Vidar Hepsø

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The Career of an Integrated Organization and Information Technology Concept

NTNU Trondheim
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-The Career of an Integrated Organization and Information Technology Concept

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Content

Preface

Having worked with organization development for a number of years I have come to see the collaborative aspects of most human activities and efforts. Thus I am very thankful to my wife Irene, I thank her not only for many inspiring discussions but also for keeping the familiy together during laboursome periods. Thanks also to my children Carina and Andrea who had to live with a rather absent-minded father during several long periods.

I would like to thank Statoil for awarding me a scholarship that made this thesis possible. Thanks to the input and support of previous and present colleagues in Statoil R&D, Norne, Statoil IT and Exploration & Development. Without your support my work would have been impossible. I thank in particular Jan Onarheim, Arnstein Borstad, Dag Sjong, Tor Hoås, Johnny Litzheim, Fredrik Wilhelmsen, Kari Skarholt, Jon Lippe, Merete Juul, Oddgeir Engdal, Terje Totland, Kristin Mauseth, Erik Bakøy and Knut-Olav Fjell.

As an insider in Statoil I have been dependent on discussing with people in the academic community. I would like to emphasize the many fruitful discussions I have had with my adviser Associate Professor Stein Johansen and the inspiring collaboration with Professor Eric Monteiro at the Norwegian University of Science and Technology (NTNU). Professor Davydd Greenwood at Cornell University has also given me major inspiration and feedback. I would like to thank the Infraglobe project participants (Claudio Ciborra, Kristin Braa, Bo Dahlbom, Antonio Cordella, Ole Hanseth, Jan Ljungberg and Kai Simon) for inspiration. Further, I thank a number of people that have given valuable feedback to things I have written on the work with this doctorate: Julian Orr, Per Morten Schiefloe, Tor G. Syversen, John Sherry and Morten Levin. I would also like to thank Stewart Clark at NTNU for doing the English editing.

Finally, but not last, I would like to thank Professor Jan Brøgger at NTNU. Jan Brøgger provided the input for my basic training in becoming an anthropologist. Even though my later career has become different from most of his academic work and practice, he helped me over the first threshold in entering the Statoil organization over ten years ago. His reputation and skills helped me to develop the credibility a young anthropologist needs.

Vidar Hepsø, Trondheim, December 2001

Introduction: Diffusion vs. Translation in Technological and Organizational Change

Statoil has invested considerable efforts in collaborative information technologies since the early 1990s. The growth of a LOTUS NOTES based infrastructure, a company-wide Intranet and other technologies and concepts that will be given a thorough presentation later, are manifestations of this policy. Various projects and organizational actors have been instrumental in developing ideas, concepts and solutions in relation to use of collaborative information technologies in Statoil. This development of new organizational practice and new information technology has been a substantial knowledge creation process. This process is traditionally seen as "diffusion" of new organizational practices and new use of information technology.

Like Bruno Latour (1987:132-144) I question the use of the concept "diffusion". How does the spreading of new organization and IT "objects" proceed, in the light of a diffusion model? In this belief, it seems that people easily agree to transmit the object. The object has its own power and forces them to assent. The behaviour of the people is believed to be caused by the diffusion of facts and machines, and obedient behaviour to turn the claims into facts and machines is forgotten. The same goes for the careful strategies that give the "object" its contours that are given assent.

Facts seem to move without people and seem to have an internal force independent of the actions of people and the support of their non-human allies. What gives the facts their thrust if this is the case? The diffusion model uses a mating system to solve this problem, believing that facts reproduce each other. The complex negotiation process of actors is forgotten. To use an analogy: the diffusion model is based in the belief that the object has the needed energy (order, command, instruction) inherent to spread by itself. The fact has a ready-made content. It is the inner quality of the fact that leads to its "diffusion" and the best quality wins. Objects are believed to move uninhibitedly unless they meet resistance and friction that burn off the original energy (in the form of resistance to change, political resistance).

The process of *translation* is another way of seeing this development, a concept that will be further elaborated throughout this thesis (see Chapter two for the main discussion). *In this perspective the new object has very little inherent "energy" and it needs to continuously be filled up with new energy by aligning and enrolling human and non-human forces in the world.* If not, it will die or deplete, as Bruno Latour (Latour 1996:86) argues: "For

technologies everyday is a working day". *In order to make it travel people must pass ideas on to each other and translate them to their own frame of reference. Since there is no inherent energy, it is only from friction that energy can arise. Without friction no translation can take place.* Friction is then an energizing clash of ideas in residence and travelling ideas that are leading to the transformation of both (Czarniawska 1997:95).

My thesis tries to go beneath the espoused idealized versions of an integrated organization and IT development, the front stage, and present some of the mechanisms at work that can both enhance and restrict such an integrated development process, the backstage. The arena is a research project in Statoil, called "The Collaborative Workspace" project (from now on called the CW project) that lasted from 1995 to 1999. Arenas are the settings in which paradigms related to organization and IT development become transformed into metaphors and symbols in everyday situations. Where groups mobilize power and in which there are trials of strength between influential paradigm-bearers. Arenas are where the situations, contexts and scenes take place, where ideas meet, are translated and decisions made.

The CW project had the ambition to develop new organizational forms, or work with organization development in tandem with developing and implementing collaborative information technologies. This research project had operational pilots in many parts of Statoil and was the fountain for many new ideas, concepts and solutions seen in relation to use of collaborative information technologies in Statoil. In this sense such a project was interesting in order to follow how an espoused integrated organization and IT development proceeded in the Statoil organization. The participants in the project group collaborated with a large external field interested in organization and IT development (researchers, consultancies and companies), internal vendors (Statoil Data) and Statoil units (the Tjeldbergodden methanol plant in 1995, the new Norne installation in 1996 and the exploration and development environment in Statoil in 1997-1998). As a consequence, the research project had a direct impact on the lives of several hundred people (new work practice and information systems), but indirectly (through the concepts and ideas) it affected thousands in the Statoil organization.

The narratives that follow in the later chapters are from the field of organization and IT development. Victor Turner (1974:17) once defined a field as the abstract cultural domains where paradigms (like how to conduct organization and IT development) are formulated, established and come into conflict. The paradigms Turner addressed consisted of rules from which many kinds of sequences of social action were generated (or in my narratives the methodology for integrated organization and IT development) but such rules and ideas also specified what sequences had to be excluded (in here: what became invisible). "Paradigm conflict arises over exclusion rules" he argued (1974:17). Organization and IT development is often seen as mere learning and empowerment. However, such a development process is also change, anger, flux and rearrangements of power structures.[1] In the management literature the espoused empowerment perspective dominate. Flux and power relations are often described as an anomaly.

The narratives that have grown out of this thesis work is that of a political field, a praxis developed through working in large organizations for over 10 years. The notion of a "political field" is important. Like Victor Turner (1974:127), I take it to be the totality of relationships (values, meanings and resources) between actors oriented towards the same prizes or values. Such an orientation includes that organizational actors compete for scarce resources, have a shared interest in safeguarding a particular distribution of resources and a willingness to

uphold or undermine a particular social order. I am well aware that human life and also organizational life is much more than politics and purposeful action, but I still argue that actors within organizations are goal oriented. This does not necessary mean that they are rational in the espoused business literature meaning of rationality. A political field is constituted by purposive goal-directed group action. However, all organizational action is situated, meaning action must have its foundation in a particular context that does not need to be aligned with more overall business goals. Goals in organizations are general, vague and have in most cases the necessary ambiguity for various interpretations, and must also have this multivocality to be flexible. This interpretation and flexibility create action that is seldom done with a view to sabotage or undermine more integrated corporate or management related organizational change efforts. In the light of the situated practices of various persons and groups, the response is sound. Seen from these situations the best interest of the company is indeed taken care of. However, seen from another perspective these actions can be interpreted as sabotage, disloyalty, conservatism and irrationality.

In the light of my previous discussion on translation vs. diffusion I will now try to formulate some questions concerning the innovation of integrated organization and IT development that will be considered in this thesis: *If we look at organization and IT development in Statoil in the last half of the 1990s, how were ideas, concepts and solutions in relation to use of collaborative information technologies (i.e. LOTUS NOTES and Intranet applications) developed and spread?* The following sub-questions will be covered in relation to this overall development: 1. How are ideas and concepts related to use of collaborative information technologies developed and spread in organizations? 2. What are the roles of human and non-human actors (information technology) in the development of collaborative information technologies? 3. What becomes visible and invisible as a consequence of such a process? 4. What can be done to deal with this invisibility in organization and IT development projects?

An anthropology of science and technology

It will soon be apparent that this thesis is of a hybrid character, mainly because I live and work in industry and have been used to multi-disciplinary collaboration (and borrowing from a number of disciplines). Since 1991 this perspective has been united under an umbrella of action research. I am a hybrid myself too, not totally emerged in the activities of Statoil and have spent very little time at the university during the last four years. In the next chapter I will present details related to this argumentation when I define my position as that of *praxhos*. In what follows I am more specific about these hybrid influences.

