e it is my answer to the second question posed above. Provocation is an explicit attempt to 'make a virtue out of necessity' concerning lack of mutual understanding, and it is an attempt to call forth some of the taken-for-granted aspects of current practice as well as challenge it.

The approach of provocation through concrete experience, though, relies on a fundamental assumption: that we are concerned about changing, and not only understanding, the practice in question.

4.2 Change

In this section I address the issue of change in cooperative systems development. The discussion is concentrated around two topics.

The first topic is that what we are concerned with in systems development is basically to change practices - the change of organizational structures, computer systems, competencies, work procedures, etc. If change was not an issue, there would most likely be no systems development process nor analysts; change is to a large degree the 'raison d'être' for systems development, and thus for an analysts.

The other topic I want to discuss is the issue that we are not the only change agents. Every practice is constantly undergoing changes and some of these are rather profound. As a consequence, building computer systems upon existing structures may be a construction on shaky ground.

To change practices

Below, the focus is on the issue of systems development as changing practices. It is approached through a critique of SSM brought forward via a discussion involving Checkland, Jackson, and Mingers.[17] The primary point, though, is not a critique of SSM as such. The critique of SSM also points to weaknesses in the perspectives presented above if we just bring them to systems development as they are.

Checkland explicitly sees SSM as a methodology to facilitate change. In a debate between Checkland, M. C. Jackson, and Mingers this view has been challenged (Checkland, 1982; Jackson, 1982; Jackson, 1983b; Mingers, 1984). The dispute is not about whether SSM can facilitate change in, for example, the sense that it can produce and introduce computer systems and thereby changes in a practice, the dispute is about whether SSM can facilitate more radical changes, for example, in challenging fundamental societal or organizational structures.

Jackson's critique is centered around stage 5 and 6 in SSM - the discussion stages. He argues that these stages facilitate a process in which the status quo is merely reproduced rather then challenged. The reasons are the emphasis on reaching common agreement, and lack of means to neither facilitate an 'unconstrained debate' nor challenge the traditions or 'common structurings', Weltanschauungen as Checkland expresses it.

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[17]The dispute took its point of departure in a discussion regarding whether SSM belong to the interpretive paradigm in Burrel and Morgan's characterisation of sociological paradigms (1979) along the two dimensions subjectivism-objectivism and radical change vs. regulation. With a modification of these dimensions to subjectivism-objectivism and order-conflict (Hirshheim & Klein, 1989) have characterised different approaches to

> … rather than challenge those structures which are historically based, the methodology prefers to deal in changes which are feasible given the existing social situation. (Jackson, 1982) p. 26.

Checkland's reply (1982) concentrates on that SSM facilitates a negotiation process between the involved actors, and that it might result in regulation or radical change depending on the actual circumstance. Hence, SSM could in principle be regulative or radical.

Mingers takes up this discussion in (Mingers, 1984). He finds that the main problem in SSM, regarding change, is that Checkland takes a position which is both individualist and idealist. The problems he sees in this are that meaning is not individually subjective but inter-subjective; the world consists primarily of actions, not ideas; these will be constrained and enabled by structures outside the individual; and people's differing interpretations are not equally valid.

Although the above discussion concerns SSM it can inform the issues of change in cooperative analysis as well. Neither the presented notions inspired by Heidegger nor those by Wittgenstein are the best concepts to address issues as, for example, constraining or enabling structures outside the individual.

As I read the above discussion we may extract three central topics:

- Whether change is a matter of changing conceptions (in the head of people) or it is a matter of changing more objective structures outside the individual.
- The normative (political) question of what kind of changes should be made. How radical are we and what are the alternatives to the existing.
- The methodological question of whether the existing social structures are taken as given and merely reproduced or whether they are challenged.

Below these three topics are addressed.

Changing conceptions or structures

Jackson and Mingers claim that SSM is subjectivistic, i.e. it focuses on subjective experiences to explain the current and change is changing peoples conceptions. Without entering the debate in detail, we can note

that Checkland does not oppose to this part of the critique from Jackson, and that Checkland explicitly sees SSM as facilitating a negotiation process, i.e. facilitating changes of conceptions.

The central argument against this position is that social and material structures outside the individual constrain and/or enable the conceptions (I may think I can fly without mechanical help, but certain structures outside my mind will tell me otherwise when I try).

We see almost the opposite position regarding Yourdon, Jackson (JSD), and Coad & Yourdon. In these approaches change is almost solely changes in the (technical) structures outside the individuals. Against these positions one can argue, as in the preceding section, that this is to go to the opposite extreme neglecting that for any change to be effective it must also be a change in conceptions (there is little point in providing people with the world's most sophisticated and powerful text processing program if they conceive it and use it as an old typewriter).

The attempt in this thesis is to take both (or neither) positions into account. On the one hand, conceptions are always conceptions of something (outside the individual) and are constrained and enabled by the social practices in which the individual is engaged. On the other hand, the world, at least the one relevant for analysis, is always a world that is interpreted and understood through the conceptions in the given practices. Change is thus primarily seen as change of social practices, i.e. change of subjective conceptions *and* material and social structures as well as the dialectic interplay between them.

Conceptually, change as changes in social practices are addressed in Chapter 5 through the presentation of activity theory, which tries to explain change as an interplay between motives (conceptions) and the contradictions embedded in social practices (structures), and in Chapter 7 where I conceptualise the dialectic interplay between constraints and potentials in current practice and possible alternative practices.

Practically, the issues of changing practices are addressed through the introduced techniques in Chapter 5 and 6.

All the techniques focus on changing conceptions through concrete experiences in current practice as well as understanding and changing current practice through conceptions of alternatives.

Furthermore, all the techniques are used in close connection to cooperative design, i.e. cooperative design envisions and concretises future possibilities (by constructing prototypes, mock-ups, etc.) and cooperative analysis uses these possibilities to investigate current constraints and potentials, which cooperative design uses to envision and concretise changed future possibilities which cooperative analysis uses …

What kind of changes

Jackson's position in the above discussion is that there exist fundamental structures in the world outside the individual which are constraining (and oppressing). Jackson's interest is basically emancipatory in challenging and changing those structures, and he calls for a theory to explain those structures. It is from this perspective that Jackson argues that SSM is regulative, i.e. it merely reproduces existing structures than challenges the status quo. As mentioned, Checkland argues that what SSM provides are the means of facilitating a negotiation process and, thus, it might result in regulation or radical change depending on the actual circumstances.

As I see the above, there is in fact two discussions involved here. One is a discussion of what should be changed and in what way, the other is the discussion of a suitable approach. I agree with Checkland when he emphasises that SSM is a method for taking action in specific circumstances, not a social theory trying to explain the social world - separating means and ends. On the other hand, of course, any method, approach, or technique is more suitable used for certain ends than others and it will always rely on some basic assumptions about how the world is and how it should be changed.

Concerning cooperative analysis it is intended as a means to analyse practices in specific circumstances, it is not meant to give an explanation of the social world as such, i.e. it is meant as an approach to pose questions rather than to give answers. However, it is naturally more suitable for posing certain questions than others, it relies on certain normative assumptions, and it provides concepts and techniques to address certain problems whereas other problems are left for other concepts and techniques.

I separate the two discussions, addressing the more normative (political) questions of what should be changed in this section and the more methodological ones of how to do it in the following section.

Cooperative analysis is situated within a tradition. As mentioned in Section 1.1 it is a tradition going back to the NJMF, DEMOS, DUE, and UTOPIA projects. Although concepts, techniques, and basic assumptions have changed during the last two decades, some themes and assumptions have been central in all the projects. The strive for democracy in the work place can be seen as the central one.

It is a fundamental assumption in this thesis that although living in a democratic community democracy often stops at the factory door. Furthermore, it is a fundamental normative assumption that cooperative analysis should relate to the issue of democracy. The practitioners involved in cooperative analysis are consequently assumed to be the people actually affected by the changes. It is a fundamental norm that a goal of cooperative systems development is to support (and ideally enhance) skills and competencies. Finally, cooperative analysis is meant to support the practitioners to make decisions for themselves in the specific circumstances, it is not an approach to 'extract' knowledge from the practice to others who then make the decisions. The fundamental political concern here is thus the concern for democracy both as a result and as a characteristic of cooperative analysis itself.

This is the concern. The next question is which concepts and techniques cooperative analyse provides. The concepts from the previous section derived from Heidegger and Wittgenstein provide the opportunity to understand issues relating to skills and competencies. They are not the best 'thinking tools' when the concern is understanding structures constraining and enabling democracy. In the next chapter I present concepts from activity theory to understand some of these structures. The techniques are all concerned with challenging current practice as discussed next.

The existing as given or challenged

As argued in Section 3.7, Yourdon, Jackson (JSD), Coad & Yourdon, and partly the MARS project share the characteristic of focusing on technical changes and taking the organizational context as given (a fixed starting point as Jackson expresses it). Checkland explicitly sees SSM as an

approach also facilitating organizational change. Jackson and Mingers acknowledge this, but challenge its ability to do so. Jackson argues that SSM is fundamentally regulative, i.e. it is more concerned with describing and understanding the world as it is, rather than with challenging it in an attempt to go beyond the status quo. Mingers argues that SSM is not capable of producing radical changes because of its tendencies towards individualism and idealism.

Mathiassen & Nielsen (1989) address this problem and give a less idealistic account of SSM. They try to modify SSM in order to handle the more objective (hard) contradictions faced by systems developers in their daily work by providing SSM with more dialectics, using contradictions in the formulation of root definitions. Their motivation is:

> We agree with Checkland that SSM in principle could be regulative or radical, but we still find it relevant to consider whether SSM could be modified to further stimulate organisational actors in challenging established tradition and beliefs. (Mathiassen & Nielsen, 1989) p. 87.

The attempt in this thesis is not to modify SSM, but it shares the concern of Mathiassen and Nielsen to challenge established traditions and beliefs. As mentioned the concern is to take seriously both that we are dealing with practices and that the aim is change. When the aim is change, describing current practice as it is currently is only part of the challenge, another part is to investigate its constraints and potentials for change. These issues are hard, if not impossible, to observe. They can, however, become visible by experimenting with possible changes within the given practice by intervening and acting within current practice.

To challenge established traditions and beliefs to investigate constraints and potentials for change in current practice and to open for the new is, thus, a major issue concerning cooperative analysis.

There is another argument for embarking on an approach of challenging, though. Challenging is a suitable approach because analysis is fundamentally concerned about bringing about changes, as argued above. What will be argued below is that it is also a suitable approach because the practices which we want to change are constantly undergoing changes independent of any analysis or systems development process. Challenging seen from this perspective serves as an attempt to get an impression of which structures are relatively persistent and which are more ‘fluid’.

To change changing practices

> 97. The mythology may change back into a state of flux, the river-bed of thoughts may shift. But I distinguish between the movement of the waters on the river-bed and the shift of the bed itself; though there is not a sharp division of the one from the other.
>
> 99. And the bank of that river consists partly of hard rock, subject to no alteration or only to an imperceptible one, partly of sand, which now in one place now in another gets washed away, or deposited. (Wittgenstein, 1969)

Wittgenstein uses this river metaphor to explain issues about what we take as given. The picture is that for someone standing in the river different elements of the river-bed are more stable than others. Some of the water in the middle of the river is swift water, some of it near the banks is calm water, the sand is rather stable and the stones or rocks are very much so. Wittgenstein asks us to think in this way about the difference between issues that we take as given and issues that we need evidence for. Some issues we are quite sure about (e.g. 'the earth is round' or Wittgenstein's own - stated in the thirties - that "no one has ever been on the moon" (Wittgenstein, 1969) § 106) and these may be compared to rocks or stones at the bank of the river. Other issues may be compared to the sand in that we may be quite sure, but, for example, acknowledge that time or experience may show otherwise. Issues as current way of organizing our practice may probably be compared to smooth water, whereas others are much more temporary.

The point in using the metaphor is, of course, not only to state that we are more sure on some issues than others. The point is the changes: that the fluid may become stable and the stable may become fluid. Not many hundreds of years ago it was rock bottom knowledge that the earth was flat and less than thirty years ago Wittgenstein's own example that no one has ever been on the moon was challenged considerably. Both of these examples have the character of one rock being replaced by another one: the world is round and there has been someone on the moon. Considering religion, for example, a few hundred years ago to a large extent the religion founded the rock bottom knowledge on which our experiences in the world were measured, interpreted, and judged (consider Copernicus). Today, at least in some countries including Denmark, religion is a rather

fluid issue whereas physics, for example, has taken over much of the role of providing our rock bottom knowledge - for the time being?

To a large extent, the same point also applies to our practices. In our everyday practices some of our material means, ways of doing things, and social structures are comparable to rocks, whereas others are more properly compared to the swift water in the middle of the river. However, just as in the case of our everyday knowledge, changes between the stable and the fluid changes in practices as well.

Consider the first two years of the AT project, for example. The organization changed from a strict hierarchical organization with three managers to an organization based on one manager and four semi-autonomous groups (about ten people in each) each with a certain subset of all the companies as their object of work, to an organization based on many small groups organized according to competencies instead of objects of work.

It changed from a computer system based on a configuration with one central mini-computer and about twenty terminals to a mixed configuration with some using terminals and some using stationary PC's, to a configuration where almost all have a portable PC and a docking station.

The company policy changed from one emphasising the 'therapeutic' aspects of inspection (advising the companies) to a policy emphasising the 'policing' aspects of inspection (find the flaws in the companies, issue an request, and if necessary take them to trial), to a policy at the moment which is a mix of the two.

None of these changes, of course, can be compared to the Copernican revolution or anything the like. Still, the changes were rather profound and questioned fundamental issues as the purpose of AT as such, the organizational structures as well as some of the primary means. When we entered the project, both the managerial structure and the purpose of the organization were regarded as rather stable issues on which to build. Today, the organizational structures, hardware and software configuration, and the purposes in inspecting are much more fluid and subject to a high degree of experimentation.

It is not only AT that is subject to change during a system development project. Every company has to make its day to day decisions and every company is relying on external relationships which it cannot control

Provoking a given practice can by no means ensure that we are able to predict all those changes. It can, however, by exposing current problems and discrepancies point to issues which we certainly should avoid basing a design on, because, most likely they will change.

Chapter 5
Provoking practice[18]

In this chapter I introduce an approach of provocation through concrete experience. Provoking serves the threefold purpose of

- *calling forth* the taken-for-grantedness in current practice
- *challenging* established practices to investigate current constraints and potentials for change
- *challenging* practice to avoid basing a design on too fluid structures.

Furthermore, the provocation is accomplished by actually trying out and experience the problematic situations. It is, thus, an attempt to take seriously that we both have to understand current practice and that changing it is the overall purpose.

5.1 Tradition and transcendence

The relationship between practice and change is one instance of the more general contradiction between tradition and transcendence. Pelle Ehn, in his doctoral thesis *Work-oriented Design of Computer Artifacts* (Ehn, 1988), gives an account of some of the dimensions of this contradiction.

> One can focus on tradition or transcendence in the *artifacts* to be used. Should a word processor be designed as a traditional typewriter or as something totally new? Another dimension is *professional competence*. Should the 'old' skills of typographers be what is designed for or should 'new' knowledge replace these skills in future use? Along the same dimension is *division of labor and cooperation*. Should the new design support the traditional

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[18]Some of the ideas presented in this chapter was first published in (Mogensen, 1990;

> organization in a composing room or suggest new ways of cooperation between typographers and journalists? There is also the contradiction between tradition and transcendence in the objects or *use values* to be produced. Should the design support the traditional services a library has produced or should it support completely new services and even new clients. Tradition or transcendence, that is the question in design. (Ehn, 1988) p. 129.

One can focus on tradition *or* transcendence, but the question is always that of tradition *and* transcendence - we are always bound in our tradition to some degree and, at the same time, have to transcend the present in order to solve our problems.

The dimensions in Ehn's elaboration of the contradiction between tradition and transcendence each concerns *what to develop*. What is in focus in this thesis is the problem of *how to find out* in the specific circumstances. In this respect the contradiction can be reformulated in more operational terms in the area of analysis: *How do we on the one hand, analyse for qualitatively new changes, and on the other hand, take current practice seriously*. This is the question addressed in this chapter.

In order to address this question, I will revisit two sources of inspiration: prototyping which can be seen as an attempt in the area of design to take practice seriously in the change efforts, and activity theory which explicitly addresses the relationship between the present and the creation of the qualitatively new, between practice and change.

5.2 Prototyping

The notion of prototyping in systems development emerged in the late 1970's (Bally, Brittan, & Wagner, 1977; Naumann & Jenkins, 1982) as a reaction against more traditional phase-oriented models (e.g. linear models, life-cycle models, waterfall models, etc.) of how to develop computer systems (Avison & Fitzgerald, 1988; Bally, et al., 1977; Boehm, 1988; Hekmatpour & Ince, 1988; Lantz, 1986). Two basic problems seem common to most of the critiques:

- The idea of successive and well defined stages with fully elaborated, and thereafter 'frozen,' documents, e.g. the requirement specification, is rather illusory. This viewpoint is taken by those emphasising the

'engineering' aspects (Lyytinen, 1987) of prototyping (Avison & Fitzgerald, 1988; Hekmatpour & Ince, 1988; Lantz, 1986).

- The strategy of detached analysis of current organization and a logical design of the new, and the accomplishment of this strategy by 'systems developers' only, are not enough to ensure system usability. This viewpoint is taken by those emphasising the participation and usability aspects of prototyping (Bødker, 1987a; Ehn, 1988; Floyd, 1987; Grønbæk, 1988), building on foundations inspired by, among others, Polanyi (1967; 1984), Winograd and Flores (1986), and the later Wittgenstein (1958).

The significance of these problems depends on the situation. The more uncertain the situation, the more severe the two problems become.[19] Therefore, the drawbacks of more traditional approaches and the need for prototyping are issues most often raised in situations characterised by a high degree of uncertainty.

The proposed solution to problems with the traditional approaches - prototyping - seems to varying degrees to be based on three characteristics (Bannon & Bødker, 1991; Boehm, 1988; Bødker, 1987b; Bødker & Grønbæk, 1989; Ehn, 1988; Floyd, 1984; Floyd, 1987; Hekmatpour & Ince, 1988; Kyng, 1988; Naumann & Jenkins, 1982; Wilson & Rosenberg, 1988):

- Prototyping is primarily directed towards *construction of the future*. In prototyping one makes prototypes, 'types' that are preliminary versions of potential computer systems.[20]
- The need for *iteration* is taken seriously and is considered a constitutive part of prototyping. Somewhat simplified, the

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[19]For a discussion on the concept of uncertainty in systems development, see (Davis, 1982; Mathiassen & Stage, 1990).