From the perspective of organization theory my work is influenced by neo-institutionalism, a tradition concerned with how ideas and concepts travel, find their form in institutions and are legitimated and institutionalized (Czarniawska & Sevòn 1996). I am also indebted to the socio-technical workplace democracy tradition in Norway of which Trondheim has a legacy since it was here it started. However, the major inspiration is from social studies of science and technology (STS^2) and the anthropological branch of this tradition, the anthropology of science and technology (AST). A major influence can also be found in what is called "informatics" in Scandinavia; the study of work practices and computer supported cooperative work (CSCW). Still, I have problems leaving the tradition of anthropology in which I was raised in the 1980s. When reflexive anthropology and postmodernism were increasing in popularity in the late 1980s, the Department of Anthropology in Trondheim continued its trail in the Humanistic direction (Erring 1986, Brøgger 1989) and a psychological almost Freudian anthropology (Brøgger 1976, Brøgger 1989, Johansen 1987).

Instead of being obsessed with symbolism, this implied continuing detailed empirical studies of people's actions, inspired by generative studies (Barth 1966), and less focus on symbolic systems. To the degree I was interested in symbols it was in the tradition of symbolic interactionism. This interest in the pragmatism of everyday activities has remained, where social life as drama is given precedence. The Freudian perspective has developed more into a clinical approach in fieldwork that is described in the next chapter as *praxhos*. It has taken me some time to see that this insider perspective that I have developed found its original source in the dyadic relations and reflection processes that Jan Brøgger describes between key informants and himself (Brøgger 1986, 1989).

In my early academic work (Hepsø 1990) where I studied transport workers, technology was not given much attention. It was a study of a community of practice that through their work created buffers to an aggressive techno-economic system, which I mainly described as a black box. I see retrospectively, that like my main sources, I ignored or had stereotyped notions on the influence that science and technology play in our lives (with an exception of Johansen 1987, Lamvik 1994, Johansen 1999). My major inspiration in this thesis, as a consequence, comes from STS and AST. Stein Johansen has over the last fifteen years been concerned with the general development of science and technology: virtual reality, complexity theory, genetic algorithms, evolutionary economics and memetics, seen from outside the STS tradition (Johansen 1987, Johansen 1993, Johansen 1999). This perspective has given me inspiration throughout my doctoral work and has ended up asking demanding questions to my STS perspectives.

The legacy of symbolic interactionism can be read in-between the lines in this work. It can be seen in the subtitle of the thesis, as Erving Goffmans (1961) "Moral career of a mental patient" that describes the institutionalization of identity and techniques used to make mental patients fit for a life within a total institution. I had to go back to the sources of this tradition, the American school of pragmatic philosophy and John Dewey's instrumentalism, to create a perspective that gives science and technology a more prominent place in my work, and still be situated in the tradition from which I came. In addition to generative models (Barth 1966), Erving Goffman and Victor Turner were my main inspiration in studying the dramatic aspects of change. Although Goffman lurks in the background (giving backstage, precedence over front stage and describing the dynamics in between), the dramatization of everyday activities in my work is more inspired by Victor Turner's social dramas, something I will soon come back to.

The AST tradition has grown strong in the 1990s. Gary Downey (1998) says that anthropological discourse recently (before reflexive anthropology (Marcus and Fisher 1986, Clifford & Marcus 1986) has made a sharp distinction between the activities of society and the development of science and technology. For a long time cultural action and technology/science were defined in separate domains. In this belief science and technology develop according to their own internal logic with specialized technical commitments free of cultural content.

Gary Lee Downey (1998) and Bryan Pfaffenberger (1988) describe the development of a transcription of human agency into technology. This started with Leslie White and Lauriston Sharp's traditional anthropological attempts to understand technology through technology determinism and give it a character of standing outside of society. Leslie White and others saw technological factors to be the prime mover of all cultural change. With the rise of theories of culture as shared and bounded symbolic systems in the 1960-70s, technology and

science was externalized from cultural accounts as well. A growing interest in the anthropology of technology developed at the end of the 1980s and changed this. In the early 1990s attempts to create genuine anthropological perspectives on technology were heralded. The reason for this was a counter reaction to STS sociologists who began to define a discipline and a reconstruction of anthropology in the STS without anthropologists participating (Hess 1992, Forsythe 1994, Downey et al. 1995). Bryan Pfaffenberger (1988, 1992, 1992b) was one of the first anthropologists to address STS issues with theories and perspectives that were founded in an anthropological tradition[3].

The anthropology of technology had to overcome nearly a century of peripheral status. Bryan Pfaffenberger (1992b: 491) describes how anthropology in its quest for professionalism came to view material culture as everything that was academically embarrassing (extreme and conjectural forms of diffusionist and evolutionist explanations, and armchair anthropology). He shows how the "Standard View of Technology" put forward a common sense view of technology that accord perfectly with an everyday understanding (Pfaffenberger 1992b: 495):

> All around us are artifacts originally developed to fulfil a specific need - juicers, word processors, vacuum cleaners, and telephones; and apart from artifacts that are decorative and symbolic, the most useful artifacts - the ones that increase out fitness or efficiency in dealing with everyday life - are associated each with a specific Master function, given by the physical or technological properties of the object itself.

Pfaffenberger develops two definitions of technology because the term technology so easily conjures up mere technical activities shorn of their social context. *Technique* refers to the system of material resources, tools, operational sequences and skills, verbal and non-verbal knowledge and specific nodes of work coordination that come into play in the fabrication of material artefacts (Pfaffenberger 1992b: 497). He defines *socio-technical systems* as the distinctive technological activities that stem from the linkage of techniques and material culture to the coordination of labour. Pfaffenberger argues that the proper and indispensable subjects of a social anthropology of technology include all three: technique, socio technical systems and material culture.

Those that develop technologies must concern themselves not only with techniques and artefacts. They must also engineer the social, economic, legal, scientific and political context of the technology. A "successful" innovation develops when all the elements of the system, the social as well as the technological have been modified so that they work together effectively. Technology expresses an embedded social vision. The perspective that grows out of this is an understanding of culture and nature in relation to technology. This is a total interpretation in Marcell Mauss's sense. Like Marcell Mauss' concept of a total gift economy; any behaviour that is technological is also, and at the same time political, social and symbolic (Pfaffenberger 1988:249):

> Every technology is a human world, a form of humanized nature, that unifies virtually every aspect of human endeavour. To construct a technology is not merely to deploy materials and techniques; it is also to construct social and economic alliances, to invent new legal principles for social relations, and to provide powerful new vehicles for culturally-provided myths.

This indicates that any study of technology's impact is in consequence the study of a complex inter causal relationship between one form of social behaviour and another. It is the hardened history of frozen fragments of human and social endeavour.

We now have an anthropology where technology is productively integrated in large parts of anthropological imagination. What has this new anthropological insight concerning

technology given us? It is beyond the scope of this work to present a review of this anthropological tradition. Readers should go elsewhere to find more details about this anthropological tradition that ranges from a general interest in science and technology, (Traweek 1988, Hess 1992, Martin 1998), cyber anthropology (Escobar 1994, Gray & Driscoll 1992), cyborg anthropology (Downey et al. 1995, Dumit et al. 1997), industrial anthropology (Baba 1986), and anthropology of work (Baba 1998).

From social dramas to technological dramas

John Dewey (1934) once argued that the aesthetic form of the theatre is inherent in socio-cultural life itself. The drama analogy has over the years been used to understand social interaction in general (Burke 1945, Goffman 1959), and also to describe social and technological change in particular (Pfaffenberger 1992, Czarniawska 1997). It is the latter perspective that I employ here and it is indebted to the work of Victor Turner. Victor Turner (1974) developed the term social dramas when he described a dynamic theory of social change that can be used to understand social and technological change in general.

Victor Turner saw the phases of social dramas as cumulating to a climax. Each phase had its own speech forms and styles, rhetoric, non-verbal language and symbolism. It is often manifested in myth or ritual, but in my use of Turner it is the drama of everyday experiences. It is often bounded in time as a project, but not viewed as a separate part of everyday life as for instance the Ndembu initiation ritual of Turner. I also intend to use the social drama as a vantage point since the ritual and symbolic dimension of technical activity is often ignored. We shall see in later chapters that participants in a performance do not always share common experience or meaning. Often, all they have in common is their common participation.

In the anthropology of science and technology Bryan Pfaffenberger (1992) has taken Victor Turner's social drama a step further into what he calls a technological drama. Technological dramas have phases that coincide more or less with that of Turner. Both Turner's and Pfaffenberger's dramas will be thoroughly presented in Chapter two. Here I end the presentation by arguing that the theory of technological dramas has a number of weaknesses that must be addressed. First, in his argumentation for an anthropology of technology the symbolism of technology (myth and ritual) is exaggerated leaving all pragmatic or instrumentalist aspects invisible. I go back to the American school of pragmatic philosophy to grasp the lived experience of tools and technologies.