[20]Lantz: *The Prototyping Methodology* (Lantz, 1986), however, expands the notion of prototyping to encompass the whole development process, including initial activities directed towards identifying problems in the current organization. However, what he actually proposes concerning these initial activities are two purely sequential phases ('Determine Feasibility' and 'Study Present System') carried out through traditional analyses by observation and interviewing, and resulting in 'Schematic Diagrams', 'Document Description Worksheets', and 'Data Flow Diagrams'. When these two phases

prototyping process can be described as: to 'guess' at one or more potential solutions; partly implement these ideas; apply/test the resulting prototypes; and, on this basis, construct a new (and hopefully better) 'guess' - whereupon the process can start over again.

- Prospective users are enabled and encouraged to get *concrete experience* with the prospective computer system by using the various prototypes. In order to assess, for instance, the usefulness and usability of a computer application, one must use it in the given context - get 'hands on'. This implies, in principle, that one cannot assess the prospective computer system before it is finished. The prototyping approach tries to overcome this contradiction by the construction of a number of preliminary programs, thus gradually making the future more concrete.

Prototyping, naturally, has its strengths and weaknesses depending on the context: design of user interfaces, technical 'engineering,' general approach to systems development, etc. Assessments can be found in (Bødker, 1987a; Floyd, 1984; Hekmatpour & Ince, 1988; Naumann & Jenkins, 1982; Wilson & Rosenberg, 1988). Here, the interest is on its strengths and weaknesses regarding the problem of analysing for qualitatively new changes as well as taking current practice seriously.

From this perspective, the emphasis on concrete contextualized experience and on the prototype as concrete medium is definitely a strength. If learning through concrete experience is important with respect to the design of future, it must be equally important with respect to investigation of constraints and potentials within current practice. Furthermore, prototyping stresses the fruitfulness of experimentation.

Still, seen from the point of view of analysis, prototyping has some drawbacks as well:

- First of all, prototyping is *directed towards the future* (potential computer applications). It does not normally consider how the new application can be based on current practice, let alone how the new application might actually *inform* current practice. On the one hand, current practice imposes a number of constraints on potential applications. On the other hand, current practice often contains the keys to what 'guesses' could be appropriate.
- Before the process of prototyping can be initiated, the participants must have some basic overall idea of what to develop. Otherwise, it is

almost impossible to make the initial 'guesses' that constitute the start of a prototyping process.

- In the strategy of successive prototypes lies a danger of blindness ('tunnel vision' (Sol, 1984), 'model effect' (Bally, et al., 1977). Once the process of development of successive prototypes has started, the danger arises that one is led to elaborate the details of the current prototype instead of questioning its underlying premises. In the process, what was initially questioned becomes more and more taken for granted, and it becomes more and more difficult to consider radical changes.[21] To what extent this is a danger to be avoided naturally depends on whether one is on the 'right' track or not, which again underscores the importance of the initial 'guesses'.
- Prototyping provides very few concepts and techniques for understanding and handling the collective aspects: investigation of current practice and design of new practices is most often accomplished *by* a collection of people as well as *for* a collection of people.[22]

Thus, as a means in analysis to handle the issues of practice and change, the idea from prototyping of learning through concrete experience and experimentation can be used. However, issues as basing the visions in current practice, overcoming blindness, and handling the collective aspects remain.

5.3 Activity Theory

Activity theory, as interpreted by Yrjö Engeström in *Learning by Expanding* (1987) and *Learning, Working and Imagining* (Engeström, 1990b), and further elaborated with respect to systems development by

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[21]For this reason, several authors propose initial design of alternative prototypes and/or mock-ups (Floyd, 1984; Hekmatpour & Ince, 1988; Kyng, 1988), but this seldom occurs in practice (Grønbæk, 1988)

[22]Exceptions to this are Pape and Thoresen: *Development of Common Systems by Prototyping* (Pape & Thoresen, 1987) and Cooperative Prototyping (Bødker, Knudsen,

Bisgaard, Mogenen, Nørby, and Thomsen (1989a; 1989b), explicitly addresses these issues.

Engeström takes his point of departure in what he calls the *futility of learning*.

> The problem is that problem solving and structuring are essentially *reactive forms of learning*. Both presuppose a given context which presents the individual with a preset learning task. Learning is defined so as to exclude the possibility of finding or creating new contexts. However, it is *this* very aspect of human performance - or rather the lack of it - that is becoming the central source of uneasiness and trouble in various fields of societal practice.
> (Engeström, 1987) p. 2

What Engeström suggests is that practitioners (those engaged in the practice in question) should themselves be enabled to find or create new contexts. Finding or creating qualitatively new contexts is what Engeström calls expansion. This, however, introduces a problem similar to the one addressed here: How does one analyse for a qualitatively new practice *and* ensure that it is founded in the current, historically developed practice?

In dealing with this question (as well as others) Engeström develops an extensive conceptual framework based on cultural-historical theory of activity. In order to give the reader an initial grasp of this framework, some of the main points are highlighted.

Activity

In activity theory a distinction is made among different levels of human agency: operations, actions, and activity. *Operations* are unconscious and triggered by conditions: when I write my signature, for instance, I am not aware of *how* I write the individual letters. *Actions* are conscious and directed towards fulfilment of goals: I am conscious of *what* I write, e.g. my signature, and its purpose, e.g. signing a document. These are two levels of an individual's agency. The third, *activity*, refers to the question of *why* an action is performed. In order to answer that, one has to take into consideration the entire collective activity, i.e. the culturally established traditions, rules, and meanings operating in the situation, e.g. the legal

implications of writing one's signature, and that signing a document often means entering into a contract. Consider, for example, a primeval collective hunt.[23] An individual member of the group may perform the action of driving a herd of animals towards the other hunters. If the overall purpose, the 'motive', is to collect food and clothes then this action of the individual member seems meaningless, and even self-destructive (frightening away the animals instead of killing them). Only when we take into consideration the division of labour, rules, and traditions of the collective activity does this individual action become, indeed, very meaningful. Activity is collective and directed towards the fulfilment of a motive (e.g. getting food and clothes), and realised through the individual actions (e.g. frightening off the herd), which in turn are carried out through unconscious operations (e.g. clapping the hands).

Mediatedness

Any truly human action is analysed as a mediated structure. Instead of a dualistic subject-object structure, human behaviour is seen as a triad, consisting of the subject, object, and mediating instruments - tools, signs, traditions, theories, methods, techniques, etc. Consider, for example, the relation between subject and object in the case of hammering a nail into a piece of wood. Clearly, the direction from subject to object (the fulfilment of the subject's intention with the object) is mediated by the hammer. Equally important, however, is the opposite direction from object to subject: how does the subject experience the object? Issues such as the relative hardness of nail, wood, and steel (the head of the hammer) are difficult to establish without hammers or similar instruments; to the touch, wood, nails, and steel feel equally hard (assuming we are talking about fresh and hard wood). Likewise, when we broaden the scope from an individual action to a collective activity the mediated structure persists, as illustrated by Engeström's triangle depicting the structure of human activity (Figure 5.1).

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[23]This example was originally given by Leont'ev. Here it is rephrased from (Engeström,

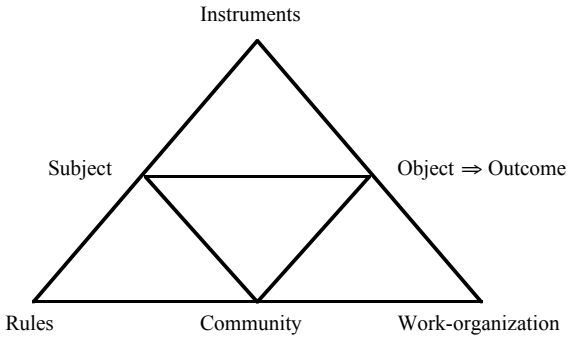

Figure 5.1: Engeström's triangle depicting the structure of human activity

The subject's relation to the community is mediated by rules, in this context a broad concept encompassing language, rituals, what is usually called rules, norms, etc. The relation between the community and the object (the work to be done) is mediated by the work organization: the community seen as a whole accomplishes the work to be done by delegating sub-tasks to individual members.

Contradictions

The basic idea is that any activity is subject to both internal and external contradictions, and that these contradictions are the primary forces behind development. In *Learning by Expanding*, contradictions are, to a great extent, treated in the context of dialectical materialism, and explained through concepts like commodity, exchange value, and use value. As a consequence, contradictions have an almost ontological status - they objectively *exist* independent of the individual subject. In short, development is conceived in the context of a dialectic resembling that of the later Hegel: Society is a dialectic totality, and development is in reaction to contradictions. But, contrary to the naive Marxian notion that we can reach a harmonious end of history, we can never overcome contradictions as such; whenever some contradictions are resolved, others arise.

The cycle of expansive development

Expansive development is proposed as a means to handle the problem of the futility of learning, and is thought of as facilitated by 'researchers'. It has been revisited with respect to systems development in (Bisgaard, et al., 1989a; Bisgaard, et al., 1989b)

The approach can be summarised as follows:

- perform historical analyses of the activity in question, and of the contradictions that prompted its development;
- elaborate current activity by exposing it to these contradictions;
- on this basis, (hopefully) get the first ideas for a new activity;
- envision an expanded activity - creating new contexts - with the help of springboards (innovative techniques);
- elaborate this vision and try it out in a microcosm;
- cope with the fact that the result is almost always unexpected, and that new contradictions arise;
- eventually start a new cycle;

Thus, development is founded in the historically developed practice, and contradictions are seen as a resource rather than something to be avoided or brushed aside.

In relation to the focus here, activity theory, also, has its strengths and weaknesses.

Taking the weaknesses first:

- The emphasis in the cycle of expansive development in the ‘analysis’ part, up to the point where a new expanded activity is envisioned, is on detached analysis by researchers. Concrete experience, which activity theory - like prototyping - generally stresses, is not utilised in these early activities.
- The potential operative means, the cycle of expansive development, is very abstract. It is a general psychological and social methodology, not a methodology for systems development.
- The framework of dialectical materialism tends to give contradictions an ontological status they do not deserve. Even to the extent that contradictions act merely as epistemological instruments, they are usually overemphasised and thus overshadow other perspectives.
- The concept of time in activity theory is in short that our past (our history) has created the present with its current contradictions in which we have to act to 'construct' a more desirable future. This notion emphasises that we are historical beings, which we are. However, it de-emphasises that our wishes and expectations to the future heavily influence how we regard our present and past (I will return to this issue in Chapter 7).

As for its strengths, activity theory does provide an instrument for understanding the connection between individuals and the practice in which they are engaged - activity. Likewise, it provides an understanding of some of the more objective structures constraining or enabling change - contradictions. Despite that activity theory tend to overemphasise contradictions (or their status) there is no doubt that contradictions may explain some of the relevant structures concerning constraints and potentials for change. Furthermore, the idea of utilising current contradictions as a resource rather than avoiding them or brushing them aside seems useful in the context here.

5.4 Provocation and concrete experience

Returning to the question posed in the introduction of how we on the one hand, analyse for qualitatively new changes, and on the other hand, take current practice seriously, the contributions from prototyping and activity

theory can be summarised. The lessons from activity theory is to analyse constraints and potentials for change by exposing problems in current practice: to provoke. Shorter Oxford English Dictionary explains the term provoke as follows

> **Provoke** … **I**. **1**. *trans*. To call forth, invoke; to summon, invite. **2**. … **3**. *trans*. To call out to a fight; to challenge, to defy.

Provoking is used here both to denote a *calling forth* of taken-for-grantedness and a *challenging* of established practice. The lessons from prototyping is to provoke by actually trying out the situations in which these problems emerge: provoking through concrete experience.

Consider a brick layer with the task of increasing the height of an existing brick wall with one meter. In order to do that he has to build upon the existing wall, and thus he has to investigate it, in order to find out which of the old stones are loose and which are solid, which can be reused and which must be removed.

Although, in general, one has to be careful in drawing an analogy between a brick wall and a practice, I think the analogy may help to clarify some of the issues involved in approaching constraints and potentials for change. In, at least, two respects there is a strong resemblance between the task of a system developer with the task of exploring constraints and potentials regarding the socially constructed structures in an organization and the brick layer. Both have to build upon the existing structures, the question is not one of tearing it all down and rebuild from scratch. Although bricks and socially constructed structures seem very different, both of them are characterised by a certain objectiveness - to an individual the socially constructed structures can be as tangible and difficult to go beyond as anything 'really' objective.

The analyst, like the brick layer, cannot investigate the issues of constraints and potentials solely by standing at the distance observing, looking in textbooks, comparing what she sees to a drawing or model, or the like. The brick layer has to go to the wall and gently knock on each stone in order to figure out which bricks are solid founded and which are not. Likewise, the analyst can observe the existing structures, experience them, compare them to theories, etc. In order to investigate their persistence or to what degree they are subject to change, however, she as well has to do a gentle knocking.

Likewise if the brick layer has the task of changing parts of the brick wall. As before, some of the preparation can be done by observing or looking at drawings. However, to investigate some issues he has to do a gentle knocking as well. He has to test whether it is possible in the old wall to remove bricks individually or they stick so tight together that removing one in effect means removing big chunks of bricks. He has to make small wholes in the old wall to investigate whether there is, for example, reinforcement or electric wires inside.

Thus, both because the analysts have the task of building on existing structures and because the aim is to change parts of the structures the analysts have to investigate constraints and potentials within the existing practice. Furthermore, some of these structures are articulated and some are non-articulated. To investigate the non-articulated issues we may provoke through concrete experience.

Taken-for-grantedness of practice

Provoking current practice serves two purposes: it serves the purpose of calling forth the otherwise non-articulated aspects of the given practice, and it serves the purpose of challenging the 'taken as given', the tradition, in that practice.

As argued via Heidegger and Wittgenstein, in Chapter 4, current practice and its problems are to a large extent taken-for-granted. Taken-for-grantedness is used to express both the invisibility or non-articulatedness of the 'knowing how' as well as the taken-as-given of established practices, 'knowing why'.

The aim in provocation through concrete experience is twofold. The one is to draw attention to (not necessarily by articulating) the otherwise not articulated or 'invisible'. The other is to challenge the existing - do a gentle knocking. From the fact that things are and have been accomplish in a certain way for years it does not necessarily follows that it should continue that way, nor does it follow that it will continue that way.

Regarding the individual handling of an artifact, an instrument in Engeström's terms, it has been argued that the artifact, *in use*, becomes 'invisible' (Heidegger, 1988a; Polanyi, 1984; Winograd & Flores, 1986). This is one of the reasons why prototyping encourages trying out the handling of the artifact in order to get concrete experience. In the

terminology of activity theory: when a subject performs an action, the focus is on the object - the what - not the handling of the mediating instrument - the operations, the how. The instrument becomes 'invisible'.

Wittgenstein points to the same issues when he says that "The aspects of things that are most important for us are hidden because of their simplicity and familiarity. (One is unable to notice something—because it is always before one's eyes.)" (Wittgenstein, 1958) § 129.

When we move from the level of individual action to the level of collective activity, we have to deal with the how (operations), the what (actions) and the *why* (activity). The reason for introducing the level of activity was exactly to be able to answer the why question; the actions of the individual 'hunter' frightening the animals seemed senseless without considering the entire activity. Why is this good (or bad), why is it done the way it is, why is it done at all, etc., all become central questions when problems in the existing practice are of concern.

In our everyday practice we usually communicate with others by focusing on the object of conversation, not the words used: We act according to the rules, norms, and values prescribing proper behaviour in the given community, we usually do not discuss or contemplate them. In the act of collaborative work, meta-questions concerning participants' roles and qualifications rarely surface. In this respect, rules, language, work-organization, and ideologies, function to a large degree as means in that they mediate between the subject and what is in focus, and thus, they become taken-for-granted. Moreover, it is only by virtue of this taken-for-grantedness that they function properly.

In our respective practices, we take issues as given in that we employ certain categories, understandings, reasons, etc. about the world, which we in the course of time come to reify as "natural", "universal", and "unquestionable". Therefore, to a large extent, *answers to the why questions are taken as given*. In everyday life, engaged in different practices, we do not constantly ask ourselves questions about why we do the things we normally do. And there are good reasons for this: we would not be able to do much else, and would probably end up in 'existential crisis'.

Bødker & Pedersen (Bødker & Pedersen, 1991), also address the question of the taken-for-grantedness of practice. They explain the phenomenon in terms of 'culture' or 'systems of meaning' and formulate it as follows:

> The workplace is seen as *being* a culture. The values and beliefs of the culture are understood to have grown out of experience, and are conceptualised as a system of meanings underlying artifacts, symbols, and work practices. Although referred to as a system, the culture is not explicit but implicit; that is, hidden behind or in the various artifacts, symbols, workroutines, and established patterns of cooperation. (Bødker & Pedersen, 1991)

Edgar H. Schein in *Organizational Culture and Leadership - A Dynamic View* (Schein, 1985) defines culture, his object of study, as the shared basic assumptions and convictions that are taken for granted because they repeatedly function in the everyday practice. Argyris & Schön in *Organizational Learning: A Theory of Action Perspective* (Argyris & Schön, 1978) emphasise the distinction between the implicit assumptions that guide an organization's actual performance, theory-in-use, and the explicit reasons, what it 'says' it does or is supposed to do, espoused theory.

In everyday practice, it is necessary that we do not have to draw attention to all the details in our handling of our different means. Likewise it is necessary not constantly to question why we do the things we do. In a situation of analysis for change, on the contrary, it is a necessity to draw attention to our everyday handling of our means as well as to question and challenge our reasons for doing so. As argued in Chapter 4, these questions cannot be addressed by observation alone (this yields the what and perhaps the how, but not the why), nor by asking only individuals, we have to 'ask' the practice.

In the following chapter I elaborate these ideas through the presentation of approaches to cooperative analysis for change based on empirical experiences as well as reflections. Before this elaboration, though, I will relate the above ideas to related approaches within cooperative design. The presentation serves, firstly, the purpose of giving the background for suggested means for accomplishing cooperative analysis, and, secondly, it serves the purpose of contextualizing the proposed approaches.

A Comparison to cooperative design techniques

Below, three approaches to cooperative design are presented: future workshop combined with metaphorical design, cooperative prototyping, and organizational games. These approaches have inspired some of the work discussed in the next chapter: experiences with organizational

games and cooperative prototyping provided the basis for 'artifacts as triggers' and the combination of future workshop and metaphorical design inspired the experimentation with dilemma games.

Based on the discussion so far, the comparison will focus on the following dimensions:

analysis ('destructing')	—	design ('constructing')
current practices	—	future practices
concrete experience	—	detached reflection
provoking	—	facilitating

Future Workshop and Metaphorical Design

Future Workshops

The future workshop is a technique originally developed for citizen groups wanting to influence town planning, environmental protection, and the like. They were originally introduced by Jungk and Müllert in *Future Workshops: How to create desirable futures* (1987), and extended for systems development by Kensing in *Generation of visions in systems development* (1987). It is a technique for finding possible solutions to common problems among a group of people. Future workshops are meetings facilitated by one or two people from the outside, and consist of three phases: Critique, Fantasy, and Implementation. The general idea is to take as point of departure a critique of the current state of affairs through a 'structured brainstorm'; turn this critique into constructive fantasy; assess the constructed visions with respect to what can be realised; and try to implement these visions.

Future workshops and provocation through concrete experience are similar in the sense that they take current problems as the point of departure and try to turn them into constructive means for further development, but the reasons for applying them are very different. The basic reason for applying Future Workshops is as a means to support resource-weak groups, whereas the reason for provocation is the taken-for-grantedness of everyday practice.

This difference in reasons, I think, leads to the two main differences between future workshops and the ideas presented here.

- Future workshops are purely intellectual/reflective and detached from the practice they are meant to change - the discussions are *about* the practice, not *in* the practice. On the contrary, the provocation proposed here is accomplished through concrete experience *in* the practice.
- The role of the 'systems developer' in Future Workshops is one of a facilitator setting the stage, ensuring that everyone is allowed to speak, etc., but not intervening at the content level. The role as a provocateur in provocation through concrete experience involves actively intervening at the content level with the aim of calling forth the otherwise non-articulated and challenge the established.

Metaphorical Design

Metaphorical Design, as presented by K. Halskov Madsen in *Breakthrough by Breakdown* (1986), is an approach aimed at getting people to talk about and reflect on their daily work in new ways by breaking down "the unreflected being of the members in an organization". The primary means to this end is the use of metaphors. The understanding of the organization in terms of other phenomena is utilised on the grounds that knowledge about these phenomena may become a potential source of inspiration in the design.

The similarities between metaphorical design and provocation through concrete experience involves the reasons for application; both try to call forth what is usually taken for granted by provoking, deliberately creating breakdowns, and the systems developer is seen by both as a provocateur. The dissimilarities involve the question of *how* to call forth:

- As with future workshops, metaphorical design is purely intellectual (reflective) and detached from the practice on which it is meant to shed new light.
- Contrary to Future Workshops, Metaphorical Design is not (explicitly) based in current problems. The metaphors seem to come almost out of nowhere. Accounts are given of how to choose metaphors, but these accounts concern characteristics of metaphors

in general, not characteristics of the specific situations the approach is meant to change.

Future Workshops and Metaphorical Design combined

Kensing & Madsen, in *Generating Visions: Future Workshops and Metaphorical Design* (1991), try to combine Future Workshops and Metaphorical Design. This combination is closer to the ideas here than the two approaches in isolation. The metaphorical design contributes the idea of the system developer as provocateur, while future workshop contributes the technique of basing the approach in current practice. Still, a major dissimilarity between the combined approach and provocation through concrete experience is the question of detached reflection versus concrete experience.

The provocateur in the combination of future workshops and metaphorical design makes use of metaphors to get participants to *understand* current practice in new ways by *thinking about* it in alternative ways. The emphasis on 'understand' and 'thinking about' comprises the main difference between the combined approach and the ideas proposed here: detached reflection versus concrete experience. By substituting 'experience' and 'doing' for 'understand' and 'thinking about,' one can see the basis for a new approach: to get participants to *experience* current practice in new ways by *doing* it in alternative ways.

Cooperative Prototyping

Cooperative Prototyping, as presented in (Bødker & Grønbæk, 1989; Bødker & Grønbæk, 1991a; Bødker & Grønbæk, 1991b; Grønbæk, 1990; Grønbæk, 1991) is a variant of prototyping where part of the design of a future computer artifact is done cooperatively by designers and prospective users. Contrary to approaches where prototype design is carried out in 'the laboratory' and later 'tested' in a prototyping session with prospective users, this approach emphasises the benefits from the interplay among prospective users and designers in the design of the prototype 'on the spot'.

The main similarity between cooperative prototyping and the ideas outlined in this thesis is the focus on concrete experience. The idea of concrete experience came after all from prototyping. A further similarity is the close interaction at the content level in cooperative prototyping. The

main dissimilarity is the focus of cooperative prototyping on the construction (design) of the future computer artifact, whereas the ideas here are more directed towards provocation of current practice.

Turning to the question of how to provoke through concrete experience, the close, open-ended interaction around the prototype in cooperative prototyping seems attractive. The focus, though, should not be on the prospective users using their knowledge about current practice to design the future computer application. Interaction around the current prototype, and the knowledge and experience gained hereby, could instead be used to call forth and elicit discrepancies in current practice. In fact, Bødker and Grønbæk, inadvertently, touched upon this possibility, reported on in (Trigg, Bødker, & Grønbæk, 1990):

> we focus on one cooperative prototyping session involving a user who did not appear to be inclined to 'play in the future'. Though the session was initially viewed as largely unsuccessful, closer inspection led to the recognition of a potentially different interaction style between users and designers around a prototype. In this case, the prototype was just as clearly a catalyst for discussion, but of a quite different form. Rather than feeling moved to drive the prototype, the user offered incidents and work procedures she saw as relevant to the part of the prototype being viewed.

Trigg, Bødker, and Grønbæk elaborate this possibility of a different interaction style between users and designers around a prototype in *Open-Ended Interaction in Cooperative Prototyping: A Video-based analysis* (1990), and suggest broadening the concept of cooperative prototyping to encompass sessions like this.

Using a prototype to call forth aspects of current practice does not so much require changes in the prototype itself, as a shift in focus from the design of the future application towards experiences in current practice. In other words, the prototype itself is left unchanged, but, the intention in using it is turned upside down. The intention is to use the prototype as a concrete medium for calling forth experiences in current practice, instead of focusing on how the prototype could be improved. In Section 6.1 I give examples on such a use of prototypes.

Organizational Games

Ehn, Mölleryd & Sjögren, inspired by the later Wittgenstein, have proposed 'Playing in reality' (Ehn, et al., 1990; Ehn & Sjögren, 1991). Here, a role-play resembling the ordinary work situation is set up with the practitioners as actors.

> The playground is a subjective but collectively negotiated interpretation of the work organization in question. The professional roles are the union of individual professional ambitions and the need for qualifications from an organizational perspective. 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. (Ehn, et al., 1990) p. 110.

As in cooperative prototyping, organizational games focus on concrete experience by simulating daily work. Furthermore, the idea of exposing a practice to breakdowns through role-playing is a kind of provocation. Moreover, organizational games bring the collective aspect more into focus. The focus, however, in this approach is on commitments and negotiation of conditions, i.e. 'construction' of the future.

The idea of an organizational game focusing on concrete experience and provocation of the collective practice seems useful in relation to the notion of provocation through concrete experience. However, it must be modified to shift the focus from commitments to the future towards provocation of the present.

Provocation through concrete experience

This chapter posed the question of how we, on the one hand, analyse for qualitatively new changes, and on the other hand, take current practice seriously. Inspiration was found from two sources: prototyping, addressing the question of how to design for usability, and activity theory, addressing the question of how to analyse for the qualitatively new *and* found it in current practice. The result was the idea of combining provocation and concrete experience. The idea was elaborated by addressing the questions of why, what, and who, leading to a notion of the *analyst as provocateur*

provoking problems in the concrete, everyday practice to call forth and challenge what is usually taken for granted.

The characteristics of this approach include:

- a focus on constraints and potentials for change within current practice, rather then describing current practice as is or designing future practices,
- an emphasis on problem-raising, rather than problem-describing or problem solving,
- provoking the taken-for-grantedness, i.e. calling forth the otherwise non-articulated and challenging the established, rather than describing it or designing for it.
- a focus on concrete experience, rather than detached observation or description,
- the role of a provocateur, rather than observer or facilitator.

From the above comparison at least three different ways to accomplish this can be seen.

The first is the approach taken in the combined future workshop and metaphorical design. As mentioned, the focus could be shifted, though, from detached reflection to concrete experiencing. Instead of the aim of participants to *understand* current practice in new ways by *thinking about* it in alternative ways, the aim could be to get participants to *experience* current practice in new ways by *doing* it in alternative ways.

A second is to use alternative artifacts such as on-the-shelf ware, prototypes, and mock-ups as vehicles for provocation. The intention is to use them as concrete media to call forth taken-for-granted issues as well as challenge current practice, instead of focusing on how they, or the use of them, could be improved. In AT experiments were carried out investigating the possibility of shifting from the current purely text based word processor to a graphical one. A new word processor was bought and tried out. 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, in current practice, of flexibility versus standardisation in the format of outgoing letters.

These instances where concrete artifacts are used to provoke current practice we might conceptualise as *provotyping*. Though the term suffers the drawback of being rather close to prototyping, it embodies the ideas well. On the one hand, provotyping resembles prototyping with respect to the need for concrete experience by working with concrete 'types'. On the other hand, the intention is not to 'guess' a possible solution ('proto'), but, as in activity theory, to *provo*ke current practice.

A third is the ideas from organizational games, but with a different focus. The approach should be modified to shift the focus from commitments to the future towards provocation of the present. The professional roles of the participants should not be preferred future roles, but those actually 'played' in current practice. Instead of focusing on 'solving' problems through commitments and negotiations, the attention should be turned towards: what goes wrong, why, and how does it relate to other parts of the practice. In organizational games the focus is on solving specific problems in a given context, in provocation through concrete experience it is the context, the practice, that is questioned. Therefore, instead of using situation cards presenting isolated problematic situations one could try to make longer coherent scenarios provoking the current context from different angles. By retaining the ordinary roles and shifting the focus from problem solving to problem elaboration or problem raising, 'playing in reality' can be used to provoke the given practice through concrete experience by means of situation cards raising problematic situations concerning the part of current practice under investigation.

The next chapter presents experiments and experiences with such approaches to cooperative analysis, focusing on analysis for change.

Chapter 6
Means for provoking practice

Below, I will introduce two means for challenging a given practice. The first is to use *artifacts to trigger discussions on current practice*. The ideas grew out of experiences in cooperative prototyping and organizational games. The investigation presented here is a detailed study of some of the *prerequisites* for an artifact to provoke current practice. The focus is, thus, not on showing a selection of examples on artifacts calling forth otherwise non-articulated issues or challenging current practice. Instead the intention is to show some of the issues involved in enabling an artifact actually to provoke current practice.

Secondly, I introduce *dilemma games*. Dilemma games resemble to some extent organizational games and metaphorical design. The focus, however, is explicitly the one of provocation outlined above. Dilemma games are an explicit attempt to get participants to *experience* current practice in new ways by *doing* it in alternative ways, and are thus intended to challenge current practice.

6.1 Artifacts as triggers[24]

This section describes experiences from the three-day Ry-seminar in the AT-project (see Chapter 2). It involved 11 participants from AT and 5 participants from Aarhus University. The goal of the seminar was to foster discussion of current and future work practices, including computer

[24]The findings presented in this section was elaborated in cooperation with Randy Trigg, and first published in (Mogensen & Trigg, 1992). The sections Appropriation, Transformation, and Confrontation from this paper is presented here with only minor

support, within the context of decentralisation directives originating at AT headquarters.

The focus in this chapter is on the possibilities to use artifacts, for example prototypes, to trigger discussions about current practice.

The term *artifact* is used to denote two different kinds of objects, prototypes and situation cards (explained in the next section). The term is chosen because it identifies two central aspects of both. Firstly, the physical nature of an artifact implies *persistence*, something concrete lasting over time. Secondly, the term artifact suggests deliberate and purposeful creation by human hands. For the artifacts discussed here, both aspects were crucial: the persistent nature of the artifacts' forms, and the appropriate, appropriable, and provocative nature of their contents.

The seminar was partly structured around an organizational game. For the purposes here, only the game's use of "situation cards" is considered. Each card contains a few sentences describing a realistic, possible, and 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. The examples here are taken from a 10 minute discussion around situation card number 8 (SC8) which reads as follows:[25]

> 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 Organizational Game was complemented by discussions conducted around cardboard mock-ups (of, for example, electronic mail) and computer-based prototypes (of, for example, registration of work). The second source of examples comes from a 20 minute session with one of the prototypes. Participating in this session were one developer and three

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[25]The text of the situation card is translated from Danish as are the quotes and transcript segments appearing later in this section. The original Danish texts are

participants from AT, an inspector, a lawyer, and a secretary. As hopefully will be shown, the parallels between these two activities are striking, especially with respect to the way each type of artifact (situation cards and prototypes) triggered discussions of practice.

The following analysis and discussion is divided into three parts. The first, appropriation, is concerned with the process of how the artifact is transformed from "something standing in the corner" with (for its designers) an *intended* use, to an artifact-that-matters with a concrete and meaningful use context. The second part, transformation, is concerned with what happens when the participants appropriate or adopt the artifact and *on their own* transform its use context. The third part, confrontation, involves clashes between the transformed context and their current practice. These usually lead to the artifact or current practice being questioned.

Appropriation

Each of the participants in the seminar came to the occasion with certain backgrounds. The people from AT primarily brought experiences from their overlapping work practices and an interest in finding alternative ways of conducting this work. The people from Aarhus University brought experiences in facilitating organizational and technological change, and an understanding of AT's work practice gained from interviews, observations, and discussions with people from AT. In addition, they brought prototypes and situation cards whose designs were based on a sense of what was problematic in AT's work practices and what might constitute reasonable alternatives.

Before the prototypes and situation cards could become artifacts-that-matter rather than isolated, largely irrelevant entities, they had to first be provided with a concrete and relevant use context.

In what follows, three aspects of this process are identified and for each examples are given from the SC8 discussion and the prototyping session:

- *seeing* what is and is not important in the artifact,
- *recognising* the artifact as potentially or imaginably relevant for one's practice, and
- coming to *"own"* the artifact.

These are not meant to occur as "phases" in some appropriation process. Rather, they are activities intertwined over time, together comprising the participants' appropriation of artifacts and their evolving use contexts.

Seeing

Given a physical artifact, how does one come to see that which is important? In the case of SC8 and the other situation cards, the participants already knew how to "see" the material. They knew, for example, that the kind of paper was irrelevant as were any coffee smudges on the back. They knew (after hearing the seminar introduction on the first day) that the text written on the card was to be read aloud and interpreted as a problematic scenario.

"Seeing" the prototype, however, required guidance for most of the meeting's participants. For the non-experienced user, the prototype first appeared as a piece of hardware having colour, shape, etc. In order to be seen as a possible instrument in everyday practice, the prototype's meaning and use needed to be brought into focus. Such guided seeing was especially evident at those points in the session where the prototype was explicitly demonstrated by the developer.

Especially important was the use-driven nature of these demonstrations. Rather than simply saying, "look at the contents of this window" or "that menu is irrelevant," the prototype was *used* according to continually evolving scenarios. In this way, the relevant parts of the artifact were made to stand out from the background. In the following example, note the way a use scenario helped developer D explicate the prototype.

(PS 1)[26]

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[26]All examples used here are taken from approximately 20 hours of videotape recorded at

D: Uhhm, and what we were thinking of was that (.) we make a list down here where for each inspection, one makes an entry like this here for each inspection one has been on (.) for example, here was a little elevator follow-up call the twenty-second in ten-ninety. So you just click on this. So then we come up to this inspection overview. (.) There, he can type in [keyboard typing] the required information.

Recognising

In order for the artifacts to be seen as artifacts-that-matter, they had to be *recognised* as potentially or imaginably relevant for the practice. The situation cards ideally identified realistic (though fictive) situations which were problematic in some way. In the case of SC8, it should have been the case that material might indeed be missing in the way described and that in such cases, the problem of finding it was both non-trivial and worth confronting. The prototype, on the other hand, had to be recognised as supporting certain AT work practices which in turn were seen as requiring machine support.

That such recognition is underway was indicated, for example, when participants felt moved to tell stories from their work. For example, during the first six minutes of discussion of SC8: a manager told the story of a case folder that was taken out of the office by an inspector who moved to a branch of AT in another city; an inspector recalled a lost case which was eventually found with the secretaries; and a secretary told of a case that sat on a lawyer's desk for six months (this in response to the lawyer's claim that cases moved quickly through his hands). Each of these examples indicated that the story-teller "recognised" the situation depicted by SC8 in his or her work. For more on narratives in prototyping sessions, see (Trigg, et al., 1991).

In the following example from the prototyping session, C realises the potential of the system to retrieve an inspector's earlier directives to a company from the computer files. Note the way that A, a practitioner,

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more than a few tenths of a second. The ellipses "..." correspond to inaudible or unclear portions of the talk. Double slashes "//" indicate overlapping talk while equal-signs "=" indicate that the subsequent utterance follows directly without a break from the current

joins system developer D in confirming that the prototype can indeed meet C's needs.

(PS 2)

C: That is, if one then, uh, knew that there had perhaps earlier been issued a directive on that which I now myself want to (…) someone has been out and appraised, right? So it would be neat if one could just call it, the directive up.

A: That would of course be // there … //

D: // You can do it //=

C: It …=

D: That's what you do.

C: That's // what one does //

D: // Because, eh, // you've of course got the list,

A: Right?

D: over all different inspections here.

In each of the above cases, recognition was *implicit* in the participants' talk. Rather than saying, "Yes, the situation on SC8 could/does happen at AT", an inspector told a story indicating her or his recognition of relevance. At other times, however, the recognition was explicit. In SC8, for example, a discussion concerning the appropriateness of the card resurfaces several times. At one point, the lawyer comments: "It's actually a dumb question. [laughter] That's because it just says where's the material, not what one should do if one can't find it". Recognition of the artifact's relevance and utility whether explicit or implicit, was a crucial feature of the appropriation that led to fruitful discussions of current and future practice.

Owning

An artifact that is considered relevant to the practice for a participant can be *appropriated* or "owned" by that participant. Appropriation was indicated, for example, when one participant "defended" the artifact (say, its relevance or utility) to another, or when the participants used the artifact for their own purposes, describing it in their own terms.