The challenge is to show how the symbolic and the pragmatic/instrumental aspects interact via improvization and the dynamics of knowledge creation. Translation is a key term here. This must be undertaken to counterpart the closed or pre-described features of action and actors in Pfaffenberger's technological dramas. Technological dramas are seldom staged in the traditional sense. Second, the theory of technological dramas needs a more sophisticated methodological granularity to understand the interactions of humans and non-humans in everyday situations. Pfaffenberger does not provide us with the necessary language to study the dynamics of a technological drama.

I bring in actor network theory (ANT) as an important supplement and try to show that ANT can both be aligned with that of an ecological mind, pragmatism and the two forms of drama. This will be handled in Chapter two. Chapter one describes my *praxhos*, a term defined to describe my industry insider position in relation to academic anthropology; it also contains the methodological reflections in this work. Chapter three presents a short description of the

setting: Statoil, and the naturalization of the group (KOT) I follow in this thesis. Chapter four describes the key elements of the original ideas of the CW project and present some "wicked" problems in IT systems development. Chapter five is an empirical chapter that describes the CW project in action in 1996, towards Norne a new oil installation. Chapter six is an analysis of the CW project in Norne. Chapter seven is another empirical chapter that follows the CW project, or VISOK, in exploration in 1997-1998. Chapter eight is the analysis of VISOK. Chapter nine is the final chapter that considers the research questions by presenting some conclusions. It argues in favour of an approach that takes up lessons from the CW project in the light of the praxhos perspective. The empirical chapters of 3, 4, 5 and 7 are written without using STS-AST terminology. It has been my intention to make these chapters accessible to practitioners not interested in STS-AST-issues. As a consequence, these chapters can be read as stand-alone narratives.

Throughout the thesis I try to combine the notion of symbolic action with instrumentalism and pragmatism. My main contribution to the field of AST and STS is to show some examples of how these elements can fit together. Finally, this doctoral work contains a number of native Statoil abbreviations. In order to write my narratives I had to use the internal langauge, but to help the readers I have provided definitions of Statoil or oil-related abbreviations in the end of this thesis.

Chapter 1 An Insider Praxhos in Anthropology

1.1 Ideal types of fieldwork narratives

In *Anthropological Locations: Boundaries and Grounds of a Field Science* Akhil Gupta and James Ferguson (Gupta & Ferguson 1997: 1-46) discuss "the field" as site, method and location in anthropology. One of their objectives is to sketch out how the notion of "the field" and "fieldwork" developed and start discussing alternatives. They describe three key consequences of the construction of the field of anthropology through the practice of fieldwork. First there is the radical separation of "the field" from "home". The data is collected and written up in the field while the reflective, polished and theoretical aspects of the work are developed at home. Entry and exit from the field authenticate and authorize the academic work that follows. Connected to this notion of field vs. home is a hierarchy of purity of field sites. Africa is more field-like and consequently more anthropological than industrial corporations. Second there is the valorization of certain kinds of knowledge to the exclusion of other kinds. There is also a hierarchy of topics or objects of study. Things that are unfamiliar and different from home become suitable as anthropological objects. Third there is the construction of a normative anthropological subject (an archetypical ethnographer, who is believed to be a middle-class Euro-American white male with an academic position), and the existence of an anthropological "self" against which anthropology classifies its "Others". Anthropological objects are assigned positions based on degrees of "Otherness". Field sites that stand most clearly opposed to a middle-class self are favoured by the hierarchy of field sites. This notion of "us" vs. "others" has strong political implications and becomes problematic for those where the anthropological project is not about the exploration of "Otherness".

Diana Forsythe (1999:6) follows the argumentation of Akhil Gupta and James Ferguson when she claims that the anthropological fieldwork has been dominated by the traditional narrative that Bronislaw Malinowski (1922) depicted in the *Argonauts of the Western Pacific*. I believe that it is possible to write specific fieldwork narratives for each anthropological school but start with Forsythe's dichotomy to define heuristic ideal types of fieldwork narratives. In her opinion the Malinowski narrative of fieldwork (Forsythe 1999:6) has the following characteristics: Fieldwork usually takes place away from the ethnographer's normal environment, both in geographical and socio-cultural terms. The informants and the anthropologists' social worlds are socially unconnected, since they live in different societies, or social strata. The informants are powerless over the way anthropologists represent them,

and the anthropologists' action during their fieldwork will have little consequences on the researchers later life. Further, the anthropologist is most likely paid by a source that is external to the people studied. He or she is only temporarily bounded. The informants' occupations are different from that of the anthropologist and the anthropologist lacks proper work and language skills in most cases. As a consequence, the anthropologist is seldom a genuine participant in the community's practices; he or she has come to observe, but a visitor.

As a contrast to this traditional narrative, Diana Forsythe describes a new fieldwork narrative (1999:7-8) that addresses the situation for anthropologists doing anthropological fieldwork within the arenas of science and technology. Such fieldwork takes place among people from similar social, cultural and class background as the anthropologist, often geographically close to home. The social world of the ethnographer and informants may overlap considerably. This collapses the roles that remain separate in the traditional narrative. Informants can be colleagues, friends or your employer. Role distinctions in the new narrative may blur or break down altogether, so that informants, founders, colleagues, employer, grant reviewers, and job referees sometimes turn out to be the same individuals. This new state of affairs changes the power relations in the dyadic relationship between anthropologist and informants. The powerless of the old narrative can have considerable power over the anthropologist, and representational issues are more complex. They read the anthropological texts, find them interesting and contest them. Fieldwork may not be temporarily bounded as strictly as in more traditional fieldwork. Indeed it may have no clear endpoint at all. One does not necessarily go away but continue to work in the same setting for a lifetime. These anthropologists find themselves studying people whose work and work skills are quite similar to their own. There might be overlaps in what they read and the topics of their academic writing. It opens up the possibility to be much fuller participants in events in the field. A situation that is unlikely to happen for many ethnographers under more traditional circumstances where being a visitor or guest is most likely the only achievable position.

These two narratives are ideal types and most anthropological fieldwork is somewhere in between. Both narratives (less the latter as I intend to show), stress the idea of value-neutrality; how to avoid intervention in the setting and portray the alleged dangers of going native as an insider. I was confident that I should remain an insider in Statoil, and at the same time study the context where I worked. This perspective laid the foundation for a project that ended up in the problematic periphery of central anthropological assumptions; related to how to do fieldwork, questions of impartiality, relations with informants, the analysis of data, the writing of ethnographic texts and moral and ethical considerations related to the people you study and walk among. It demanded a sophisticated form of reflexivity in relation to: methods, data analysis, writing of texts and credibility of anthropological research. This chapter presents the methodological perspectives of this thesis, in terms of four overall issues: i) a detailed description of my position as insider industrial anthropologist compared to academic anthropology that I have oriented myself towards including my epistemological and ontological position, ii) my choice of methods, iii) my collection of data and analysis, and finally, iv) the credibility and trustworthiness of the research that is conducted.

1.2 Reflexivity and practice in science and technology

In order to define an insider perspective I had to find a way from present "state-of-the-art anthropology". There were two main influences here. The first source of influence was the

growing occupation in anthropology with *praxis* (Bourdieu 1977, Bennett 1996, Rubinstein 1986, Barth 1994, 1997, Greenwood 2000, Baba 2000). Fredrik Barth has been a major spokes-person for articulating a more sophisticated unification on theory and practice in anthropology (Barth 1989, 1994, 1997). Much of his recent work has taken shape as a reaction to the post modernistic, reflexive and interpretative criticism that was popular in the 80s and early 1990s. Barth argues for the need to pick up the pieces and resume the tasks of regular anthropology (Barth 1994).

Reflexive anthropology (Marcus & Fisher 1986, Clifford & Marcus 1986, Rabinow 1985, Rose 1990) was in the front of developing a critical and sophisticated discussion of anthropological practice and knowledge production related to a number of important issues: the authority and legitimation of ethnographic texts, fieldwork practice, data analysis and the roles and politics of anthropological practice. What can this mean for an insider anthropologist working in Statoil that is picking up the pieces of postmodernistic critique? I will return to this shortly.

My second source of influence came from another rather new anthropological discipline: the anthropology of science and technology (Hess et al. 1992, Downey & Dumit 1997, Franklin 1998, Martin 1998) (from now called AST) and a tradition closely associated with AST: social studies of science and technology (STS). AST and STS are diverse disciplines and I can only give a superficial description of their projects here, more will be said in later chapters.

Since the personal and structural impositions in my work as an insider were different from that of a traditional academic anthropologist I regard it as very important to define the key features of my position (within the landscape of AST, STS more in general and the *praxis* perspective in anthropology). I have elsewhere called this an ethos of an industrial anthropologist (Hepsø 2000). It is a hybrid position because it has taken up elements of features situated in different domains in anthropological theory and practice: insider-outsider, pure-applied, intervention-participant observation, home-fieldwork and academy-industry.