During the SC8 discussion, an inspector, after re-inspecting the text on the card, claimed, “But even if we can’t find the material, we can still investigate the accident”. As she said this, she waved the situation card and put it back in the center of the table. In this way, she called into question not the card’s relevance, but rather the degree to which its situation was problematic. The manager responded by defending the card (“It is actually reasonable enough”) with a story about a case that couldn’t be found. Amid the ensuing discussion, the inspector too admitted that the situation depicted by SC8 really was problematic.

We observed the ownership process again during the prototyping session, but in a slightly different form. In the following example, notice how A and C jointly “take over” the job of explaining the prototype’s functioning. Notice also the level of their engagement as indicated by the amount of overlapping talk. Here D drives the prototype, but provides no explanations.

(PS 3)

C: // Would that then say // [A reaches over C to point at screen] // here I’ve got myself the directive.//

A: // so here I’ve got the directive // No, so there

C: Yeah, there. And then it comes // out //

A: // And so // the directive comes

C: And then it is, you know, the whole, // who- //

A: // So // it is // directive over there //

C: // all the // text, that’s given, that is the directive … once,

Such engagement indicated that the artifact and its intended use context was being appropriated as an artifact-that-matters with respect to their work practice.

Appropriation thus involved the participants’ acceptance of the artifacts and their intended use contexts as relevant to current practice, and worth further work (some situation cards failed in this respect, and were consequently dropped). In what follows the focus is shifted toward what happens when the artifacts and their use context have been appropriated and are subsequently used in further discussions and experimentation.

Transformation

The artifacts were never appropriated exactly as is or as intended by their designers. Over time, they were transformed so as to gain new contexts of plausible use. At the seminar, two kinds of transformations were observed. First, experience with the artifact led to an extension of its context with new plausible situations. At the same time, this led to the artifact being used to (re-)ground this evolving context, transforming the artifact itself or the understanding of it.

Extending the context

At the same time the artifact and its intended use were being appropriated, an extension of the artifact's initial context took place. Situation cards, for example, started out representing isolated problematic situations. Once appropriated, the participants reformulated and transformed them with, for example: relevant concrete experiences, plausible consequences, other closely related and perhaps more appropriate situations and problems, etc. In this way, the situation card acquired new concrete contexts.

At one point in the SC8 discussion, for example, an inspector suggested that the case might be with the lawyers. In this way it would be "out of the loop" and thus lost to the inspectors for an extended period of time. For the next minute or so, SC8 was discussed *as though* the card had originally specified this legal "phase."

In the prototyping session, a similar phenomenon could be seen. Contexts were developed and transformed by the participants in ways that were not part of the demonstrator's planned scenario, but which were then incorporated and treated *as though* they were part of the prototype's original expected use. Often, this involved "holes" or missing parts of the demo which the participants used their imaginations to fill in. In the following example, however, B suggests an entirely new means for the prototype to keep track of activity on a daily basis.

(PS 4)

B: Yes, then you should make= what one perhaps needs,

C: No, but I don't think that was that, I thought it was just the number of hours=

B: what's it called, besides that, is to make a daily code, a daily list, what I've done that day=

D: // yeah //

A: [to C] // No but // that's of course what we should have, how many hours, we're out that is, we should of course know how many hours we have

B: Yeah, right? So you haven't made a weekly accounting, you have a day, then you've … visited the company some hours … altogether so much time, so much office time, so many kilometers, spent so many hours outside, right?

Their discussion continued in this way further exploring B's idea of creating a daily form. Later, when demonstrating the automatic creation of a weekly account:

(PS 5)

D: Uh but we can try something else (.) we can try to make a new one. We can for example, uh, sorry (.) That's right … We can try to make a new weekly account uh for example for week forty-three [typing]

B: I wouldn't have it for a week I'd have it for a day

D: // Right, right //

A: // yeah but it is of course // a weekly account

B: it is automatically created from that

D: yeah yeah, it's just a step along the way

Notice that the daily form is now being treated as though it is part of the prototype. Moreover, the weekly account which *is* supported by the current prototype is assumed to have been created on the basis of these new daily forms. Here we see not just an elaboration of the new use context, but a transformation of the original intended use of the prototype.

(Re-)grounding discussion

As we have seen, the appropriated artifacts gradually acquired contexts of use. At the same time, the physical, persistent nature of the artifacts helped re-ground discussions. In this way, the connection between the artifact and its imagined use situation was maintained and reiterated over time.

In the case of the situation cards, this was usually accomplished by rereading the card to see what was literally written there. In the case of SC8, the easy answer, “The material is in the company folder, of course!” led to their presumption that the company folder itself had vanished. Later, the discussion turned to the question of how much material is in fact worth saving in the folder, given that (as an inspector pointed out), the accident could be investigated using only the new directive. At this point, one of the participants retrieved the card, read it to himself, and stated, “It’s not necessarily the whole folder that’s gone.” As it turned out, this regrounding (after suggestions of various other literal readings of the card) led to a summing up and conclusion of the entire SC8 discussion.

In the prototyping session, regrounding also involved redirecting discussion to the artifact. This was sometimes accomplished by the system developer drawing the users’ attention to some part of the prototype as in the following example. Here, D argues that the prototype’s representation of driving time is a result of the way it organises information by company instead of by inspector.

(PS 6)

A: that's irrelevant for company, yeah

B: the time at the company is relevant, // but the driving time to the company is not so relevant, because it, you can't divide it up among ten different companies [pointing at screen]

D: Now, // now // look at this.

A: [to B] // No. //

D: Okay, look. [Points at screen.] What we were in here, that was the company registry, that's something, what should we say, information belonging to a company.

A: ah

D: The day thing we're talking about, that doesn't belong to companies, that belongs to you. Right?

But this grounding is just as likely to be prompted by a non-developer. In the following example, B argues for the daily form idea. When the discussion turns to the relation between B's idea and the current practice of weekly accounting, A asks what actually is on the prototype's weekly form (which shows the information currently recorded every week). This regrounding prompts D to show an example of the prototype's weekly reporting facility.

(PS 7)

B: A whole daily accounting for what // one // has done on one day.

A: // Yeah. //

D: Yes.

A: And yeah that's a part of weekly accounting.

B: Right, but uh it could be combined together at the end. // There's lots you do in a day that doesn't wind up in the weekly account. //

A: // What's in the weekly accounting is it that … [pointing at screen?] //

D: We can of course try to find one that's been created.

Confrontation

The discussion up to this point has concentrated on the appropriation of the artifact and the interplay between the artifact and its evolving use context that led to transformations of both. The evolving contextualisation of the artifact suggested a new practice - a new way of conducting work. As the contextualized artifact became more concrete for the participants through their experiences with it and their reinterpretations of it, the suggested new practice became an increasingly plausible alternative. This section considers confrontations or "clashes" between the new practice and the current one, usually resulting in questioning and challenging either the contextualized artifact (and thus the suggested new practice) or current practice. The focus is on an extended example from the prototyping session involving two clashes. The first led to a proposal for redesigning the artifact, and thus "redesigning" the suggested new practice. The second triggered discussions of current practice.

Questioning the new practice

The first clash was between system developer D's proposal for a new way of registering mileage driven and the AT workers' current practice. The example starts with D introducing the idea of registering the amount of kilometers driven from one company to another, instead of the current practice of registering kilometers driven per day. This led to a protest from B based on their current practice.

(PS 8)

D: //that's easily done because// (.) we just have to add on kilometers, you always write kilometers don't you

A: yes and time, yes, of course driving time, and then we have five hours away from home=

B: you can't do that for every single company=

A: no you haven't driven=

B: you are not allowed to go out to a single company and come straight home again, so that's no good.

After rephrasing (and to some degree agreeing to) the idea of registering kilometers per company, B began to formulate a redesign of the prototype

based on a new day-calendar "card" (see PS 4 above). Several aspects of the situation contributed to B's turn toward design:

- the prototype had been appropriated and recognised as relevant, and thus worth redesigning,
- evidence of the mismatch between prototype and practice was clearly visible on the screen,
- all were aware that this was a prototyping session, and thus that suggesting changes was fair game, and finally,
- the context of the session made it clear that the goal was understanding and supporting their work practice, not just demonstrating predesigned "solutions."

In this case the clash between the contextualized artifact and current practice was addressed by reconsidering and redesigning the contextualized artifact.

Questioning current practice

The second clash occurred when the new idea of making daily reports was related to current practice, in particular the practice of making weekly reports. In the following, B notes that daily forms could be automatically incorporated in the weekly report, but acknowledges (having seen what is *not* included in the prototype's automatic generation of the weekly report) that the daily report information must still be typed in.

(PS 9)

B: just as one should if one does it right and that is that you uh make your own daily calendar, right. It would then automatically be transferred

D: yes

B: but of course it requires that I have done it

The discussion then turns to three subtopics: the "invisibility" of office work, management's demand for accountability, and the overhead of registration work. B argues that certain forms of work (e.g. meetings) go unreported today, and that such records might someday be useful as justification to the directorate in Copenhagen. A on the other hand, expresses concern over the extra work required.

(PS 10)

B: yes yes, but when you [points at C] sit there and make these // doctors

C: //planning meetings//

B: or sorting these work related diseases that come in, these you do not write down anywhere.

A: no, now we have to be careful that it all, you know, it does not become registrations, because, uh

B: the day they demand

A: listen, it takes time to sit and do that

B: yes, but, the day they [the directorate] demand that you have to account for what you've been doing. Then you'll need it [pointing at screen].

A: //I'll go back then//

C: //…// all the letters all the stuff I'm engaged with

B: yes

A: now you've also got to take care, kids, we also have to//

B: //I agree with you on that//

A: do something, don't we?

Here, the prototype triggered a clash between A and B's different experiences and perspectives on their work practices. As a lawyer responsible for justifying decisions and practices at AT, A emphasises the usefulness of record keeping. As an inspector already burdened with "overhead" work, B underscores the implications extra reporting would have for their day-to-day workloads. In contrast to the first clash, the result here was an elaboration and reconsideration of current practice rather than the new practice suggested by the prototype.

Artifacts as means for provoking

The above analysis of about ten minutes of a prototyping session and discussions around a situation card hopefully shows some of the processes involved in the transformation of an artifact from 'a thing in the corner' to an artifact-that-matters, capable of provoking current practice. Below, I

give three examples from the seminar on situations in which the concrete experiences in using the artifacts drew attention to issues taken-for-granted or not articulated beforehand.

After the prototyping session reported above, D pursued the question about registering kilometers driven per visit - he was not entirely satisfied with “we don’t do it that way” and potential overhead as being the only arguments. The discussion afterwards disclosed that what was at stake was probably not so much a question of procedure, but probably more a question 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.

Furthermore, until this session we (the AT as well as the researchers) had taken for granted that the proper organising of materials was according to the companies being inspected. This assumption was challenged when it was noticed (see PS 6 above) that some of the material was probably more meaningfully organised according to the inspectors. We knew beforehand that historically the AT had taken over a company database from another public sector, but had never been aware that this might imply that the organising of material according to companies, historically, had more to do with technical convenience than actual needs in the AT.

In a mock-up session at the same seminar, we tried to demonstrate possibilities in using electronic communication in case handling using present procedures as starting points. It turned out, however, that to understand current practice was as much a challenge as to envision future use. Until then, case handling was unarticulated or, rather, each individual thought they new and agreed on how case handling should be and was done, and therefore it was not a topic for discussion. Through the concrete experiences with the mock-up it became evident that there were rather profound discrepancies between how it was done and how it should be done (according to management).

6.2 Dilemma game

The purpose of dilemma games is the analytical one of understanding some of the dynamics in the organization by provocation. It is accomplished by the participants acting through scenarios that expose dilemmas. It is led by one or more provocateurs who on the basis of a very

flexible script introduce scenarios and urge people to take action. The scenarios develop according to the actions chosen by the participants - actions have consequences.

This chapter elaborates a concrete instance of such a game from the AT project. The game took place within the broader context of the Ry-seminar which in turn was a response to certain problems in the AT.

The seminar was a reaction to the following situation in the AT project in the summer 1992. The change process concerning new technology (see Section 2.1) has been undertaken leading so far to the installation of PC's running Microsoft-Windows with WordPerfect for windows and VIRK as the primary applications in a local area network.

Everybody can see possibilities in the new technology, but few can find the resources to actually learn and utilise it. The understanding is more or less that buying new hardware will in itself solve current problems, leaving the current practices almost unchanged. Everybody can, in principle, see potential benefits as well as they can see that work (educational as well as concerning changed work practice) is required to get this benefit, but, only in principle. When the issues are brought up there is always a piece of hardware that we should wait for, or a piece of software to be developed that might resolve the problem. Moreover, the people from the AT feel more and more frustrated - they are always running behind the technological development (whenever they can almost handle one part of the new technology, two new have been introduced) and want to do something about it, yet they cannot find the mental nor the material resources.

In order to address some of these problems, a two day seminar between one group from the AT (8 people) and three researchers was decided upon. The purpose of the seminar was twofold. On the one hand, it was to start some of the work required in the shift from the old to the new technology, for example education in the use of network and changes in the organization of work. On the other hand, it was an explicit purpose of the seminar to bring (some of) the problems to the surface from the everyday entanglement and to bring the formulation of these down from the abstract to a more concrete and understandable level.

The seminar consisted, among others, of the following activities:

- Opening a PC, showing concretely what was meant by floppy-drives, hard disks, internal memory, and how information via the 'bus' was transferred between these.
- Work discipline regarding network with shared drives; simulated file transfer between machines showing issues as multitude of copies, how to locate a file, etc.
- Discussion on future technology based on a prototype concerning case handling.
- Discussion on future technology concerning the use of portable PC's, based on a dias show.
- A game of dilemma, exposing dilemmas in existing work practices and between the existing practice and future possibilities.
- Discussion on how to organize the work in the group, particularly the division of labour between inspectors and secretaries.
- Evaluation and wrap-up.

One of the activities carried out in this seminar was mainly addressing the latter of the two purposes mentioned above - a *game of dilemma*. It is the rationale behind and experiences with this activity that is the concern of this section.

The purpose of the game of dilemma was the analytical one of doing a gentle knocking - to understand some of the dynamics in the organization - what were the constraints and what were the potentials in the organization in the change process undertaken.

The gentle knocking was accomplished through the exposure of dilemmas. A dilemma, as used here, is a situation in which one has to choose among two or more possibilities, but (for different reasons) either wants none of them or all of them. Activity theory (see Section 5.3) provides a general view on what could constitute dilemmas, contradictions. Below, I present three general types of contradictions which potentially can constitute dilemmas. The potential dilemmas are explained through general examples from the AT, the specific dilemmas raised in the game are presented later.

Contradicting goals. Engeström, building on Marx, argues that these discrepancies are caused by contradictions between the use value and the exchange value of commodities produced by the practice. More

generally, these contradictions often stem from the fact that people are, at the same time, engaged in several practices with different goals (e.g. the practice of the local branch, the practice of the whole organization, the practice of family life, etc.). In AT the inspectors, on the one hand, try to ensure safety of the work environment by discussing with workplace representatives what is wrong and how the situation could be improved, etc. On the other hand, what is demanded from the central organization in AT is measurable data about the work in order to legitimate the organization politically, e.g. time spent in the field on workplaces, number of workplaces visited, and number of demands made. Thus, if the inspectors do their jobs 'properly' by spending time in discussion with the workplace representatives, their performance according to the statistics delivered to the central organization will decrease, and vice versa.

Contradicting elements of practice. In Figure 5.1 a practice is depicted as an entirety of: subjects acting; tasks to be performed; means to perform them; organization of work; rules, language, traditions, and norms; communities; and objectives. Rather than constituting a 'synthesis', these elements often 'counteract' one another. For example, introducing new work tasks while retaining old instruments to accomplish them may introduce discrepancies between the new tasks and the old instruments; the introduction of new computer applications can result in discrepancies between these and the old division of labour; intended rules of safety routines can be in opposition to the need to get things done. In AT, to a large degree, work was organised according to the inspectors' trades: i.e. health-worker, craftsman, engineer, etc. But the objects of their work, workplaces, displayed problems in all these areas. Hence, the inspectors either encountered problems for which they lacked the competence to solve, or they did not notice the problems at all.

Contradictions between actual and prescribed practice. Argyris & Schön (1978) conceptualise this discrepancy as the difference between espoused theory and theory-in-use. Engeström perceives the discrepancy in a historical light and calls it a contradiction between an old and a new activity. In general, every organization formulates procedures, rules, divisions of labour, etc. for what should be done, how and why. Often, this differs considerably from what is actually going

on. An organization may ‘decide’ on a new way of doing things (new company policy, introduction of new computer systems, etc.), but this does not necessarily mean that the decision is in fact effective: that those involved actually act according to the new way. In any practice, one can probably find many remnants of old practices. In AT, for example, a reorganization was carried out, as a response to the discrepancy between the organization according to the trades of the inspectors and the object of their work. The organization shifted to a structure based on autonomous groups with the intention that organizations of a given type should now be treated by a single group. It turned out, however, that many of the inspectors (the old-timers) had a conception of their role as a ‘sheriff’ working alone, a remnant from the old practice counteracting the new group-based practice (Markussen, 1992).

The game of dilemma

The game consisted of two parts: the game of dilemma as such (one hour) and a subsequent discussion of the topics raised during the game (one hour). The general course of action was that two provocateurs provided concrete scenarios taken from the everyday work in the AT with a slight twist in order to call forth the dilemmas. The participants were asked to take this as their situation and act accordingly, which led to new situations (probably pushed by the provocateurs) in which to act, and so forth.

The Aarhus branch of AT consisted of 4 semi-autonomous groups each concerned with their specific area of inspection. The participants in the game of dilemma were such a group, consisting of the group secretary, six inspectors one of which was also the group leader and two of which were also instructors, and two researchers in the role of provocateurs. The instructors are inspectors that have special obligations concerning maintenance of the computer systems and instructing the rest in the use of them.

The participants, through the whole game, were pushed actually to tell what they would do and not just tell what they could, should or might do. This was done both in order to make the whole game more realistic - in their everyday working lives, for example on inspection in a plant nursery,

dilemmas - actions have consequences, thinking of what you might do has much less so.

Before the game of dilemma, the provocateurs had written a *script* containing

- the general planned course of action
- organised around different (what was expected to be) dilemmas
- and with a high degree of flexibility (for each question, the script branched into different possible courses, according to what the participants chose to do).

In what follows, first a transcription of the first minutes is presented in order to give a flavour of how the game of dilemma was carried out (the transcription is made to the best of our memory after the game; it turned out that we had ended up with four hours of videotape without sound). Secondly, three of the dilemmas raised during the game are presented on the basis of both what actually happened as well as the discussion following the game of dilemma.