In what follows I will call it *praxhos,* a mixture of two words praxis and ethos. First, because it is a set of attitudes to the world aligned with Gregory Bateson's (1936) concept of ethos. Second, since it is grounded in an embodied practice, a lived insider world enmeshed with human and ethical values, I take out elements of praxis. Still, to make sure that the insider element is kept in mind I want to use the term *praxhos*, since the notion of praxis is used by the academy. *Praxhos can therefore also be seen as an epistemological insider critique to institutionalized assumptions about what anthropology might be.*

1.3 The praxhos of an industrial anthropologist

Epistemological critiques of anthropology's knowledge production have increased in quantity over the years (Wagner 1975, 31-34, Marcus & Fisher 1986, Clifford & Marcus 1986, Rose 1990, Latour 1993, Cerroni-Long 1995, Williams 1997, Lutz 1988, Hess 1991). My praxhos follows up this idea and views anthropology from an industrial setting via an insider perspective. Let me now describe the two elements of *praxhos* in larger details before I describe the six aspects of my *praxhos*.

Gregory Bateson defined ethos as an expression of a culturally standardized system of organization, the "instincts" and emotions of individuals, a feel of culture that is causative in shaping behaviour (Bateson 1936: 118), an attitude towards reality and the world. Bateson

used *eidos* to describe the social structure, and action more in general. He (Bateson 1972:83) used the analogy of a river and its banks to describe the relationship between ethos and eidos. The river moulds the banks and the banks mould the river. Ethos moulds the social structure and is guided by it. An ethos is then a frame of reference in which action takes place (Bateson 1936:119-122). Praxis, the other element of *praxhos*, comes in as a natural supplement through action. Praxis in the Greek meaning of the word corresponds to actions or doings. Aristotle ascribed a technical meaning that is lost in the English word "practice". William Partridge (1985:142) uses "praxis" to designate the sciences and arts that deal with activities characteristic of human, ethical and political life. Here the distinction is made between "theoria" and "praxis" in which the former are theories or activities of the sciences and arts concerned with knowledge for its own sake. The latter is theory and activity in those sciences and arts that are concerned with doing something:

.. where the end embodied in the activity is not primarily the production of an artifact (e.g., creating knowledge, per se), but rather the performance of the activity in a certain way - performing the activity in an ethically responsible and politically effective way (i.e., creating knowledge that is instrumental to ethical and political ends). *Praxis* in this context signifies the theories and activities that affect human ethical and political behavior in social life. Such theories and activities contrast with other theories and activities not involved with or relevant to ethical and political behavior in social life.

In English, "practice" describes the mundane, the everyday activities often unconcerned with theory. However, praxis embodies ethical and political theory and practice as a process of social life, including intellectual life. It is a negotiation between what is considered as objective knowledge and depicts subjective knowledge being transformed through action. The subjective knowledge is the generative force whereby the objective knowledge is constructed, adapted and changed (Partridge 1985:152):

The objective component of practice, then, corresponds readily to the applied anthropologist's concept of the symbolic/structural order. The subjective component of practice is that subjective organizational rationale in which actors are habituated.

A practitioner of praxis is engaged in an interaction between theory and activity in the real world, as William Partridge argues (1985: 144):

...an interaction through which social life is lived in such a way that the practitioner is compelled to make ethical and political decisions that matter. This is possible precisely because the practitioner of *praxis* has reference, and in order to continue being some embedded must continually, constantly adjust both theory and activity. *Praxis* is a *kind of knowledge* of the world that compels ethical and political decisions; it is an ongoing interaction with the world in which the results or outcome of those decisions shape the nature of the *praxis* that is achieved. Because social life requires that decisions must be taken, *praxis* is in part subjective; it is grounded in decisions taken by actors, not by spectators, who must live in the consequences.

My *praxhos* shares the elements of Partridge's praxis, but in order to argue for an insider or hybrid alternative to praxis I call it *praxhos*. To sum up, *praxhos* is a set of sentiments, an ethical and political attitude towards reality and the world that through action leads to particular ethical and political consequences. It is an alternative, or subset, to praxis lived through by an insider (praxis is lived through as an outsider) and finds its shape through the dynamic negotiation between subjective and objective knowledge through action. It has a number of similarities with Aristotle's *phronesis*[4]. Six main aspects or facets of this praxhos position will now be further elaborated.

1. The whole person aspect: The anthropologist is more a whole person in the fieldwork setting. The key essence of my praxhos position is the following: When working as an industrial anthropologist there is a constant demand for consistent performance. Because of

the values of the organizational structure and the culture you live and work in, it is very difficult to split your "self" in two, one as an anthropologist and another as a company employee without constructing and reconstructing your life as a farce. *A praxhos must be lived.* I am unable to devalue my choice of working for Statoil by performing insincerely, that is, by maintaining a constant distance between identity and role. Such problems exist in all anthropological fieldwork, regardless of whether it is industrial anthropology or not, but it is stronger the closer you are to your own culture and milieu. The main point is that we as anthropologists invest too little attention to what this multiplexity of character means. What would Edmund Leach say if he was asked to tell how his background as an engineer and army officer influenced his work as an anthropologist? Alexandra Jaffe (1995: 37) describes a primary example of this tension between the roles of a member of a corporation (an army officer) and being an anthropologist:

> But my experience as an anthropologist in the Army also emphasizes to me that the dynamics of involvement/ detachment are extremely complex and are influenced by factors that the ethnographer can only partly control...ethnography is not about resolving but exploring the relationships between involvement and detachment that is a part of life in general. Reflexivity or involvement cannot be turned on or off at the will of the ethnographer, who carries an extensive baggage of social/personal history and academic assumptions into the field. While it may be desirable to unpack these tacit assumptions, it is often very difficult and sometimes disquieting...I assumed that my military identity would remain secondary and that my concerns as an officer would never seem as real and legitimate as carrying out my academic training. At the heart of my assumption about military duty was a belief that the ideology of membership, and the values and value of the institution in the abstract, had a primary, determinate effect on the experience of membership. I did not believe that the ethical/ideological premises of military membership were as inherently valuable as those of the academic world.

In my case this multiplex identity of anthropologist and company employee meant seeing myself as a human resource strategist and my work as an integration of the sub-roles: friendly helper, autodidact computer programmer, facilitator, strategist, anthropologist and salesperson integrated into a "phantom role" (Pace 1991). I have a basic educational background in anthropology. However, it is the work in this insider phantom role and the combination of work skills and knowledge that makes me develop new ideas. In the end this knowledge is portrayed as anthropology, but little of this reservoir of knowledge is just anthropology. In the field I worked with those that have the expertise and found that an insider anthropologist needs to grasp an "overall" picture of a given setting.

By participating I learn about disciplines where I have no formal training. Openness to taking the local knowledge seriously is a consequence of this, and just being an anthropologist is not enough in these complex settings. Within high-tech organizations like Statoil you need updated working knowledge and practical skills in a number of domains in order to be able to enter the complex life worlds of the people of which you collaborate or study. I do not have the nerve to study organization development and information technology without being able to programme computers and understand a native IT language.

An important question remains (that is both ethical and methodological): can anthropologists or ethnographers of science and technology study (like Sharon Traweek (1988), Paul Rabinow (1996, 1997) and Bruno Latour (1979,1987) have done) and then "deconstruct" a work domain where they are laypersons (natural science, genetics)? In the STS, many scholars are bi-professionals, i.e., social science and genetics, but there is an increasing critique of this deconstruction (see Brockman 1996). Because of the complexity of the work practices of these scientists I accept that this is problematic, and the solution I see in my context is a joint or a collaborative effort (aspect 3), an interventionist or prescriptive agenda

(aspect 4) and a process of co-learning (aspect 5). Before I start addressing these issues I must discuss the systems in which multiple anthropologists work.

2. *The system representation aspect: the system you represent will colour the content of your practice.* In 1997 Statoil awarded me a 4-year scholarship to write a doctoral thesis in anthropology. I started to work for Statoil, the State oil company of Norway in 1991 and have since then worked with research in multidisciplinary teams with people in operations, engineers, computer scientists and fellow social scientists in a variety of settings in Statoil from production of oil to exploration of new oil resources. I started as a researcher and ended up being the project manager of an important organizational research pilot in 1996. When my scholarship was awarded a number of official and unofficial expectations came along. I still worked for Statoil, the scholarship represented 80 % of my working hours, and for the last 20 % I had to take part in ongoing research projects.

Statoil demanded that the study I conducted should be "useful" for Statoil, that is, to inform action in present business activities in the organization. The fieldwork had to take part in Statoil and be a part of an ongoing research project that my colleagues were conducting. Many of the persons that I would be studying were close friends and colleagues. They were knowledge workers, critical and reflexive thinkers, some had doctorates themselves and several had a background in the social sciences. My colleagues had expectations about my work and how it could be useful in their own development, both personally and as a team. Statoil is a well-bred capitalist, but partly state owned company, and my perspective will be influenced from my position within such a system, both related to organizational values, goals, and what I can do. Statoil is a key symbol of Norwegian society and industry. In many ways it is a company operated by capitalist principles and values but it is also dedicated to carry out the policies of Norwegian legislation that regulate: employer-employee relations, work environment and quality of working life. To maintain a critical role towards the politics of science and technology while at the same time participating in a setting that develops both science and technologies is challenging, but not impossible.