In the transcript covering the first minutes of the game P is one of the provocateurs, IN an inspector, IH an inspector who happens to be on holiday, II an inspector who also is an instructor, 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 safety steward from the plant nursery 'the green apple' calls and tells that half an hour ago an accident occurred in the plant nursery: one of the gardeners had suddenly tumbled and has now been brought to the hospital, unconscious. The plant nursery is usually the area of IH, but IH is on holiday in the Alps, so the case is given to IN.

IN you know that IH visited this very plant nursery just before he went to holiday. When he returned to the office from the visit, he talked about something concerning pesticides which they had started using, and something about that he wanted to check this thing out. Furthermore, you saw IH browsing in some books concerning pesticides and start working on some document(s) on the PC.

OK, IN what do you do?

IN: 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?

IN: I should take a

P: Not should, what do you do

IN: OK, I will check out the material

P: How?

IN: I would probably take a look on IH's machine

P: Do you?

IN: yes

P: You cannot find it

IN: Then I will ask his secretary to help find the document

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

IN: S could you help me find the material on IH's machine?

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

P: The safety steward from 'the green apple' calls. They are rather nervous out there. Some want to stop working. They ask what becomes of AT.

IN: I'll be there in a moment, but first we will check IH'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.

IN: I will phone IH and ask about it

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

IN: OK, I will drive to the company

The dilemma game continued. IN went to the plant nursery, talked to the manager and the safety steward (both represented by P). None of these could give much more information than IN had already got. Finally, he decided to close down the plant nursery until the issues about the new pesticide had been resolved. Shortly hereafter, the sick gardener is diagnosed as only having a stomach infection (his wife had become ill as well). When IH returns from holiday he tells that he started on the request

to the company but after more elaborate search in literature he found out there were no problems with the new pesticide, but he had forgotten to delete the file.

In order to do something about these matters II decided to develop a small program that 1) allowed people to publicise materials on their own choice and 2) allowed search on the network in the set of publicised materials. He offered the program to the ones that wanted it. Every single person was asked whether they wanted the program.

Dilemmas investigated

Below I briefly describe three of the dilemmas investigated. There were far more dilemmas, but these were the three first raised and they relate to the part of the scenario described above.

Private vs. public material on the PC's

Our pre-understanding was that this issue would be an important one. Based on our own experiences and experiences with similar situations in other companies we thought that problems would surface when we confronted the participants with problems concerning 'private' PC's interconnected in a 'public' network. To what extent do people have the right to look into other people's material?

The situation was provoked by putting IN into the situation where he obviously lacked knowledge and at the same time knew that IH had some potential relevant material (without IH being present to ask for permission).

It turned out, however, that this issue was not as controversial as expected. In the AT, all material received and produced had hitherto been archived in the central paper archive and most produced material involved at least two people (an inspector and a secretary). In effect, the possibilities for enclosure of personal material to the others in the branch are not, in a significant way at least, constrained by the history of the branch, i.e. the tradition of openness, the procedures of collaborative writing, the rules of no 'ownership' to produced documents, etc.

Use of existing knowledge vs. uncertainty about its status

The issue of using other peoples' material, on the other hand, led directly into another dilemma. The dilemma between the wish and possibilities for utilising the existing knowledge in the organization and the potential uncertainty regarding the status of material.

The situation was provoked shortly after the situation described in detail above. IN had found the material that IH had been working on, had gone to the plant nursery, and because of the suspicions to the new pesticide described in the material he had ended up closing down the plant nursery until further examinations had shown whether the pesticide was in fact dangerous or not. In the end it turned out that the gardener had only suffered from a gastric infection (his wife became ill as well) and that IH had later on, but before going on holiday, found out that the pesticide was harmless, but had not deleted the file (why should he, he knew the expressed suspicion was wrong and had not sent out a demand to the company).

In this case there was a mismatch between the possibilities of further utilisation of existing knowledge (often in the form of written material) and the constraints and potentials in the existing practices. Until now, because of the paper archive in combination with a computer system to keep track of the content of the archives, no material was made public, i.e. filed in the archive, before they were finished and sent out. Over a long period of time, procedures to handle this 'shared memory' of the organization had evolved, but there were no formal procedures or actual practices to handle how to assess the status of material that was not archived. It had simply not been an issue.

In the game of dilemma a small utility was made by one of the instructors (II). A utility that on the one hand allowed one to subscribe a document to the network and, on the other hand, it allowed people to search on and retrieve from the network documents that were subscribed to it. This utility gave rise to the next dilemma.

Individual programs vs. stability of the network

The next dilemma investigated was the one between a multitude of utility programs and individually tailored versions of standard software packages, on the one hand, and the stability and maintainability of the network as a whole on the other. The introduction of PC's in a network

instead of one central computer (running software developed centrally) opens up the possibilities of getting and utilising different software packages for the multitude of different (smaller) tasks, the development of ones own, the tailoring of the individual configuration of the PC (Microsoft-Windows) as well as a lot of the packages, and so forth. On the other hand, the very same possibility tends to imply that the individual machines as well as the network in which they are located become more unstable and therefore less useful.

After the instructor (II) had developed the utility allowing publication, search, and retrieval of documents to and from the network, each participant was offered this new utility. All but one decided to use the utility. After some elaboration on the issue of potential software, the network, one day (shortly after the network software had been upgraded), begins to run slower and slower. The scenario was elaborated by actually going through the following 'debugging' phase in quite a detail: who would take action (it turned out to be the instructors), what did they do to find the problem(s), what software did they find on the different machines, how did people react (in the middle of their ordinary work) to be asked frequently to remove utilities, change their set-up, reboot, etc. It turns out that II's utility is causing the problems.

The scenario made visible to the participants, among others, the following issues.

Regarding the possibilities of introducing new and more flexible software, the current practice had a lot of potentials by virtue of the instructors who were both inspectors and local computer experts, whereas some of the old work procedures were constraining the utilisation of new possibilities.

Regarding the possibilities for the people to perform their jobs, new technology was a potential as well as a constraints. For the instructors actually to perform their primary job - inspecting - introduction of new software was a constraint, in that it meant more time spent on maintaining the network, whereas the new technology potentially could enable the work for the rest of the inspectors.

After the game of dilemma

As a last activity, the seminar was wrapped up. The participants suggested to make an action plan for the near future. This last activity took place on a Thursday. It was decided that:

- during Friday, one of the supervisors with the most intimate knowledge about Microsoft-Windows and WordPerfect would make templates for the standard letters used by the inspectors.
- these templates were to be installed on every PC during Monday morning.
- by Monday noon, everybody had to use WordPerfect for all their documentation.
- Tuesday afternoon, P from the game of dilemma would come out and help setting up the last bits and pieces concerning the Windows set-up and the connections to the server.

When P arrived on Tuesday, the changes were in fact effectuated (and some months later a programmer was hired to take care of the network maintenance). This has to be seen on the background that the group was given the PC's half a year before, and that they had been given courses in the use of WordPerfect and Microsoft-Windows four months before.

Of course, this development is not solely due to the dilemma game or the seminar as such. On the other hand, the seminar

- did provide an understanding that there was new possibilities worth while pursuing,
- showed, by challenging the status quo, that these possibilities would not materialise from out of nowhere, but had to be pursued actively, and
- showed a number of concrete ways of actually pursuing these possibilities.

The dilemma game by confronting the practice with different possible scenarios showed some of the constraints and potentials in current practice as well as it challenged established structures and procedures. Above I gave three examples of such dilemmas. In the next chapter I will elaborate in more general terms on the relationship between future possibilities and current constraints and potentials.

Chapter 7
Analysis for change

In Chapter 3 and 4 it was argued that the primary purpose of a systems development process as a whole is change, organizational as well as technical. Therefore, when analysis is viewed as a means to the end of accomplishing changes, one of the key objectives of analysis must be an analysis of constraints and potentials for change within current practice. One thing is to describe current practice as it is, another is to understand its inherent dynamics and inertia. The primary purpose of cooperative analysis is thus seen as *facilitating taking action in order to bring about change*, rather than explaining how practice is. In the previous chapter two examples were given. The first investigated some of the prerequisites for an artifact to provoke established practice, and the second exemplified a technique aimed at deliberately provoking practice.

The aim of this and the following chapter is to expand on these experiences and give a more general account on cooperative analysis.

First, I address the notion of analysis for change. It is not possible to address the issue of change without also addressing the issue of time (implicitly or explicitly). As mentioned, the conception of time in activity theory presented in Section 5.3 is that our past (our history) has created the present with its current problems in which we have to act to 'construct' a more desirable future. This notion emphasises that we are historical beings, which we are. Below, I will introduce another conception of time originating from Heidegger. There is two reasons for this. The one is that by adopting the conception of time from activity theory there is a constant 'danger' that we might end up in some kind of historical determinism (in the extreme, if we are historical products our present constraints and capabilities and thus our future are given). The other and more important argument is that Heidegger's conception of time, where our directedness towards the future and our existence as historical beings are expressed as a dialectical relationship, seems more appropriate for the situations in

which to apply cooperative analysis. Our analysis is always focused according to our conceptions of the future (what changes to make) as well as it is based on our past experiences.

7.1 A Heideggerian notion of time

In order to elaborate the issue of constraints and potentials for change, some arguments originating from the philosophy of Heidegger will be revisited (Heidegger, 1979), but in the context of analysis in systems development[27]. It is not in any way a philosophical exposition making claims about our ontological conditions for being or the like, rather it is parts from of a larger argument brought forward here in order to draw attention to *some* aspects of our everyday lives, and thus *some* aspects concerning cooperative analysis.

The reasons for bringing these issues forth in this context are that Heidegger takes his point of departure in our practical everyday engagement in the world - practice - and that he explicitly addresses the issues of time, constraints and potentials (factuality in the words of Heidegger) and their interdependence with future possibilities.

In the presentation, for each of Heidegger's time-modalities (future, past, and present) it is attempted to capture the general idea in the first paragraph and subsequently this idea is elaborated through the example of everyday driving of a car in the traffic.

Future

First and foremost we are directed towards the future ('Entwerfen', projecting, being open), because we are fundamentally concerned about our own existence as a possibility (we are always doing something active directed towards the future, if nothing else, in order to stay alive). We are ahead-of-ourselves in that we are projecting the future and at the same time are open to interpretation of what will come. This is what Heidegger calls the existential *possibilities* ('existenziale Möglichkeiten').

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[27]For a more thorough and more philosophically oriented account and discussion of these

When we are driving a car, we constantly keep our awareness on what happens with the traffic in front of us while at the same time we (try to) project (design) the situations we will encounter: A traffic light is coming up, I better slow down in case it turns red (or I might speed up to catch it while it is green); this guy from the side road in front of me is driving rather fast, is he really going to stop, I better keep a foot on the break; I want to pass this slow truck, I better keep to the middle of the road to be able to look further ahead; etc. In the smooth flow of traffic, in a sense, we 'are' mentally ahead-of-ourselves. The distance we are ahead-of-ourselves, of course, depends on the situation: whether we are experts or novices not able to look more than 5 seconds ahead because we are more than occupied with shifting gears, keeping the car on the road, avoiding immediate obstacles, etc.; or whether we are driving in a city or on a highway in the countryside.

Past

In this directedness towards the future we have to deal with the actual factuality in which we are thrown. This factuality is the historically developed world, in which we actually live, including ourselves, our competencies, previous experiences, etc. On the one hand, in this thrownness ('Geworfenheit') we must act from within the factuality, which is the product of the history so far. But, on the other hand, the history of the factuality is interpreted and changed in light of the present intentions. Hence we act on the basis of the history and changes (the interpretation of) that history as well. This is what Heidegger calls the existential *necessities* ('existenziale Notwendigkeiten').

When we drive, in projecting the future we always act within the historically developed factuality of ourselves, the car, the road, the culture of driving in the specific country, etc. On the one hand, in order to be carried out, my intentions have to rely on my own developed skills as a driver, my experiences as a driver, the car I am driving, the contingencies of the road, what is 'allowed' in the specific driving culture, etc. On the other hand, to a large extent, these factualities are constitutive for my projection of the future (if, for example, I have once had the experience of a car from a side road coming right out in front of me, I will tend to be more aware of the possibility of such instances).

Present

In this mutual constituency between the future and the past we are present in our purposeful engagement ('besorgene Umgang'). First of all we are being-in-the-world ('In-der-Welt-Sein'), which means that we are always already being by the other beings ('je-schon-sein-bei'). The latter sentence, although probably a bit cryptically, tries to express that we are 1) by the other beings, i.e. we are basically engaged in a social world; 2) already being by the other beings, i.e. the 'others' are there before us, we are born into a sociality and every institution, construct, culture, etc., we encounter are formed or constructed by this social world; 3) always already being by the other beings, i.e. that this basic existential is a general one - we are always situated in a world shaped and formed by our fellow human beings.

Being-in-the-world stresses that we are always engaged in and with the rest of the world, we cannot detach ourselves from it. For example, contemplating on the world is always also a contemplating *in* the world. On the one hand, it is not possible to find a position of 'god's eye' outside the world, we are always acting within the world, acting within: our own as well as the others' interests, our own expectations as well as the others' expectations, our own as well as the ambition of the others, etc.

One consequence of this is that when we encounter something new, for example an area of analysis, we will encounter it within our own horizon. We are not 'tabula rasa', we cannot avoid coming to the field of analysis with some pre-understanding - what we expect to gain from it as well as our previous experience.

On the other hand, this draws attention to the fact that no matter what we do it will have consequences in the world. To be 'passive', contemplating for example, is also a way of acting. When driving, I am not the only one that projects possibilities relying on the given factualities. All the others are doing the same. We are constantly trying to work out each other's intentions, ambitions, interests, constraints, possibilities, etc. And at the same time as we are actually driving, we cannot, for example, 'freeze' the traffic in 30 seconds in order to get things straight.

Summing up

Although in the examples the issues are presented as seen from the viewpoint of the individual, this is not meant to express that the characteristics of constraints, potentials, and possibilities are individual nor subjective matters only. To a large extent the constraints and potentials as well as the possibilities are socially constructed, and seen from the individual they can be as objective or tangible as anything else. It is a socially constructed rule that in Denmark you must drive in right side of the road, and it is very tangible in the sense that it has tangible consequences to disobey it. More elaborate discussions on these issues can be found in (Dahlbom, 1992; Rorty, 1989; Rorty, 1991).

From the viewpoint of analysis in systems development, the issue here is not whether the above presentation is or is not the basic existentials for our everyday lives. The issue is not whether we always in any circumstance are directed toward the future, or whether this is *the* perspective to take when dealing with analysis. The issue is whether the above perspective points to some characteristics of our lives, and whether these characteristics are important in analysis. I think they do. When we as analysts enter a new organization, we do it with a purpose. We do not perform analysis for its own sake, we analyse because we want to inform a design process, inform our colleagues about specific findings, because we are hired to inform the organization, etc. We do have a purpose in coming to the organization and we do have some expectations as to what we will find, based on our knowledge interests and our previous experiences. When we enter an organization we expect to find something that we can call an organization, i.e. social structures of some kind, we usually expect to find it 'inhabited' by adults and not managed by, for example, a 5 year old kid, we expect to find a, perhaps implicit, purpose with the organization, we expect it to obey certain (locally formulated) rules, etc.

To sum up the issues touched upon that will be discussed later:

Time. The notion of time in the approaches described in Chapter 3 and activity theory discussed in Section 5.3 tends to be as follows: The past 'creates' the problematic situations in the present, which demands changes in the future. Heidegger's notion of time is somewhat different: First and foremost we are directed towards the future; in this directedness we are bound to the historical context in

which we are situated (the past); in this mutual constituency between the future and the past we are present in our purposeful engagement.

Constraints, potentials and possibilities. The presented approaches take their point of departure in some identified need(s) or problems in the present practice, which are either taken as is or negotiated, and the subsequent activities aim at resolving these problems or fulfilment of the needs. What the notion of time presented here suggests is that, to a large extent, the conceived possibilities influence what are constraints, needs, and problems and what are potentials, fulfilment, and solutions. And, to a large extent, the historically developed constraints and potentials, the factuality, determine what possibilities are conceived of as well as what possibilities are realistic to pursue.

Pre-understanding. Every analysis will be done through the eyes of the specific conception of the future - what we expect to meet - held by the analysts as well as the practitioners. What we see in the analysis and the way in which we interpret the results is to a large degree influenced by our pre-understanding - the conception of the situation (and possible solutions) we have beforehand. It does matter whether one is coming to the field of analysis with a pre-understanding of finding, for example, taken-for-granted assumptions, unarticulated norms, and tacit knowledge, or classes and objects with objective specifiable actions.

Being-in-the-world. The general attitude towards systems development in the presented approaches emphasises that first one should reflect then act. The concept of Being-in-the-world emphasises that the analysis is done in the world and not detached from it, i.e the world is constantly changing during an analysis as well as the analysis, voluntarily or not, will affect the world - the practice.

7.2 Constraints, potentials, and possibilities

In Chapter 3 it was argued that when we are concerned with analysis in systems development

1) change is an issue of major importance. The primary purpose of analysis was thus seen as facilitating taking action in order to bring about change, rather than explaining how the practice is

2) analysis, then, should also be concerned with the constraints and potentials for change within current practice.

A closer look on constraints and potentials and their relationship to the possibilities under investigation is the issue of this section.

First of all, constraints and potentials are always constraints and potentials for something. It is meaningless to speak about them in isolation, constraints in order to be meaningful must constrain something, and potentials must be potentials for something. Here we are interested in the issue of change and, furthermore, we are focusing on situations in which the specific kind of change is not given - to decide what specific kinds of change to pursue is one of the objectives of analysis not its point of departure. Therefore in what follows, the focus is on *constraints and potentials for possibilities for change*.

Secondly, what is conceived as constraints and potentials respectively is highly dependent on what possibilities are under consideration. Consider a specific task in a specific practice. If one aims at automating it, one will probably conceive current technology as the potential and the fuzziness regarding description of the task as a constraint. On the other hand, if one aims at developing computer support for the people accomplishing the task, one will probably conceive the current fuzziness as the potential and available technology as a constraining factor.

In the AT-project, when we began to develop the first prototypes, the issue of registration was seen as one of the main problems. In the daily work of the inspectors focusing on visiting companies, checking them, and respond either in terms of guiding them or issuing demands, the issue of having to register much information to be used by the central office was seen as a major constraint for the work of inspecting. The fact that they had to register the same information two or three times due to non-integrated systems, of course, made the problem even worse. The possibilities of what they saw as 'real' inspecting were constrained by all the office work.