The challenge with my work is *critical participation* and in the later chapters I will give a number of examples of how this "critical participation" can be conducted. The greatest challenge is that of co-optation, that is, my work as a researcher is used in another fashion than was intended originally, or that organizational stakeholders adapt your idea and use it in a different setting to support their own ends. I have experienced both intentional and unintentional co-optation and learnt to live with it, but have also taken measures against it. Much co-optation is unintentionally done by organizational stakeholders and can be sorted out by discussing the issues with the actors themselves. I have concluded a number of projects I could not support because of my own convictions whether these were of an ethical nature or more related to the end product or the ongoing processes in the projects themselves. As there are abundant research projects in Statoil I have had the privilege to be able to maintain such a position. On several occasions I have ended collaboration with people that I have not considered trustworthy because of the reasons discussed. However, I acknowledge that co-optation is always possible; but that it is a chance you have to take when intervening in the lives of people in an organization.

How does academic anthropology look at these issues at the turn of the century? The standard perspective in anthropology is still to believe in value neutrality and avoid interventionist projects that might jeopardize the value free flow of ethnographic descriptions and interpretations. If anthropological knowledge production of some sort is relevant for industrial

companies, the best thing is to retain this distant and non-participative role. Potential co-optation and the loss of academic integrity are important issues to address, but in many ways it has paralysed anthropologists from developing new collaborative patterns and fieldwork practice. In addition, it leaves little room for discussing the politics of traditional anthropological fieldwork practices.

The literature on the politics of academic anthropology has recently grown in intensity. Dan Rose's (1990) descriptions of anthropology as a bureaucratic form of life that makes the pursuit of ethnography difficult is one example. The academic anthropologist in Rose's world is a protagonist of his or her corporation: the academy that will inhabit its own bureaucratic logic as I inhabit mine in Statoil. Further, consider the critique of the academy's bureaucratic logic: the elitism, monopolitic knowledge production and non participative role of the Humboldtian university (Greenwood & Levin 1999), the bureaucratization in terms of revenue based budgeting and other mechanisms that turns the university more and more into a traditional corporation (Hess 1999) or Marietta Baba's (2000:31) description of the Humboldtian habitus:

> This habitus, the tendency to demand that theory be couched in exotic terms, is an important characteristic of anthropological culture, one that requires for its development an education accessible only to the few. The resulting exclusivity of theory construction and its exotic nature maintains the closed nature of the theoretical inner circle and safeguards the claims of theoretical elites to a privileged position within our disciplinary sub culture.

Davydd Greenwood (1999:56) describes anthropology at the turn of the century as "inaction research": "self-serving and self-referential activities of academics speaking to academics regarding what other academics said about what other academics said". He sees the humanities involve in skilful engagement with social groups to assist them in developing the skills and analysis to change their situation (Greenwood 1999:56). William Partridge (1985: 157) addresses the issue of a concern with *praxis* that he contrasts with the following:

> This ethic of action contrasts vividly with the *ethic of non-involvement*, which fits hand-in-glove with abstract anthropology, the way of knowing about the world called *theoria* or the theory of the theory... It explicitly condemns scientific work in the public and private sector outside the university as polluting and views the involvement of anthropologists in the institutions of the modern world as prostitution. It candidly argues for abstract anthropology as a kind of social criticism - a non-committed, nonparticipatory series of pronouncements as to the state of the world and its multitudinous organizational entities. This is the ethic of a sideline field judge, which for *theoria* raises political and social impotency to a level of moral exemplum.

For an insider anthropologist who wants to be useful in the lives of people the situation Baba, Greenwood and Partridge describe is intolerable. It is important to provide models of alternative, non-reifying ways of thinking and to write about science, technology and society but I see the need to intervene in a positive manner in the lives of people.

Some further input to this usefulness can be found in a recent edition of the *Anthropology of Work Review* (Hogle & Downey 1999) where the editors invite readers to consider the challenges raised as opportunities arise to move creatively towards new forms of critical ethnography and narratives that make a difference without having to choose between entrenched opposition and co-optation. Bringing in practitioners like John Sherry and Lucy Suchman, the editors (Hogle & Downey 1999): ask: "How do we make an anthropology of science and technology and work that is both critical and respectful, co-operative and yet free to express dissent, responsive and empathetic yet maintaining fidelity to intellectual and methodological groundings?"

Lucy Suchman (1999:12) says in her paper that her anthropology is a way of involving a view of critique not as ridicule but as questioning of basic assumptions, and of practice not as transcendent but as deeply implicated. She believes, speaking from her own practice at XEROX, that the identities of informants may change as we enable them to critically assess their own assumptions. Suchman's goal is to make visible and facilitate *indigenous dissent* (Suchman 1999:12): "...I recognize the paradoxes and contradictions involved: while my status within the corporation makes me vulnerable, it also grants me power and privilege". The next four aspects of *praxhos* will describe my attempt to get out of this alleged "inaction research" and continuing the process of indigenous dissent. I start by describing anthropology as a collaborative effort (aspect 3).

3. The collaboration aspect: the anthropologist is in most cases a team member. Marietta Baba (1986) once argued that the lone anthropologist has few chances in the interdisciplinary team environments of the business world. The anthropologist has to be familiar with the theories and methods of other disciplines and be able to communicate and negotiate with a range of professionals, in my case in Statoil: offshore workers, engineers, MBA's, earth scientists and computer professionals. It also entails an ability to translate the detailed findings into written and spoken forms that are concise, streamlined and understandable to non-anthropologists (Baba 1986). Team ethnography is increasingly acknowledged as a methodology as opposed to the lone ranger perspective (Erickson & Stull 1998). Integrated insider and outsider team research is also becoming increasingly popular (Bartunek & Louis 1996).

A practitioner of *praxhos* functions as an ordinary team member and is given space in a research process because he or she has qualifications that the others do not have. In my project, the other team members and I had complementary roles. However, a praxhos anthropologist has to play by the same rules as the other team members. The reality construction process that includes writing texts is in traditional ethnographic studies entirely in the hands of the anthropologist. For the practitioner of praxhos this construction process is a joint effort.

Different team members compete on what view and voices should be dominant, and all team members make sacrifices in this process, in order to develop a thorough understanding of the socially constructed organizational realities. When different knowledge domains are combined, something new emerges, that the engineer or the anthropologist never would have seen on their own. It blurs the distinction between the anthropologist and the engineer. This did not indicate in my case that cosmologies became identical, but by participating in fieldwork or in the research process a shared context and experience base developed. This shared context makes it possible to create a shared narrative that triggered the further development of reflection in the research process.

This perspective is not unproblematic. John Sherry (1999:20) shows how there will always be tension surrounding anthropologists' professional identities and the ways we perform and construct them. He describes himself as being a member of multiple communities and to be in a situation where we must always balance and discern competing agendas.

> By providing non-specialists with a legitimate sense of participation in ethnographic data gathering and /or analysis, anthropologists ensure a more receptive audience for the alternative interpretations and potential critiques that may arise within the course of a project". "The most fruitful dialogues between ethnography and design seem to occur when anthropologists manage a hybrid- maintaining some specialisation while encouraging colleagues to share both fieldwork and the critical perspectives afforded by our discipline.... At the same time, by

involving engineers in the gathering of field data, anthropologists in high-tech firms may find a way out from under the burden to produce some elusive "perfect" text.. The same politics of participation that allow design teams to use a shared field experience for achieving design consensus may actually provide an occasion for an anthropologist team member to engage members of the team critically, challenging assumptions without having to worry about crafting the right performance to get the right kind of attention at the right time.

The perspective of Sherry, which I support, is still problematic from the perspective of AST and most STS. AST says that the main danger in mediation (of the sort described) lies in the question of membership, for membership brings commitments that can last. (Downey & Dumit 1997: 16):

One can gain the opportunity to participate comfortably in a consulting role, offering valuable advice that helps each perspective take account of others. But to what extent does achieving membership make it more difficult to distance one's work and ones self? To what extent does one limit one's role to a consultant politics, stuck in the job of helping others concoct strategies to fulfil their objectives?

I acknowledge that I have to deal with this insider paradox methodologically, see Section 1.5 for more details about how I did this. Critical voices of ethnographers may evaporate in a group of engineers and computer scientists, but as I see it, the only way to have a decent relationship to professionals whose competence I can only access as a layperson is team work of the kind that Sherry describes. I regard it as methodologically problematic to deconstruct non-anthropological scientists' or specialists' cosmologies by myself. This is regardless of the fact that you work with professionals or study their practice.

4. The intervention aspect: The focus will move from descriptions and interpretations to interventions and acting on the results of the research. AST addresses the writing of anthropological texts from the perspective of intervention. What specific form or content do these interventions take? Anthropological fieldwork practice and texts should signify intervention within the growing arena of science and technology (Downey and Dumit 1997:27). This kind of intervention has the objective of defining several types of critical narratives to describe how a given situation has developed. It should make boundaries visible and show what types of theoretization or narratives cultural or political elites have rendered invisible.

The major problem is still the critical distance that AST advocates, for two main reasons: How do you know that the critique is sound, that it is actually a "representative" narrative of the situation(s) described? Secondly, just criticizing practice may open the eyes of groups but intervention with texts will not necessarily lead to change. Two additional products are needed: first a falsification mechanism to judge the probability of interpretations in a dialogical setting, and second, a perspective that opens up a possibility to take the critical perspectives into a theory of action that can make people change their situation.

This last point will take the *praxhos* anthropologist beyond a narrative paradigm and interpretations of narratives. In this litmus test, it will be the "workability" of the narratives that will be the criteria of truth. Arenas for dialogue (Dewey 1934) and "to keep the conversation going" will be an important agenda for the research. Participants in the research should act on the "findings" or texts. Changed practice in the organizational setting will be the ultimate criteria if the "findings" were true or not, see Section 1.5. This idea of a "test" is strange for most anthropologists practising today, as Davydd Greenwood (2000:165-166) argues:

My experience of cultural anthropology in the last three decades does not lead me to think that any but a tiny minority of cultural anthropological theorizers have shown interest in "testing" their theories. Rather, it seems to me that the practice of so-called theoretical anthropologists is to articulate their theories (usually heavily larded with jargon), criticize other theories, and debate with each other. Operationalizing theory and subjecting theories to anything remotely reassembling a "test" is rare behavior. As a result, I personally doubt that the need to test theory will provide a common ground with anthropologists engaged in "praxis". I see the privileging of untested and often untestable theories as a common trend in anthropology, sociology, feminist studies, ethnic studies, cultural studies, literary studies, and so forth in the post-Vietnam era.

In the light of Greenwood's pessimism, let us deal with testing and intervention in some detail. This situation has not always existed and I bring in the work of Sol Tax, and action anthropology, to argue that this has been tried in the past and can become a component of a *praxhos*. Action anthropology is associated with the work of Sol Tax and his colleagues that from 1948-1959 conducted a long-term project among the Mesquakies Indians, known as the Fox project (Tax 1952, Tax 1958). Tax describes action anthropology as follows (Tax 1952:103):

By definition, action anthropology is an activity in which an anthropologist has two coordinate goals, to neither one which he will delegate an inferior position. He wants to help a group of people to solve a problem, *and* he wants to learn something in the process. He refuses ever to think or to say that the people involved are for him a means for advancing his knowledge; and he refuses to think or to say that he is simply applying science to the solutions of those people's problems...In any case, he has moral justification for expecting the community which gains from his scholarship to help the development of new knowledge that may be used to help others. One may characterize action anthropology by saying that the community in which it works is not only its *subject of study* but also its *object.*

Action anthropology stressed the clinical, the experimental, as Sol Tax (1952:105) argued:

The best way if not the only way to test a hypothesis concerning a group's perception of a situation is to change the situation in terms of the hypothesis. Indeed, one may say that description of the culture itself (in such terms) requires a program of action in the same way that diagnosis of a sickness often requires treatment. The interplay between understanding of the situation and doing something about it and understanding it better is so intimate in theory concerning the dynamics of acculturation that simple observation is a wholly inadequate tool...The basic problem that the action anthropologist deals with is community organization, and his chief tool is education... He must guess and improvise, and in some degree always play by feel. In order to learn, he must therefore teach; and thus deny himself the simpler role of observer, or even participant observer. He becomes in a sense a more responsible scientist, playing "for keeps" in the development of his theory; with the consequences of error and burden heavy upon his own work, his future, and his conscience. Lost then is the conformable familiarity of objectivity, and the mantle of science as it is usually understood.

Fundamental theories of practice and theory have been discussed for a long time within the borders of anthropology (Hill & Baba 2000). The multidisciplinary character of this intervention work has already been mentioned by John Sherry and Lucy Suchman, that participate in the informatics related communities like CSCW (Computer Supported Cooperative Work) and CPSR (Computer Professionals for Social Responsibility). Most of my previous publications have also been within these multidisciplinary communities (Hepsø 1997, Hepsø et al. 1997, Gjersvik & Hepsø 1998). As Davydd Greenwood argues, and it is most likely that both Sherry and Suchman will concur, the problem of theory-practice is much broader than the internal problems in professional and intellectual relationships in anthropology. As a consequence, the solutions cannot be formulated solely from within the field. Greenwood (2000:167) argues:

If we believe that the theory-practice problem is an internal one to anthropology, then we seek internal solutions in dialogue and professional reorganization. If we believe that these problems are endemic to critical and reformist social science, then it makes more sense to address them through a broader coalition of social researchers committed to the integration of theory and practice for the purpose of social reform.

Greenwoods solution, as mine has been through much of my praxhos, is to enter these multi-disciplinary arenas and collaborate with communities that are interested in social reform irrespective of whether they are social scientists, engineers or computer programmers. Through my previous professional work action research has been an alternative here. Action Research (AR) is social research carried out by a team encompassing a professional action researcher (or several) and members of an organization or community seeking to improve their situation.

We dwell on one particular version of it: pragmatic action research (Greenwood & Levin 1998). It has a number of characteristics that make it different from traditional, applied social research. Firstly, AR promotes broad participation in the research process and supports action leading to a more just or satisfying situation for the stakeholders. Secondly, the professional researcher and the stakeholders define the problems to be examined together, co-generate relevant knowledge about them, learn and execute social research techniques, take actions, and interpret the results of action based on what they have learned. This means that AR democratizes the relationship between the professional researcher and the locally interested stakeholders. Thirdly, AR rests on the belief and experience that everyone including professional action researchers constantly accumulate, and organize, as well as use complex knowledge in everyday life. Lastly, AR is not applied research in the traditional sense, because it explicitly rejects the separation between thought and action that underlies the pure-applied distinction that has characterized social research for a number of generations. Valid social knowledge is derived from practical reasoning one is engaged in through action. Action is the only sensible way to generate and test new knowledge. AR is a combination of three elements: research, action and participation (Greenwood & Levin 1998;6):

> ...AR is a form of research that generates knowledge claims for the express purpose of taking action to promote social change and social analysis. But the social change we refer to is not just any kind of change. AR aims to increase the ability of the involved community or organization members to control their own destinies more effectively and to keep improving their capacity to do so.

5. The co-learning aspect: The principle of co-learning. Robert Rubinstein (1986) argues that work on practical problems provides opportunities for the development of new and more powerful theories and is likely to give anthropologists chances to develop new theories that might not easily be explored in other contexts. In the Statoil research projects I participated in the mid 1990s, the lines between the researchers and the people with which we were collaborating had become increasingly blurred. It had become a mutual process of learning and knowledge creation, where we also tried to act on the knowledge that was developed to improve our performance. It became evident for me that my doctoral work should also provide learning opportunities for the context I studied. If this was to come true, I had to create arenas where I could share my work with the people of the corporation, receive feedback and help them in their own reflective process. This included a wish to let the people I worked with also have considerable power to decide which questions and issues should be included in the work and in my analysis. I believed in encouraging people to work with research even though they were not professional researchers. In this lies a belief that research should incorporate democratic values. As a consequence, involving the diverse stakeholders of the context in the research process.

Given such a perspective and in the spirit of philosophical pragmatism, I found action research's co-generative model to be the only viable research position. The co-generative model evolves around an encounter between the worlds of practical reasoning and

scientifically constructed knowledge. It does not assert the superiority of either type of knowledge. It believes that research processes should bridge these worlds by integrating practitioners and professionals in the same knowledge generation process (Greenwood & Levin 1998). Rubinstein has caught the essence of such activities when he calls science an open-ended process where theories are more or less useful, than true or false. His argumentation (Rubinstein 1986:272) is founded in pragmatism because human knowledge is always contingent and incomplete; the truth of a theory is always an open question:

> Moreover, since scientific judgements and practical judgements are equally and always taken under conditions of uncertainty, emphasizing the structure of activity underlying applied and basic research reveals them not necessary be different. What distinguishes science and theoretical innovation from nonscience is not the arena in which work is carried out, but rather how those seeking knowledge react to the unexpected, anomalous data... In the presence of what Charles Peirce calls the "scientific spirit", theoretical innovation is no more likely to come from a work in the basic discipline than from work in an applied area.

There is a large element of philosophical pragmatism (Dewey 1934) in this approach to truth. Truth is not a correspondence between subjective ideas and externally existing objects. It is not a relationship at all but a practical criterion of action. Your idea that there is a chair on the other side of the room is true if you are able to sit down in it. Ideas are true if their consequences are such that they enable someone to carry out some action successfully. If one should validate the guesses it will not be based upon a logic of empirical verification. The aim is to show that an interpretation is more probable in the light of what is known and differs from saying something is true or not. The *praxhos* anthropologist therefore sees the nature of knowledge and validations as an argumentative discipline comparable to the juridical procedures of legal interpretations. This process always goes on within a social situation that recognizes the power of cross-examination and interpretation.