Subsequently a prototype was implemented that tried to address these problems. The prototype integrated what was formerly three isolated systems, it supported the use of information entered by, for example, automatically retrieving names and addresses on companies into the word processor when writing letters; supporting access to material entered with respect to previously conducted visits to the same company, allowed overview of cases assigned to specific inspectors, etc.

The prototype was tried out in cooperation with the practitioners from the AT in subsequent sessions (c.f. the prototyping session described in Section 6.1). In these sessions the practitioners became aware of new possibilities regarding the use of existing information. The prototype illustrated possibilities concerning how they could improve their own day-to-day work by virtue of these registrations that had formerly been conceived of as a mere nuisance. In effect, what was formerly conceived as a constraint in daily inspecting was turned into a potential for daily inspecting. This led to suggestions for even further registrations.

At the Great Belt, when possibilities regarding reporting to management are the concern, the three systems KIS, Artemis, and SØS are potentials. When the regarded possibilities, as they were in the EuroCoOp project, are support for daily inspecting they are closer to being constraints. Regarding these possibilities, the three systems mainly represent extra work tasks in the form of providing information to these systems. These systems are hard to use as support in daily inspecting because they are non-integrated and made for reporting (statistics and the like) not re-finding of relevant material or creating overview (reporting) on the more detailed level needed for inspection.

Thirdly, what is conceived as possibilities is highly dependent on constraints and potentials within current practice. It is the factuality in which we are placed, with its constraints and potentials that constitute our experiences and our way of thinking, i.e. it enables us to conceive some possibilities while others remain unseen; and it is the factuality constituted by our traditions, procedures, norms, etc. that delimits what possibilities are realistic.

The practitioners employed in the AT are educated within a variety of trades (reflecting the diversities in the companies they are inspecting), i.e. they are machinists, engineers, carpenters, nurses, psychologists, chemists, bricklayers, etc. Most of the people at the Great Belt are educated as engineers. The relationship between GB and its contractors is a relationship heavily influenced by economic factors (at the moment, summer 1993, the contractor claims an amount of 2 billion Dkr, about US $350 mill., in extra payment). There is no economical relationship between the AT and the companies they inspect.

These constraints and potentials mean in consequence that

1) Technically advanced and demanding, with respect to technical competence, applications are much more a possibility at the GB than in the AT. A comprehensive, distributed hypermedia architecture where the inspectors or supervisors themselves maintain and create links between text documents, pictures, videos, drawings, etc. located on different disks, is an obvious possibility at the GB. It is not a likely possibility in the AT. Not because it is not relevant, it is. However, in a situation where many people find it very incomprehensible that they have to handle a multitude of different drives (floppy drives, your own hard disk(s), the other's hard disk, hard disks on the server, and more), and many people still find it difficult to use the word processor, an ambitious hypermedia architecture maintained by the inspectors themselves is not a realistic possibility. It would have to be maintained centrally, which for other reasons is not feasible - there is no omniscient agent with the required knowledge about the actual relationships between materials.

2) Applications supporting openness, sharing of material, and cooperation between the organizations involved in the subject matter, i.e. the work safety and the bridge respectively, are much more a possibility in the AT than at the GB. At the GB the subject matter is the bridge or parts of it. Whenever problems occur in the construction people from the GB as well as the contractor are involved. The ideal possibility of supporting the problem solving and the negotiation in these situations between people from the contractor, situated in the Netherlands and Nyborg, and the people from the GB, situated in Copenhagen and Knudshoved, is a very constrained possibility, if not a non-possibility. Although it is recognised that such support in principle could provide substantial help in the daily work, it is not considered a possibility due to the concern that confidential material could be disclosed. In the AT, at the moment, possibilities are being investigated in using portable computers, connected via modem to the central computer, at the companies being inspected and in close cooperation with these.

The relationship between constraints, potentials, and possibilities is depicted in Figure 7.1. Constraints and potentials are characteristics of parts of the historically developed current practice, and possibilities denote possible futures. The word possibility instead of, for example, future or change, is chosen in order to emphasise that it is not a given

future, but rather a space of more or less realistic and preferable futures among which the analysis can choose, within the limits of the constraints and potentials.

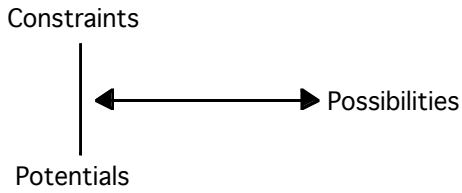

Figure 7.1: The relationship between constraints, potentials, and possibilities

The double arrow between constraints-potentials and possibilities is meant to indicate the mutual dependency between these, and the line between constraints and potentials indicates that we are talking about a range rather than absolute positions - a given part of a practice may be characterised as either a potential, a constraint, or something in between, depending on what possibilities are considered.

- Constraints and potentials are always constraints and potentials for something - possibilities.
- What constitutes constraints and potentials, respectively, is highly dependent on which possibilities are under consideration.
- What is conceived as, and what are realistic possibilities are highly dependent on constraints and potentials within current practice.

As more specific and detailed examples on these relationships I will take a closer look on the two situations of confrontation from 6.1 and the three examples on dilemmas raised in 6.2.

The example on redesigning the prototype from 'questioning the new practice' in Section 6.1 is an example illustrating that current constraints and potentials highly influence what is considered realistic possibilities. The proposed possibility was to enhance the possibilities for supporting some of the accounting to the weekly report and to economy (the inspectors get paid according to driven kilometers). It turned out, though, not to be a realistic possibility (PS8), because of the constraining mismatch between prototype and current practice. The proposed solution to redesign the prototype (daily 'card') can be seen as an attempt to design potentials (daily registering) for making the account-support a more realistic possibility.

The other example from Section 6.1, 'questioning current practice', shows how different possibilities affect what in current practice is conceived as constraints and potentials, respectively. B, considering the possibilities of increased demands on the accountability of inspectors and secretaries, sees an increase in the daily registering as a potential, both to draw attention to the otherwise rather 'invisible' office work and to counter the possibilities of increased central demands on accounting. A, considering the possibilities regarding daily inspecting, sees the same issues as constraining this work in that it introduces more overhead.

Turning to the three examples on dilemmas raised in the dilemma game (Section 6.2) we can see the same relationships between constraints, potentials, and possibilities.

In the first one we posed the possibility of using existing knowledge in the organization. The intention was to highlight some of the constraining factors in current practice, for example established norms of privacy. It turned out, however, that current practice regarding this possibility had much more potential than expected, due to the tradition of openness, procedures of collaborative writing, rules of no ‘ownership’ to produced documents, etc.

The next dilemma raised, however, pointed to some constraints in current practice, given the possibilities of using existing knowledge. Due to current procedures, sharing of knowledge and experiences was carried out through the central archive and informal conversations. In effect this meant that another inspector would only get the information if he or she happened to get the company-folder containing the information. There were no means for exchanging or distributing experiences to the rest of the organization (except for the informal ones).

The third dilemma considered the possibilities of introducing new and more flexible software. What became visible here, were the constraints and potentials in the practice of having inspectors as instructors as well. Until then, with a rather stable technology, it had by and large been a potential that the instructors were inspectors as well. Considering the new possibilities the situation became more blurred. It was a potential that these instructors had an intimate knowledge in the area of possible uses, but a constraint in the sense that an increase in the number of used applications and the new possibilities in tailoring them, meant more technical work for the instructors, thus limiting them in their work of inspecting.

7.3 Provoking and building up

Some constraints and potentials for change are rather concrete and can be analysed in a straightforward way, for instance a fixed budget represents a very concrete constraint (or potential depending on the amount of money and the perspective taken) and is unproblematically analysed. Some constraints and potentials are much less so. When we focus on practice, e.g. ways of doing, norms, traditions, organizational culture, or language, it is usually not clear how these issues relate to change: how persistent are they, to what degree can they be changed, to what degree should they be changed. All these questions are difficult to answer.

The difficulty arises out of at least three issues:

- many aspects of practice are taken for granted in the everyday engagement;
- constraints and potentials are only constraints and potentials in relation to some possibilities and vice versa, i.e constraints and potentials can only be analysed in relation to something, for example a possibility for change.
- constraints and potentials are often less tangible (for an outside analyst) than, say, documents, prescribed procedures, prescribed functions, and customers;

In a sense analysis of constraints and potentials for change, and analysis of what is, represent two different dimensions.

An analysis of current practice as it is, implies an understanding of current work practices, systems, norms, traditions, competencies, resources, contradictions, etc., and the relations among them at a given point in time.

Analysing constraints and potentials for change imply an understanding of the same issues (or some of them), but in a temporal perspective: to what degree are they subject to change and to what degree are they constraining or enabling the possibilities under consideration.

So far it has been argued that one way of approaching constraints and potentials is the one of provocation. There is a flip side of the coin, though. In order for something to provoke, it must be a possibility *within the practice*. If one comes to a session with an application that people could not care less about, it cannot provoke because it does not matter.

The prototype discussed in Section 6.1 could only provoke because it was seen by the participants as a feasible possibility to improve their daily work, and the problematic situations in the dilemma game (Section 6.2) could only provoke because, to the participants, they represented realistic and plausible possibilities for the future work in the AT.

In the case of the prototype the construction of possibilities was accomplished through

- the initial analyses (walking around, interviewing, following the inspectors on company visits, etc.),
- the design of the possibility (prototype and intended use),
- and the introduction of this possibility to the participants in the Odder seminar (Section 2.1) via the demoing of the prototype by constantly referring to current work practice.

The situations discussed in the organizational game were constructed

- via the initial analyses,
- the future workshop conducted before the Ry seminar,
- the selection of situations and the formulation of the situation cards,
- and finally the actual construction by the participants in the organizational game by concrete examples, interpretation of the cards, discussion of relevance, etc.

In the organizational game the problematic situations discussed were not, as in the case of the prototype and the game of dilemma, as much future situations as they were current ones. On the other hand, the criteria for relevance, i.e. whether the situation expressed on the card mattered, was whether the situation was likely to reappear in the future - whether it was a possibility, but in these cases most often a non-desirable possibility.

Finally, regarding the possibilities in the dilemma game they were constructed through

- initial analyses as above,
- AT's installation of PC's and network,
- education in using the PC's,
- education at the Ry seminar in the use of network and the distribution of files on many different drives,
- and finally the actual construction of the problematic situations in the game, partly by the script written beforehand by the provocateurs and partly by the actions the participants carried out during the game.

In all the cases the provocation was accomplished through the construction of possibilities. Furthermore, they were all possibilities *within* the practices, i.e. the possibilities investigated were all possibilities for this particular practice in question, both regarding the more objective factualities as well as the more subjective aspects. They were realistic possibilities in the sense that they could become reality with a reasonable effort within the given constraints and potentials, and they were understood and interpreted as possibilities. In all three examples part of the work was construction of an understanding and interpretation of the possibilities: the demoing by the analyst/designer in the case of the prototype; the practitioners' discussion of situation cards in the organizational game; and education and initial discussion in the dilemma game - the 'dispute' between IN and P in the beginning of the dilemma game is a dispute concerning the interpretation of the rules of the game as well as a dispute concerning the situation: concrete and practical or abstract and reflective.

In the examples presented in this thesis, the provocation and (sometimes) subsequent triggering of new ideas and understandings were accomplished through the construction of possibilities

- within the practice, i.e. in the particular practice in question they were
- realistic, i.e. likely to become reality within the given constraints and potentials, and
- understood, i.e. not only in principle a possibility but seen as such by the participants.

The argument here is that this applies more generally. In order for something to provoke or challenge, it must matter. The difference, discrepancy, or contradiction between my current reality and an alternative one can only provoke if the latter matters to me, whether it is a desirable alternative or a non-desirable one which is likely to become reality. In order for this alternative to matter, it must somehow be a possibility within the practice(s) I am engaged in - even the most horrifying or desirable possibility may mean little to me, if it is very unlikely to appear or I do not understand it as a possibility. To one that believes, one in a religious practice, the possibilities of hell and heaven do matter and may influence their lives now; to one not engaged in such a

practice they play a minor role and are not likely to influence their present endeavours.

In order to complement the more descriptive ones, the proposed approach to constraints and potentials can thus be formulated as the dialectical interplay between construction of possibilities and provoking (destructing) current practice:

- On the one hand it aims at constructing possibilities within the practice by constructing
  - possibilities-that-matter, i.e. realistic possibilities, within the given constraints and potentials
  - possibilities-that-provoke, i.e. alternatives to current practice (via provotypes, situation cards, scenarios, etc.)
  - understanding of these possibilities
- On the other hand the aim is to challenge the existing constraints and potentials through
  - provoking the taken-for-grantedness of current constraints and potentials
  - by exposing it to the alternative possibilities-that-matter
  - to call forth and trigger new understandings of current practice and thereby new possibilities to construct.

It is the construction of alternative possibilities which enables the provocation, and it is the provocation which triggers new understanding and new possibilities to construct.

In Section 6.1 it was shown how parts of the construction took place concerning the prototype and the situation card at the Ry-seminar. It was shown how the artifacts with their intended use were turned into possibilities-that-matter via appropriation and transformation of the respective artifacts, and how these possibilities-that-matter could trigger new understandings when clashes occurred between the possibilities and current practice.

The next section elaborates on some characteristics of situation cards, prototypes and problematic situations in dilemma games that enable and facilitate this construction and provocation.

7.4 Realistic possibilities

In the preceding chapters three means to approaching constraints and potentials have been presented:

- prototypes and provotypes
- situation cards in an organizational game
- problematic situations in dilemma games

In the preceding section it was argued that an important aspect for something to provoke was that it was a realistic possibility, i.e. it was either an obtainable possibility with a reasonable effort given the constraints and potentials or it was a possibility likely to become reality (e.g. a non-preferable possibility). There is another sense of realistic and possibility which has showed important in the sessions provoking via the means of provotypes, situation cards, and dilemmas: realistic in the sense of resembling reality and being close to real, and possibility in the sense of something changeable and something non-real.

Although these means for provoking are very different they share the characteristic of being *close to real* and *concrete*: all were based on current practice, they were related to current practice, they were specific, they were persistent over time, and they were rather tangible.

On the other hand, an essential aspect of these means is that they are *not real*: they can be changed, the consequences of exploring them might not be that serious, they allow for experimentations, etc.

Consider the use of a flight simulator. Its usefulness is a consequence of the same seemingly contradiction: that it is very close to reality, and at the same time very far from reality. It is essential that it resembles a real cockpit, and that what you can do with it resembles what you can do to a plane. On the other hand, the whole point is that it is not reality: when you crash your 'plane' in the simulator it does not have the same consequences as in reality.

The purpose of using a flight simulator is to change current practice of the pilot or the pilot-to-be, it is not to change the flight simulator. The simulator is a means to allow the pilot to experience problematic or critical situations that he or she is otherwise not able to, and thereby gain insight into the constraints and potentials of the plane as well as him or herself.

Concerning the means presented here, the concreteness and resemblance to reality were accomplished, mainly, through three aspects: incorporation of specifics from everyday practice, taking seriously that actions have consequences, and finally the persistence of the situations and artifacts.

Specifics from everyday practice. In Section 6.1 it was described how the situation cards and prototypes were appropriated and transformed through the presentation and interpretation of and interaction with the respective artifacts. The primary means in this respect were specific examples and stories from everyday practice, provided by the analysts on the basis of their previous analyses as well as the practitioners in the interaction with the artifacts. In the dilemma game the situations put forward were not random, but for the most part situations that occur frequently in the practice of AT. The means, though, to tackle the situations were new - networked PC's. In all the three cases it was this resemblance to everyday practice accomplished through the incorporation of specifics from this practice that enabled the participants to recognise the situations, both as meaningful and relevant.

Actions have consequences. This was an explicit means for provoking in the dilemma game. The whole idea in the game is to evolve via the actions of the participants and thereby elicit some of the possible consequences. In the prototyping session, the suggestions for redesign were imagined as being implemented on the spot, and the prototype was subsequently used according to these imagined changes. The example reported on in Section 6.1 is one example of a suggestion for change, the introduction of the daily form, that was subsequently "used" resulting in the discussions about accountability and overhead concerning registration. In the organizational game consequences of actions were not, at least to same degree, treated as an issue. The situation cards were treated as independent which meant that actions taken in relation to one situation were not carried on to the next situations. As stated already, the organizational game was intended to serve the purpose of design rather than the purpose of provocation and analysis. On the other hand, carrying the decisions taken regarding one situation on to the following, is an obvious candidate for modification if one wish to use the ideas from the organizational game in the setting of analysis.

Persistence. Although it may sometimes prove successful to solve problems by ignoring them, they usually tend to pop up again. One may 'close the eyes' for a period of time, but when they are 'opened' again the problems are usually still there (probably in a graver form). Concerning the prototype and situation cards their materialness naturally provides a certain persistence. The situation card expressing a problem or a problem with the registration form in the prototype is still there on the table or screen after a digression in the discussion. In the game of dilemma there were no material artifacts to ensure or support persistence. Instead, persistence was accomplished by the provocateurs' insisting on a problem. In the first part of the dilemma such insistence can be seen. IN is confronted with a problem which he is rather reluctant to address. It is P's insistence on action instead of speculation that pushes him to actually do something about it. IN is further reminded of the persistence of the problem when the security steward from the plant nursery calls and emphasises the urgency.

These three aspects can be seen as instances of three more general aspects important to the situations and artifacts in order to resemble everyday practice:

- the situations should look like everyday practice,
- they should behave like everyday practice and finally,
- they should do so over time.

The three aspects of specifics, consequences, and persistence, apart from serving the purpose of recognizability, a prerequisite for provocation, also serve the purpose of provocation more directly.

The specifics as seen for example in Section 6.1 can serve as triggers and, furthermore, the specifics also highlight the diversity in the practice, potentially leading to clashes.

On the one hand, insisting that actions have consequences can show the tangible results of some of the often intangible constraints and potentials (norms, traditions, cultures, etc.) and, on the other hand, a strong argument for revising current practice is if it has undesirable consequences.

It is the persistence that keeps a specific problem as an issue in the sessions. Often, voluntarily or not, people try to explain away a problem, digress in the discussion, or simply ignore the potential problems

Sometimes this is perfectly all right, there might not be a problem after all or the problem might be of such a kind that it should not be pursued, at least in the present situation[28]. Often, however, the persistence leads to actual addressing the problem by insisting that it is a problem, by regrounding after a digression, or simply reminding.

Finally, the specifics, insisting on actions and their consequences, as well as the persistence (lasting over time) serve the purpose of externalising the issues at stake. It brings the issues from 'the heads of the individuals' to something more common and more objectified.