Compared to AST and STS that share much of the same position of pragmatism (Bowker 1994, Bowker & Star 1999, Latour 1999), most of these perspectives lack a theory of action. Action research on the other hand consists of practical reasoning in action and local reflections by native participants on their actions. A co-generative process consists of at least two phases. The first deals with the clarification of an initial research question (that should be of great importance for the heterogeneous group), whereas the second involves the initiation and continuation of a social change and meaning construction process. The research question always changes in the process. There are two main groups, first a loosely assembled community group and a researcher(s), whose major aim is to facilitate a co-learning process aimed at finding solutions to local problems. The action researcher does not blindly accept the problem formulations of the community; it is a mutual process between the community and action researcher, a democratic dialogue. It is of major importance in such a co-generative process to create spaces for the learning process that ultimately results in the creation of meaning that the community trust.

The feedback learning loops that result from communicative action on these diverse arenas are twofold: For the community participants the most important product is to improve their action knowledge. The action researcher's main product is new knowledge and empirical data for publications. The community has genuine knowledge about the context, while the action researcher brings in more generic anthropological knowledge. The researcher must let go of the power to the community as the process progresses (Greenwood & Levin 1998:122):

> For a process to be called AR, it must be systematic and oriented around posing questions whose answer require the gathering and analysis of data and the generation of interpretations directly tested in the field of action...it is not AR unless the knowledge is expressed, analyzed, and tested in action by the participants.

The interaction between local knowledge and anthropological knowledge through a co-generative process is the core principle of action research. The co-generative idea is a sophisticated co-learning model based on the principles of John Dewey's pragmatism. Anthropology, even AST, struggles to match the relationship of mutual learning action research proposes between anthropologists and "informants". This *praxhos* relationship between anthropologist and informants is therefore much more like a co-learning relationship.

There are AST examples that show tendencies to move in the direction of a more co-generative learning model. One such is "hiring in" (Downey & Lucena 1997; 119-120). In this concept Downey and Lucena try to give a more sophisticated description of a relationship between the researcher and the informant. They indicate a willingness on the part of the social researchers to allow their work to be assessed and evaluated in the theoretical terms current in the field of analysis and intervention. From my praxhos perspective inspired by co-generative learning and pragmatism their argumentation drowns in the alleged dangers of co-optation and social engineering. What is important with "hiring in" and another concept "partner theorizing" (Downey & Rogers 1995) is that they are reflection models that might inform action but their shortcomings are that they are not theories of action. Therefore, they are not directly linked to changed action as a co-generative approach is.

To make well-informed research choices in a co-generative model the *praxhos* anthropologist needs a language that can describe the complex technoscientific realities of today's organizations. This brings us to the last aspect of *praxhos*.

6. The actant aspect: science and technologies participate as agents in producing and reproducing the diverse features of social life, including modalities of subjectivity. Such a praxhos will be interested in the kinds of theory that operate in the world and the activities in which these are embodied. It grows out of the relationship between what people do and the theories that people have about what they do and is deemed to be part of the subjective experience of the world in ongoing human activity (Partridge: 1985:146). "Through the conscious construction of a culture, legitimacy is established, claims are justified, identities secured and boundaries are asserted.". William Partridge (1985) argues that to complete the analysis of praxis one must look at the processes whereby interactional rationale, or the subjective component of practice give feedback to and transform formal, symbolic/structural order or the objective component.

My early academic work was founded in Humanistic approaches, symbolic interactionism, generative models of change and a psychological Freudian inspired anthropology. Partridge, like myself, follows the tradition that posits the nature of culture as the product of social manipulation, negotiation, barter, improvization and conflict between social units. The problem is that these perspectives do not handle the relationship between technology and humans satisfactorily. I work in an organization that is organized around technologies and information technology in particular. Technoscience is increasingly influencing our lives, something I did not see when I conducted my earlier work. Traditionally, anthropology has been ill equipped to interpret man-machine relationships and the complex hybrid webs created by Technoscience. AST and STS, in general, propose an alternative, an examination of the argument that human subjects and subjectivity are crucially as much a function of machines, machine relations and information transfers as they are machine producers and operators.

To ignore the agencies of technologies would drastically limit anthropological inquiries into the contemporary human condition (Downey & Dumit 1995). It advocates a position where the technoscientific reality penetrates every aspect of human life. Since AST and STS are critical, but interpretative perspectives, they can be used to develop the necessary understanding of a given social field or domain. However, they can inform action, but I argue that we must go to action research to find a theory of action. However, AR lacks a sophisticated language (or the necessary granularity) to understand complex socio-technical phenomena and in the chapters that follow both perspectives are used via a *gestalt switch.* Both AR and AST perspectives are therefore necessary components of a praxhos to have the necessary understanding of organization and technological issues. I share AST's technological perspective but leave their position of critical distance and vague ideas about intervention behind.

These are the six aspects or facets of my *praxhos*; whole person, system representation, collaboration, intervention, co-learning and actant, and all are knitted together into an invisible unity. I have presented these aspects to describe my position as a practitioner of anthropology. Let me now present the choice of methods that arise from this unity.

1.4 Choice of methods

What should be the form of scientific knowledge based upon this ontological and epistemological position? The forms of scientific knowledge arising from this are narratives (Czarniawska 1998). It is possible to build a connection between human action, a narrative or text. Every narrative waits to be enacted. As already stated I give the metaphor and analogy of drama precedence over that of text. Organizational narratives are both inscriptions of past performances and scripts and staging instructions for future performances (Czarniawska 1998). They are interpretative and the collective property of a group.

My narratives take the form of episodes or tales with detailed descriptions or discussions about the processes that the group went through in the development of knowledge that is communicated or acted on. It follows the rhetorical conventions of narrative writing and tries to avoid and decontexualize knowledge to an abstract language that alienates. Organizations are of course much more than texts and narratives. My company Statoil produces a number of intermediate and end products in its business, but all these products must be connected into some meaningful whole for the people of the corporation to grasp the essence of Statoil. The narrative is the main mode of human knowledge and communication that produces the meanings whereby different products of human endeavour (in terms of actions and events) are linked together. The collaboration with Norne, a new oil installation (in 1996) and VISOK, and collaboration within exploration and development (1997-1998) that is the empirical basis of this thesis are described as dramas. In both cases in-depth study through participant observation and open-ended interviews have been employed[5].

1.5 Collection of data and analysis

How have I used the methods to arrive at my conclusions? The collection of data has been going on for a period of 4 years. This long period is unique for a number of reasons. Most anthropologists do not have the chance to conduct such a long-term study. During these years I have spend my time both as a traditional ethnographer (with participant observation) and as a consequence of my professional work more active participation as a facilitator in change processes. I have written diaries from fieldwork in both cases, less in the start from 1995-1996 but increasingly from 1997-1998. Most of my data is from the VISOK part of the

project (1997-1998). I have conducted open-ended interviews both within the research team and the larger Statoil macro-setting (25 interviews). Interviews and participant observation have been used as complementary techniques. I have done a number of interviews to elicit accounts of practice in and around the project I studied. The gaps in between interviews and observations have been a major source of insight. I have also done participant observation to contrast these accounts.

Much information in the project has been available electronically in LOTUS NOTES project databases and these gave me access to e-mail discussions, reports and reflection processes. I believe that all human understanding is achieved by iterating between considering the independent meaning of the parts and the whole as they form in a hermeneutic circle. In my case the whole has been the knowledge production in the "Collaborative Workspace" project. The parts have been the fragments of data collected using the data material. I have gone from the overall knowledge production in the research team to the diffusion and implementation of the new knowledge in the larger Statoil organization, that is, the nitty-gritty details of everyday activities to keep the project on track. In my use of the hermeneutic circle I have gone through a number of iterations between the whole and the parts to arrive at my conclusions, thereby filling gaps and unresolved contradictions.

In this process I have used a method of historical reconstruction (see Figure 1.1). When I gathered the data material it was put together in a linear time metaphor, since the narratives use chronology as the major organizing device. External conditions outside the project were essential to understand internal project issues. I started with the overall setting of an information infrastructure in Statoil (Monteiro and Hepsø 1998) that gave both possibilities and constraints. One basic feature is the growth of the LOTUS NOTES infrastructure from 1017 to 18300 users that was of key importance to understand the local setting in the research project, since LOTUS NOTES-based technologies were the key collaborative technology used in the research project. I tracked the dates of important IT-incidents in Statoil and placed them in the chart (like implementation of WINDOWS 3.11. WINDOWS 95, company-wide area network and LOTUS NOTES release 4).