7.5 Analysis as change

There is a tendency in all the approaches presented in Chapter 3 to conceive analysis as a purely reflective process. Furthermore, there is a tendency to conceive the *purpose* of analysis as, solely, providing a basis for design. The purpose of analysis is to understand the (relevant aspects of) current practice for the purpose of making it accessible to people outside the practice in question - be it designers, managers, other researches, or the like - through representations in various forms. This understanding is used in the design and realisation of new computer based systems, which when introduced provide the 'feedback' to the practice.

There is nothing wrong with that, on the contrary, in most systems development projects it is a necessity. What has been argued for above and illustrated through the examples, is that *parts of* an analysis can fruitfully be performed in a much more experimental and cooperative way, as a sort of *action analysis*. In the sections above it has been argued that provocation and building up of possibilities can constitute a fruitful approach to an analysis of constraints and potentials for change. Sometimes, though, one may go a step further.

Like the traffic in the examples from the presentation of the Heideggerian notion of time, the given practice does not 'freeze' in the period of a

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[28]In the organizational game, problems concerning the personality of manager, who was not present at the seminar, popped up several times. Rightly or wrongly, we (the analysts) decided that this was a problem not to be pursued by us at the seminar in

systems development project. In the AT project during the first 2 year the organization changed from

- a strict hierarchical organization with three managers to an organization based on one manager and four semi-autonomous groups (about ten people in each) each with a certain subset of all the companies as their object of work, to an organization based on many small groups organized according to competencies instead of objects of work.
- a computer system based on a configuration with one central mini-computer and about twenty terminals to a mixed configuration with some using terminals and some using stationary PC's, to a configuration where almost all have a portable PC and a docking station.
- a company policy emphasising the 'therapeutic' aspects of inspection (advising the companies) to a policy emphasising the 'policing' aspects of inspection (find the flaws in the companies, issue an request, and if necessary take them to trial), to a policy at the moment which are a mix of the two.

During a systems development project, every company has to make its day to day decisions, some of which may mean considerable changes in the organization. This is an argument for not conceiving analysis as something only done in the early parts of a systems development process, but something done in parallel with the other activities the whole way through. But, it is also an argument for an analysis which informs and affects both the systems development process as well as the practice itself. The analysis can be used directly in the change processes which the practice is constantly undergoing, and not only indirectly via a new design.

In the AT project the analyses have been directly used to inform and affect the practice in several ways, three such examples are:

- the analysis showed that although the old system was not the world's best, it had still many capabilities that people requested, but they were not aware of the capabilities at all or they did not know how to use them. Both in order to support the practice as such and in order to explore the constraints and potentials of the old system we educated people in the extended use of the system - we changed some of the constraints and potentials concerning competencies.

- at two instances the Aarhus branch of the AT was granted a sum of money to buy new technology. In both cases we acted as consultants drawing on our previous analyses as well as on the visions on possibly futures developed in the AT project. In both cases the central EDP-department suggested hardware running on a DOS platform. In both cases we argued for larger PC's running Microsoft-Windows - choosing a UNIX or Mac platform was not a possibility within AT. In both cases the Microsoft-Windows platform was the result.
- after the installation of stationary PC's running Windows and WordPerfect, the question of how to use the new technology arose. We offered (as an isolated activity actually being paid) to teach the new technology. The education served the purpose of enhancing the technological competencies in AT as well as it was part of the overall analysis of constraints and potentials, which were of importance regarding the visions concerning more advanced technology.

In these cases in the AT-project it was not only a question of simulating possibilities and thereby indirectly changing current constraints and potentials. In these instances we actively changed current constraints and potentials (competencies and platform respectively). Whether these are feasible activities in an analysis depends on at least two issues.

Firstly, such activities must make a difference in everyday work. One does not spend two weeks on learning a specific application unless it is certain that the acquired competencies in fact can be used. The above activities all served the purpose of building up competencies, and they all did it in a context in which there was coherence between the exploratory aims and the demands to current work.

Secondly, it depends on the systems development context. Whether it is feasible in analysis actually to change current constraints and potentials depends heavily on the relationships between analysis and design, and between the organizational and contractual relationships between the practices involved. I will return to this issue in Chapter 9, in which I discuss cooperative analysis *and* design.

Chapter 8
Cooperative analysis

Cooperative design emphasises the need for the competencies and knowledge of both system developers and practitioners, as well as it emphasises the importance of a mutual learning process, usually through concrete means as prototypes (Bødker & Grønbæk, 1991b), mock-ups (Ehn & Kyng, 1991), commitments on a playground (Ehn & Sjögren, 1991), sheets of paper on a wall (Kensing & Madsen, 1991), etc.

In contrast, with SSM being partly an exception, all the approaches to analysis presented in this thesis tend to conceive analysis as an endeavour in which only the analysts should learn something. The practitioners are being interviewed, observed, analysed, etc., they are not, at least intentionally, actively engaged in a learning process. Analysis is conceived of as a rather one way process in which knowledge is 'transferred' from the given practice to the analysts.[29]

What has been argued for an exemplified above is a more cooperative analysis, in which analysis supports learning regarding both the practitioners as well as the analysts. There are several arguments for this, some of which are given below.

Seen from the point of view of the practice being analysed, a cooperative analysis enables a more active influence on changes, in contrast to what Engeström called reactive learning (see Section 5.3): always running behind the development trying to learn and adapt to it.

Seen from a cooperative design perspective the purpose of analysis is as much to enable practitioners to engage in a process of cooperative design as it is to 'produce' an understanding of current practice.

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[29] [illegible]

From the point of view of analysis, assuming a purpose of analysing for change as argued above, the focus is on analysing constraints and potentials for change. This is difficult to accomplish without actually interacting with that practice, provoking it. Provoking is to challenge the practice and it is to call forth the otherwise not articulated, i.e. enabling the practitioners to revise practice and learn new aspects about it. Analysing constraints and potentials of a practice is also to investigate the constraints and potentials concerning individuals' competencies regarding certain ways of doing things, willingness or resistance to certain changes, purposes of being engaged in the practice, etc. A powerful way of investigating these issues is actually to try them in a cooperative learning process, cooperative analysis.

When we talk about a cooperative analysis, though, we also talk about the meeting of different practices and different understandings.

8.1 Pre-understanding

The purpose of analysis is to understand and affect a given practice. On the other hand, it is not possible to understand a new practice without some understanding of this practice beforehand. We do not have to invent a language from scratch, partly we already share a language (assuming that the analyst' practice and the practice under investigation belong to the same linguistic area). It is not a totally alien culture, we do partly share a form of life and we do partly share a history. On the other hand, partly, every practice develops its own culture, traditions, norms, procedures, language, purposes, visions, etc. (Argyris & Schön, 1974; Argyris & Schön, 1978; Bødker & Pedersen, 1991; Engeström, 1987; Polanyi, 1984; Schein, 1985; Suchman, 1987).

To have a partial understanding of an area of analysis before we analyse it is both inevitable, necessary, and problematic.

It is *inevitable* in the sense that the world is understood before us; when we enter this world it is already understood, interpreted, and attributed meaning, and during our lives we partly take over these understandings, interpretations, and meanings as well as we partly change them according to our own experiences. This is one of the major purposes of education.

It is *necessary* in the sense that understanding of the new presupposes some understanding of the area under investigation beforehand. An

analysis of, for example, the Great Belt would not be possible in practice if it could not rely on basic concepts being (partly) understood beforehand such as organization, work, engineer, secretary, drawings, letters, etc. Not to mention the pre-understanding embedded in the use of a common language.

Finally, the pre-understanding is *problematic* in the sense that it might be 'wrong' and it might cause a certain blindness. We do not tend to question and investigate what we already (think we) understand (c.f. the discussion of taken-for-grantedness in Chapter 4 and 5).

Pre-understanding denotes our historically developed understanding that we bring to the situation to analyse and act upon, for example, our knowledge interest (Habermas, 1974), we are never neutral actors but always pursuing certain interests; our paradigm(s) (Kuhn, 1970), we belong to a tradition sharing a set of basic assumptions; and our prejudice (Gadamer, 1960) that, on the one hand blinds us to aspects, but on the other hand makes understanding possible in that we do not have to 'judge' on all issues from scratch.

Heidegger offers three concepts to grasp some of the issues involved in pre-understanding:[30]

Fore-having: what we have before us, i.e. the project, enterprise, task that we are engaged in with its purposes and interests. In the contexts discussed in this thesis, primarily, the fore-having is the task of analysis in systems development. The understanding and affecting of a given practice is performed in the context of the fore-having of analysis for change, i.e. it is performed with specific purposes.

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[30] (Heidegger, 1962) § 32

Fore-conception: what we grasp in advance. Fore-conception denotes both the explicit hypotheses and conceptualisations that we make beforehand, for example conceptualisations like 'objects and classes', 'data-flow', or 'tacit knowledge', and more implicit and taken for granted assumptions, prejudices, understandings, etc. We tend, for example, more or less implicitly to assume beforehand that the given practice is in some way coherent and meaningful.

Fore-sight: what we see in advance. Based on the fore-having, the task with specific purposes, and the fore-conception, the historically developed understanding, we have certain anticipations to the area under investigation. We apply a certain perspective, highlighting some aspects of the given practice while others remain more unnoticed.

The issue of pre-understanding raises two questions. The first is the question of what pre-understanding is embedded, implicitly or explicitly, in the various approaches. This has been discussed in the previous chapters under different headings. To summarise, we can say that the approaches represented by Yourdon, Jackson, and Coad & Yourdon all see the fore-having of *analysis* as the task of modelling, with the aim of providing specifications for automating the relevant parts of existing practice, and to determine which services and information the prospective system should provide. All of them, explicitly, apply the analyst with a certain set of fore-conceptions in order to determine or guide how the area of analysis is conceived, in terms of data flow and data structures, entities and actions, Class-&-Objects and their behaviour, etc. Consequently, what the approaches provide material for, is a fore-sight of being able to model, i.e. anticipating characteristics as completeness, coherency, consistency, and a perspective focusing on aspects that are objective, explicitly stated, observable from the outside, specifiable, etc. These aspects and characteristics *are* important when the issue is one of producing software with probably hundreds of thousands of lines of code, but the question is whether it is the most feasible pre-understanding when the issue is analysis of a given practice.

In contrast, the approaches inspired by cultural anthropology have a fore-having of understanding current practice on its own terms (in contrast to modelling and specifying). The focus is on understanding the practice in question as it is, not on changing it. Although the approaches explicitly attempt to avoid a priori categories, naturally, they all have certain fore-

conceptions. They all assume that it is meaningful to talk about a practice, which among other things implies assumptions about a meaningful sociality, common structurings, and certain recurrent patterns in that sociality; they all conceptualise issues as tacit knowledge and taken for grantedness; and they all tend to conceptualise the world as (partly) a construct of social human agency, not an entity given by 'nature'. In turn, the fore-sight is characterised by a perspective from within the given practice with a focus on subjective accounts of experiences rather than external and objective accounts. Furthermore, the fore-having of an analysis from within the given practice (as understood by the individuals) and pre-conceptions of 'constructivism' and taken for grantedness of work practices leads to a focus on the specifics rather than the general aspects.

The MARS project and SSM can both be seen as approaches between these extremes, with a tendency towards the 'modelling' and cultural anthropological approaches respectively. Although emphasising descriptions, the MARS project stresses the importance of taking the specific situations into account in selecting means, and although close to the cultural anthropological approaches, SSM stresses change as well as it makes use of the pre-given conceptions in soft systems thinking.

The attempt in this thesis has a fore-having of understanding current practice for change, i.e. understanding the dynamics within current practice. The fore-conceptions include taken-for-grantedness, practice, change, intervention, provocation, building up, etc. as discussed in the previous chapters. Finally, the fore-sight (what I am looking for in analysis) is mainly characterised by constraints, potentials, and possibilities within the given practice. In this respect, the pre-understanding in this thesis is that we have to take seriously *both* that we are dealing with historically and socially developed human practices *and* that our purpose for engagement with them in the first place is that they are to be changed.

The other question raised by the issue of pre-understanding is how we, as analysts, in analysis treats our own actual pre-understanding. This is the subject of the next section.

8.2 Challenging pre-understanding

As argued above, we do have a partial understanding of an area of analysis before we actually analyse it, and this is both inevitable, necessary and problematic. Our actual pre-understanding is shaped by our own personal history, experiences of others that we know about, theoretical conceptualisations as the above mentioned, and much more. This pre-understanding naturally, to varying degrees, affects the analysis.

Yourdon, Jackson, Coad & Yourdon, and the MARS project either do not address this question or take for granted that it is unproblematic to have an analyst with a pre-understanding from outside the given practice to actually do the analysis.

In contrast, pre-understanding is one of the key issues in the cultural anthropological approaches. They see pre-understanding as problematic in the sense that it influences and shapes the analysis, which easily leads to an analysis more influenced by the pre-understanding than the actual circumstances.

Instead of analysing from without in imposing (external) predefined frameworks and theories, or analysing from within trying to avoid any pre-understandings from the outside, what is suggested in this thesis is another approach more in line with SSM. SSM, like the cultural anthropological approaches, explicitly addresses that the general pre-understanding of the analysts (soft systems thinkers in SSM) may not be the right one, and the idea is to display several alternative interpretations (although all formulated via soft systems thinking, implying specific notations and strategies) and present these to the practice in question.

What has been argued for and exemplified so far in this thesis can be characterised as an approach of *coming from without, acting within*. One is coming from without with pre-understandings shaped by theories, frameworks, previous experiences in the field, the technological 'state of the art', etc. Instead of imposing this on the area of analysis as the way of describing it or trying to discard the pre-understanding, one can confront the area of analysis with this pre-understanding. In a way this is to make a virtue out of necessity, in that inevitably we come to the area of analysis with a pre-understanding, but it certainly does not have to be the 'proper' one.

Although in general the arguments from the cultural anthropological approaches are acknowledged, there are at least three arguments for embarking on the approach suggested here.

Firstly, the idea of avoiding pre-understanding is very much in line with one of Husserl's central ideas about phenomenological analysis: the idea of bracketing one's assumptions (epoché). Simply stated this means: in a conceptual analysis always try to find the assumptions behind your statement, bracket them, and see what is left. This is a powerful tool in conceptual analysis, but there is an underlying assumption in it: that the analysis is done detached from what is being analysed and that the 'object' of analysis is one which cannot (or should not) retort. In analysis in systems development, and cultural anthropology as well, the 'object' of analysis is to a large extent human beings and their entanglement in their everyday lives. In contrast to an analysis of, say, the being of a hammer or the validity of a proposition, analysis in systems development has an 'object' of analysis who has the ability to comment, deny, or agree on the analysts' pre-understandings.

Secondly, what has been highlighted so far, is that this approach supports the challenging of the practice being analysed, i.e. it challenges the pre-understandings of the people in that practice. Another aspect of this approach, however, is that by actively provoking by building up possibilities one's own pre-understanding is to a large extent laid bare. Not directly in the sense that one tries to explain what one takes for granted or how one perceives the world, but indirectly in that it is the analyst's given pre-understanding which is used to construct these possibilities, which in turn are called into question. In a sense, this is the essence of prototyping in the area of design. We saw it concerning a number of situation cards when the cards were 'rejected' as being irrelevant; we saw it in the case of reporting of kilometers driven in the case with the cooperative prototyping session, and we saw it in the case of the first dilemma raised concerning issues of privacy in the dilemma game. In all these cases, we, the analysts and designers, were the ones who constructed the possibilities based on our pre-understandings and our analysis (which again was shaped by our pre-understandings), and these pre-understandings were indirectly challenged when the practitioners retorted.

Thirdly, the analysis is done with a purpose. In systems development at least the analysis is seldom done solely for the sake of understanding the

practice in question as such, it is done with the purpose of changing it or the purpose of investigating constraints and possibilities for change. If change, and especially a technological one, was not an issue the analyst would most likely not be there. This is not to say that sociological in depth investigations of concrete work settings cannot inform design, they can. But it is to say that in an analysis in a specific systems development process it is very hard if not impossible, and probably not very fruitful, to try to avoid the pre-understanding of (technological) change, in that it is the 'raison d'être' for the whole process.

The arguments can be summed up. The unquestioned bringing to bear of specific pre-understandings in the 'modelling' approaches are problematic, in that it imposes general structures from without, from programming languages, on the given practice. On the other hand, trying to avoid pre-understanding is first of all strictly speaking impossible, secondly, it misses that the practice can actually retort, and thirdly, it de-emphasises that change is a very important element in the fore-having of analysis. Instead, actively to confront the analysed practice with our own pre-understandings, via mock-ups, prototypes, situation cards, scenarios, etc., these may be challenged, and we get the chance to learn something.

In some respects, the suggested approach resembles Wittgenstein's approach regarding the taken-for-grantedness and limits of language. Wittgenstein's approach was one of indirectly showing. The *Tractatus* by directly stating the formal functioning of language, indirectly casted light on some of the ethical issues, that which we cannot speak about. The *Investigations* used language games.

> Our clear and simple language-games are not preparatory studies for a future regularization of language—as it were first approximations, ignoring friction and air-resistance. The language-games are rather

> set up as *objects of comparison* which are meant to throw light on the facts of our language by way not only of similarities, but also of dissimilarities. (Wittgenstein, 1958) § 130.

Toulmin reports from Wittgenstein's lectures in which he used fables and parables to bring people to an understanding of his points.

> For such "imaginary tales" amounted, as he said himself, to no more than "assembling reminders of the obvious"; in this way, he was simply bringing his hearers to the point of *recognizing for themselves* something implicit in their own linguistic practices which he could not explicitly *assert* without abandoning his own principles. (Janik & Toulmin, 1973) p. 229.

In contrast to analysis as conceived here, Wittgenstein knows the "answers" which he tries to convey to his readers or students and he makes use of imaginary language games and tales. In analysis we usually do not know the answers and, as argued above, we can make use of more concrete means.

Where Wittgenstein uses imaginary tales and language games to bring his readers or "hearers to the point of recognizing for themselves something implicit in their own linguistic practices", the notion here is to use the elaboration around concrete prototypes or scenarios to bring analysts as well as practitioners to recognise something otherwise implicit in their respective practices.

As seen in the cases reported on in Chapter 6, in elaborating on prototypes or scenarios a set of different practices and pre-understandings were brought together. Some of the time, the elaboration went on without interruption indicating that the respective pre-understandings were more or less in correlation. At other times, clashes occurred challenging either one of them.

The idea of confronting the analysed practice with the pre-understandings provides a new perspective on the degree to which the analysts need knowledge about the practice which they investigate; one 'half' of the issue of mutual understanding. Lack of mutual understanding between practitioners and analysts is most often seen as a hindrance to joint systems development.

From the perspective here this issue is perceived differently:

- By obtaining mutual understanding, a mutual 'blindness', i.e. a mutual taken-for-grantedness, is acquired as well. One runs the risk of becoming unable to see the forest for the trees.
- Instead one can confront the practice with this - initial - lack of mutual understanding. In order to provoke, to analyse for change in a practice, it is often more fruitful to come from the outside with different viewpoints, than coming from the inside taking the practice for granted.

Of course, it is a question of balance - of entering and understanding a given practice whilst remaining outside with different points of view and provocative tools and ideas.

8.3 Roles in cooperative analysis

Regarding analysis, numerous perceptions of the 'roles' of practitioners and system developers can be seen. Some of them are:

- The system developer interviews the practitioner to gain knowledge of the practice in question (e.g. Yourdon, Jackson, Coad & Yourdon, and MARS).
- The practitioners are observed and recorded in their daily work for subsequent analysis by the system developers (e.g. cultural anthropological approaches).
- The system developers discuss current practice and different interpretations of it with the practitioners to gain an understanding, as rich as possible, of the practitioner's situation (e.g. SSM).
- The system developer and the practitioners are engaged in mutual learning, i.e. practitioners learn about technological possibilities and system developers about current practice (e.g. the roles conceptualised in the UTOPIA project (Bødker, et al., 1987; Ehn & Kyng, 1984)).

The roles taken on in the sessions reported on here were often some in which the practitioners and the analysts were concerned about the same issue: investigating current practice. This role is different to the above

mentioned in that it neither implies that only the analysts should learn nor does it suggest two different 'learning agendas'. Instead people are seen as cooperating on the same 'object' - current practice. Both have to deepen their understanding of the given current practice and its constraints and potentials for change. The system developers because they are outsiders, and the practitioners for two reasons:

- one's own practice is to a large extent taken for granted. Engaged in everyday life we do not often contemplate why we drive a car the way we do, how we keep the balance on the bicycle, why democracy (at least in the democratic countries) is almost solely a positive term. And there are good reasons for that: we would not be able to do much else.
- the different practitioners are in many respects also outsiders. The manager does not know, at least in detail, what the secretaries are doing, and the secretary does not know what the inspector does when s/he is checking different workplaces, and the inspector does not know….

On the other hand, the common subject matter - current practice - is approached with very diverse competencies, perspectives, and backgrounds.

We can conceptualise some of the analysts' roles by considering three ideal types (imagined extremes). Imagine the practitioners as on a journey - a practice being changed. The distinctions are made as to the location of the analysts in front of, beside, or behind the practitioners.

- As an *expert*, the analyst investigates current state of affairs and different possibilities, finds out which ones are best, and presents the solution to the practitioners as the route to follow. This role resembles the role of a 'traditional' analyst entering a practice encompassing problems, making surveys, suggesting solutions, and so forth. The expert can be said to stand *in front* of the practitioners giving the answers to which way to go.
- As a *facilitator*, the analyst outlines possible interpretations of current practice, possible changes, and supports the practitioners with techniques to explore these possibilities. This role partly resembles that of an analyst or designer in participatory systems development or SSM. The facilitator takes current practice as given and facilitates the exploration of possible changes. The facilitator can

be said to stand *beside* the practitioners supplying means to investigate which way to go.

- As a *provocateur*, the analyst confronts the practice with possible interpretations of current practice and future possibilities in order to challenge current constraints and potentials. The provocateur urges or invites realisation - both in the sense of becoming aware of and in the sense of making concrete - of current practice, thereby investigating possibilities for change within current practice. This role is the ideal type in provocation as outlined in the preceding chapters. In this respect the provocateur can be said to *stand behind* the practitioners challenging current position to find out what to keep and what to avoid on the future route.

The ideal roles are summarised in Figure 8.1.

	Current practice	Who learns	Position
Expert	Given	Analysts	In front
Facilitator	Given	Practitioners and Analysts	Besides
Provocateur	Challenged	Practitioners and Analysts	Behind

Figure 8.1: Three ideal roles in analysis

As mentioned, the roles are meant as ideal types (imagined extremes) highlighting differences. In any actual analysis, any of the roles is plausible in certain situations, but none of them are likely to be the only role taken over a period of time or a range of situations.

The ideal types can be related to ideal situations. If the situation is one in which it is possible 'objectively' to decide beforehand what might characterise a satisfactory solution (speed up the word processing; create statistics over the number of books registered in our system; transform files in this format into files of that format; etc.), the most suitable role is most likely the one of an expert - assuming that the necessary competence is present. If the situation is one in which we cannot find such 'objective' criteria, when the question is concerned with human practices, the most suitable role is likely to be facilitator or provocateur. The choice depends on the extent to which the problems are known beforehand. When the

situation is one of problem elaboration or problem 'definition' - we know that something is wrong, but not what or why - provocateur might be appropriate. When the problems are (more or less) known, and the approach taken is directed towards possible solutions, the suitable role is likely to be facilitator.

Obviously, the different roles have their respective advantages and weaknesses depending on the concrete situations. In the AT project we acted, for example, as experts when consulted about hardware and software platforms and when analysing network possibilities, facilitators in organisational games and future workshop sessions, and provocateurs in dilemma games and preparing situation cards. In the EuroCoOp/EuroCODE project the roles were primarily ones of experts and facilitators due to the focus in this project on designing generic applications, i.e. the analysis at GB was more concerned with understanding current practice as it was than challenging it. Still we acted deliberately as provocateurs in the future workshop when challenging established practices of using keywords, and sometimes (un-deliberately) our proposed possibilities challenged established practices.

Regarding roles of the practitioners, obviously, I do not have the same empirical basis as regarding roles of analysts (I have tried the conceptualised analysts' roles). Still, in using the spatial metaphor concerning roles of an analyst, some claims are automatically made regarding the role of the practitioners. If the analysts are 'in front' of the practitioners, as an expert, the practitioners must be 'behind', and when the analysts are 'behind' the practitioners must be 'in front'. Besides being a consequence of the metaphor, this seems in fact sensible. The situations in which we are experts are also the situations in which we think we know what is going on (rightly or wrongly), i.e. situations in which we apply our pre-understanding and take it more or less for granted, and it is these taken-for-granted pre-understandings that fruitfully might be challenged by a provocateur.

Consider, for example, the cooperative prototyping session reported on in Section 6.1. Some of the time, the system developer D was the expert explaining the use of the prototype, and the practitioners were the ones acting as provocateurs, most notably concerning the registering of kilometres

B: you can't do that for every single company=

A: no you haven't driven=

B: you are not allowed to go out to a single company and come straight home again, so that's no good.

Some of the time, D and the practitioners were 'beside' each other, and the practitioners facilitated the demonstration by adding details, agreeing, suggesting new uses, etc. For example when D was driving the prototype, but all explanations were due to A and C:

C: // Would that then say // [A reaches over C to point at screen] // here I've got myself the directive.//

A: // so here I've got the directive // No, so there

C: Yeah, there. And then it comes // out //

A: // And so // the directive comes

C: And then it is, you know, the whole, // who- //

A: // So // it is // directive over there //

C: // all the // text, that's given, that is the directive … once,

And sometimes, the practitioners were the experts (e.g. concerning issues about their current practice) and the analysts were the provocateurs. In the cooperative prototyping session the provocation was primarily accomplished via the produced prototype, whereas the role of provocateur was explicit in the dilemma game.

Chapter 9
Cooperative analysis and design

This thesis took its point of departure in conceptualising and exemplifying a counterpart to cooperative design: cooperative analysis. The primary concern until now, therefore, has been the how, what, and why concerning this issue, especially with emphasis on analysis for change.

When we broaden the scope, though, and consider cooperative analysis *and* design other issues come to mind as well.

One is what is missing. It is obvious that the preceding chapters do not cover the whole story of cooperative analysis within an overall cooperative development. For example, although I have focused on analysis of the dynamics of a given practice this is by no means to say that, for example, more descriptive approaches do not or should not play a major role. Being able to understand what is and to communicate this understanding to others via descriptions of some kind is and will continue to be an important part of analysis. Likewise, it is left to future work to investigate how to manage a larger cooperative analysis (and design), as well as the context of cooperative analysis (and design) regarding issues as what kind of contracts, what kind of organizations, what kind of situations, etc.

Another issue is how the presented ideas apply in a broader context. This is the issue for the following two sections in which I provide ideas to understand and practice cooperative analysis and design in the situations of designing (many) applications to one practice and designing one application to many practices (market) respectively. Both cases are to be seen more as candidates for future work than actual suggestions.

9.1 Cooperative analysis and design for one practice

As argued in Chapter 7, constraints and potentials for change within a given practice are highly dependent on which possibilities are under consideration. This has impacts concerning how one analyses, as seen in the preceding chapters, but it may also have impacts on how we conceptualise and practice cooperative systems development as such. That is, from the perspective taken in this thesis, the relationship between the analysed practice, analysis and design.

In the AT project we conceptualised our work regarding the technological changes in AT as a two-level strategy (Bødker, et al., 1993a). On the one hand, much of the work was directed towards long term visions to enhanced computer support in AT grounded in current practice (e.g. through cooperative prototyping and mock-ups). On the other hand, we spent a considerable amount of energy in short term activities enabling the practice to pursue the envisioned possibilities (e.g. teaching the use of VIRK, the use of PC's, and the Odder seminar). The elaboration of long term visions informed the short term consulting and decisions regarding, for example, purchase of software and hardware; and the short term activities enabled (or constrained) the longer term visions as well as they gave rise to new possibilities.

This idea of a two-level strategy can probably inform the relationships between analysis and design as well. Cooperative design as conceptualised for example in *Design at Work* bases itself in current practice and is directed towards envisioning future possibilities as well as it concretises these possibilities, e.g. through the construction of prototypes and mock-ups. Cooperative analysis is directed towards understanding and changing constraints and potentials within current practice, and its point of departure is possible changes to the given practice. Seen this way, cooperative analysis and design in a dialectical interplay continuously elaborate each other's resources.

Cooperative design by using current practice as a resource envisions new possibilities. On the one hand, it tries to ensure that future technology actually fits the practice, and, on the other hand, it always introduces the risk of being too conservative if it takes current practice as it is as the point of departure. Cooperative analysis by using future possibilities as a resource tries on the one hand to provide an understanding of constraints

and potentials within current practice as well as it challenges and probably changes them.

In this way, the continuos interplay between cooperative design and analysis can be seen as addressing two levels. Cooperative analysis can be seen as bringing (some of) the constraints and potentials to the surface from the everyday entanglement, and cooperative design can be seen to bring possibilities 'down' from the abstract to a more concrete and understandable level. Furthermore, changes are accomplished on both levels. In cooperative design possibilities are constructed and re-constructed to fit current practice, whereas, in analysis current practice is changed and reinterpreted in light of future possibilities, for example by changing conceptions, competencies, hardware and software platforms, organisation, etc., as seen in the AT project.

In the beginning of the AT project the possibilities for technological change focused our analysis to investigate constraints and potentials within current technology and its use. The analysis, among other issues, revealed as one of the major problems the non-integratedness of current systems. The strive for integrating existing systems was, thus, one of the primary aims in the first prototype. The introduction and elaboration of this prototype revealed in the analysis, among others, the problems of control and overhead concerning registering (see Section 6.1). When the possibilities of actually buying new technology arose, it was the elaborated visions that informed the analysis of what specific software and hardware to buy, and it was the results of this that enabled the second prototypes to be implemented on the new platform as well as taking into account the problems of, for example, registering.

In this way cooperative analysis and design are conceived as parallel and continuously using each other's results as resources in the work, which yields new results that again are used by the other, and so forth. Furthermore, both cooperative analysis and design are conceived as contributing to change. Cooperative analysis influences the more short term changes informed by longer term visions, and cooperative design influences the longer term changes informed by the analysis of current constraints and potentials.

9.2 Cooperative analysis and design for generic products

In the above section the focus has been on situations in which the aim was to develop one or more computer applications and to change organisational structures in a specific practice. In this section I address the question of what cooperative analysis has to offer in situations where the aim is to develop generic products to a market.

The aim of EuroCoOp was and the aim of EuroCODE is (1993) to develop generic CSCW applications to a market. To this end, GB was chosen as an appropriate setting for getting experiences with the possible uses of these applications. GB was appropriate partly because of its complexity and its distributed work. What probably counted more, was that the GB had the resources and the interest in actually working with the suggested new technologies enabling them to challenge our designs and provide new ideas. What made GB an appropriate user-site was not so much a question of whether it was representative or typical, it was more because they were committed to actually use the designs and committed to actually challenge them.

Put a bit simplistic, one could say that the aim in these projects is not for us (the researchers) to change and develop for the GB, but rather vice versa that the task of GB to a large extent is to change our designs. Metaphorically, we can say that the situation in the AT project resembled one in which we had a nail and the problem of getting it into the wood looking for suitable hammers, whereas the situation in EuroCoOp/EuroCODE is more characterised by having a hammer looking for nails to apply it on. (The challenge is of course not, like the baby, to take everything for a nail.)

Consider the outline of the interplay between cooperative analysis and design for the AT project presented above. Regarding the situation in the EuroCoOp/EuroCODE project the picture is in a way turned upside down. The point of departure was not constraints and potentials within a given use-practice, but more or less concrete designs (ranging from initial design ideas to industrial prototypes). The possibilities investigated was not future practices at the GB as such, but possible uses of the given applications.

On the other hand, there is a close resemblance between the two situations. In a way, we are talking about the same components but from two entirely different perspectives. What are current constraints and potentials for the designers, the current designs, represent long term possibilities for the people at the GB. What are current constraints and potentials for the people at the GB, their current practice, represents possible use-situations for the applications.

GB is a partner in EuroCoOp/EuroCODE and thus paid for the work. This can ensure that the people from GB participate, but it cannot ensure that they participate interested. Their own accounts on their motivation for participating were that the participation opened up new possibilities hitherto not known to them and thereby made them see their current practice from new perspectives. For the people at GB, the work was thus, to a large extent, seen as building up of new (long term) possibilities which they used to analyse current constraints and potentials - challenge established practices.

From the perspective of the designers, it was the factual constraints and potentials within GB that challenged current designs and led to redesigns. In the beginning of the EuroCoOp project the conceived possibilities were focused on supporting the sharing of materials, particularly cooperative authoring. These possibilities contributed to focus the analysis. The analysis revealed, however, that the problems in current practice were more fundamental and were related to actually re-finding the material (the re-finding was a prerequisite for sharing). As mentioned in Section 2.2 we introduced in the analysis the idea of interlinking documents with respect to content instead of only searching via key-words, without much success. It was a fundamental part of existing practice that searching was accomplished via key-words (and thus solutions had to be found in better key-words) and it was hard for people to grasp what it could mean to interlink documents. As a consequence, our first prototype focused on showing some of the possibilities in interlinking primarily text-documents. This prototype was introduced to the people from GB, and people could now experience the possibilities in interlinking documents. This challenged the current way of organising material at the GB, and people began to reconceptualise current work in light of the new possibilities. That the idea of interlinking material was actually conceived as a possibility-that-mattered and thus revised with respect to supporting the work at GB led to several challenges for the design. One of the major

challenges was that we had to support the interlinking of not only one type of documents, but had to interlink material from all the diversity of applications present at the GB. This lead to second and much more extended and general prototype of a hypermedia application. Today the hypermedia is an industrial prototype (aimed at the market) and it is one of the main components in the CSCW shell being developed in EuroCODE, interlinking many of the applications developed in this project.[31]

Comparing our starting point and the results, there is no doubt that cooperative analysis and design in this case provided indispensable input to the process of designing generic applications.

The extent to which these experiences apply more generally has to be seen. There are, however, some initial arguments that may motivate further investigation.

Firstly, by addressing actual situations within a concrete use-practice the investigated possibilities, as seen from the practitioners, become possibilities-that-matter, and thereby the work with these possibilities becomes worth pursuing.

Secondly, it addresses the issue of blindness (‘tunnel vision’, ‘model effect’) discussed in Section 5.2 by using specific situations to challenge current design, i.e showing its constraints and potentials.

Thirdly, it draws on the practitioners' competencies in doing so, i.e. it turns the practitioners into a much more constructive and active role than the passive one of being 'objects of study' or one of answering questionnaires (confirming or denying the pre-understanding of the ones asking).

Finally, by virtue of the three arguments above, it might serve as a means to go beyond the respective pre-understandings of the developers and practitioners, potentially leading to qualitatively new designs.

9.3 Challenging practice?

What has been proposed in this thesis is a conception of analysis in systems development characterised by cooperation and intervention, i.e. as

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[31]For further information concerning the hypermedia, see for example (Grønbæk, Hem,

a cooperative endeavour facilitating taking action to bring about change. As a short summary, the following questions concerning cooperative analysis have been conceptualised and answered in this thesis:

Why embark on cooperative analysis: Because of three fundamental problems in analysis: taken-for-grantedness of current practice, the problem of analysing the capabilities regarding changes within a practice, and the problem of basing new designs on continuously changing practices.

How to accomplish cooperative analysis: By a general approach of provoking as well as more specific techniques like provoking via artifacts, dilemma games, and modified techniques from cooperative design.

What is analysed in cooperative analysis: The dialectical interplay between, on the one hand, constraints and potentials within current practice and, on the other hand, possibilities for future practices.

Who accomplishes cooperative analysis: The cooperative practice of analysts, designers, and practitioners, respectively taking on the roles of expert, facilitator, and provocateur depending on the specific situations.

Concerning systems development practice the ideas introduced in this thesis may be used with various levels of ambitions. They may be used to inform current development practice with its usual techniques by providing awareness of alternative possibilities and ways of pursuing them, or the development practice may take in cooperative analysis as an integrated part interacting with more descriptive approaches to analysis as well as with design.

Concerning systems development research the ideas presented in this thesis may be used to revisit current analysis and design techniques, development of new techniques, or it may be used to challenge established traditions in analysis by providing alternatives.

The title of this thesis is *challenging practice*. The approach to cooperative analysis suggested here is one of challenging the practice being analysed. Furthermore, I hope that the empirical examples convey that embarking on such an approach is indeed a challenging practice for analysts as well as practitioners. Finally, it is my hope that the ideas will be taken up in the spirit of challenge in this thesis: as a challenge to existing practices of

system development and system development research by providing possibilities-that-matter.

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