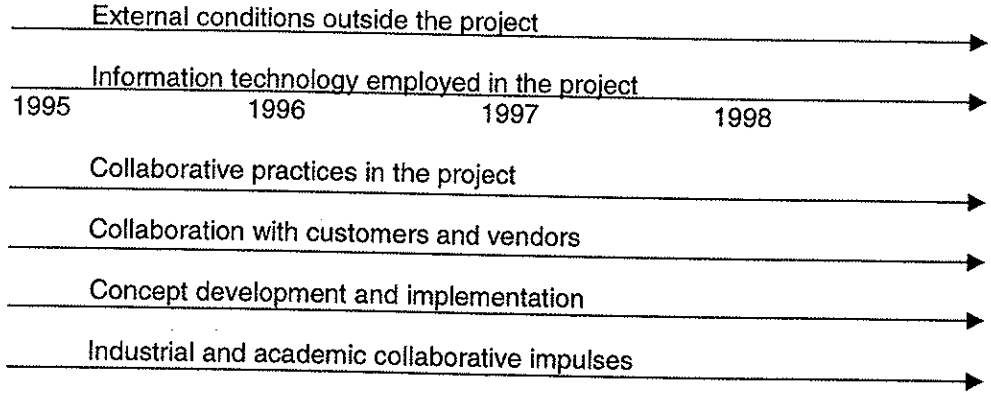

Figure 1.1: The Collaborative Workspace project seen in relation to a number of external and external forces

Through the fieldwork a number of additional categories that had large consequences for this information infrastructure were created based on the data collected. By using the time dimension as the "anchor" is was possible to see how the development of the NOTES based

information infrastructure was connected to a number of other company efforts: ongoing IT/IS projects, the rise and fall of organizational actors and ongoing organization development projects played a considerable role, because they pushed for new organizational demands, roles, and allocated resources for IS/IT. Spirits of the time changed considerably in the period as well. From TQM, ISO 9001, to BPR and knowledge management at the end of the period. Each gave the development of the NOTES information infrastructure support from different rhetorical sources.

External conditions outside of Statoil were also of major importance: the closer co-operation in the oil industry at the time, push from government related to NORSOK, the fluctuations in oil prices and Internet. At the other end of the hermeneutic circle was the "Collaborative Workspace" project. It consisted of the remaining lines; the development of various collaborative technologies in the project, the development of collaborative practices in the project, important incidents with customers and vendors, the development of the collaborative IT -concept, and the industrial and academic collaborative impulses that were important in the project.

Mapping of the incidents in time were important to be able to see a potential overlap both within and between the micro and macro. This linear model worked as a conceptual map that a deeper contextual analysis could use as a starting point and made it easier to develop a social and historical background of the research setting related to the narrative I wanted to tell. This method brought up an important point regarding cultural boundaries of groups.

Like many AST anthropologists I share impatience with bounded field sites (Downey & Dumit 1997:11). Even though I started with a little group, there are always leaks, flows of information, artefacts, people and resources in and out of this small setting all the time. I had to study groups, concepts, facts and artefacts that were interconnected with my group and others, but that were not necessarily acknowledged by any group as important. This of course shows that the distinction I have made between the micro and macro is heuristic and that it is all an intertwined non-hierarchical network of micro and macro phenomena (Latour 1987). I follow Emily Martins (1998:36) argument that such a space I have described in Figure 1.1 is discontinuous, fractured, convoluted, and in constant change. However, to map or cross such a space we need images that show how strange bedfellows, odd combinations and discontinuous junctures work together within the network. I show how elements are bundled and linked together in situations were there are no apriori connections.

1.5.1 The research process

A critical reflection is necessary regarding how the research material or data were socially constructed through the interaction between the participants in the "Collaborative Workspace" project and me. There were three main arenas (see Figure 1.2) that were important in this process. The "Collaborative Workspace" project itself with a number of ongoing mundane everyday activities scheduled in plans and oriented towards concrete products (a new Intranet application, LOTUS NOTES database and other less tangible products like work methodologies, etc. This is what I refer to as *the empirical setting.*

This is the major empirical setting for the Statoil participants in the project. There is another context that is strongly dependent on the running project. This is the internal *reflection in the group* that was planned (monthly reflection hours, search conferences, project meetings and colloquiums) or incidents that developed spontaneously as a consequence of the project (debriefings, informal gatherings and discussions, coffee pep talks and parties). This was the

projects own reflection of the empirical data that they acquired. They gathered data, they analysed the data, evaluated the data and defined major "findings". These "findings" were discussed, written down and the most important lessons learnt were implemented in the running research project at given points and acted on.

The implemented efforts were again evaluated in a later data collection and data analysis in the project. My own thesis work was in the midst of this. In Figure 1.2 it is described in a linear fashion, but it was iterative, going back and forth in a cyclical fashion. An example of the work with the 1997 VISOK research report can illustrate what I mean by this iterative and cyclic process. I had followed the participants during fieldwork in the organization, and had the task of helping them to discuss and articulate their lessons learnt in 1997. Such a report was therefore a summary of the year that had passed and contained the overall planning of activities in the year to come.

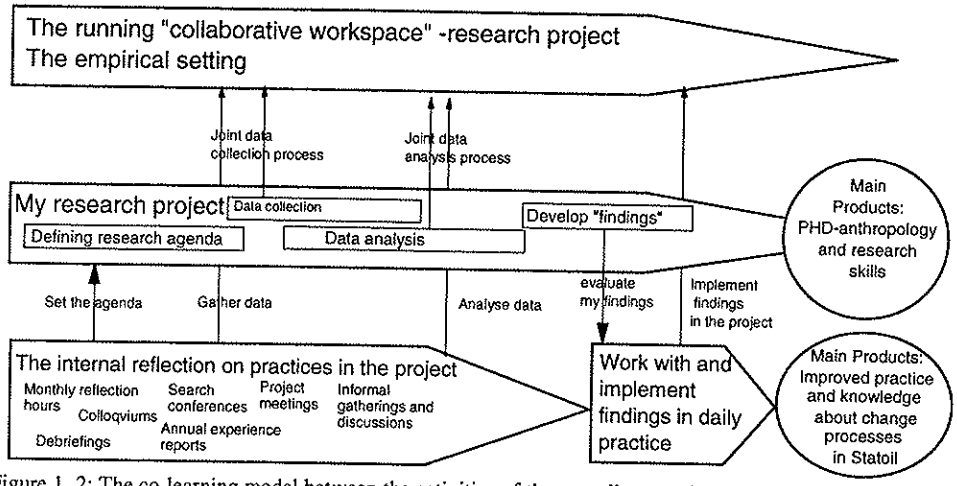

Figure 1. 2: The co-learning model between the activities of the overall research project, my PhD-project and the internal reflection process on and in these activities within the overall research project

This process was arranged as follows at the end of 1997 and early parts of 1998. A two-day workshop was arranged with the project participants and stakeholders of the customer organizations. The aim was to describe an overall narrative of what had happened in the year that had passed, good/bad lessons in the project and define future actions for 1998 together with the customers.

The dialogue that developed was conducted both in groups and plenary sessions, and the overall sketch of the research report was set up at this meeting, covering the following issues (combined lessons learnt in 1997 and future action in 1998): internal processes in the customer organization, relations between the CW-project and the customer organization, internal relations in the CW-project team, processes in the KOT group their relations to others Statoil collaborators. The meeting also set up a number of work methodologies that had "worked" in 1997 and gave input to how these could be improved in 1998; like flowcharting, fieldwork methodologies and cyclic prototyping. The remaining work was organized in later group sessions and through individual work.

An electronic meeting room, with an idea generation tool, was used to brainstorm on the ideas that had come up according to the above structure. After this meeting VISOK participants

were given assignments to write their parts of the report. Dedicated people were given the responsibility to write down the lessons learnt, with input from others related to the above issues. Throughout this process all the written material was accessible in a LOTUS NOTES project database, so that each VISOK member could provide comments to the texts. In this later part of the process I gave input to the methodologies used, provided feedback to the texts related to paradoxes and shortages. The VISOK project manager did the last "brush up" of the texts and created a research report, that was distributed to the project and the customer organization. I will now go through the steps of the research process.

Defining the research agenda
My research agenda was defined together with a number of stakeholders in the project. Through discussions, through presentations of my ideas the people that were meant to form the empirical basis for my work were allowed to give feedback on what should be the focus of the study. The research questions were a consequence of this process: a need to understand the dynamics of organization development and IT. This was a process that started in the end of 1996, before I started my doctoral work. A number of formal-informal meetings and discussions in 1997 and in early 1998 made me narrow the focus of study to be relevant for the research group and the larger Statoil organization.

Data collection
Parts of the material were collected when working as an organizational facilitator and researcher in the autumn of 1995, and project manager in the Norne pilot in 1996. In this part of the project I functioned as an ordinary Statoil employee, but used hotel evenings and spare project time to write diaries. From 1997-99 I collaborated with the research group when they were collecting the data for the research project in the empirical setting, however in a more distant observing role. Their collection of data was based upon several sources: meetings and interviews with participants and stakeholders. They connected their own analysis but I gave them input to various methodologies that could be used (ethnography, flowcharting, stakeholder analysis and search conferences).

In addition, I collected my own material but kept it to myself at this stage. In various parts of the data collection phase I worked with outsiders (Eric Monteiro in 1998) and Norwegian Telecom Research in 1999 (evaluating the impact on the collaborative research project in Norne operations) to maintain an open attitude to the empirical setting that made me biased. Several masters students also conducted their work in the vicinity of the project I studied. My empirical data consisted of more overall issues on mundane project activities in "the Collaborative Workspace" research project, but it also consisted of data, tales related to the group's own reflection and learning process. I had access to the same information and people as the rest of the research team. I kept my office in Statoil throughout the whole doctoral work, and hardly spent any time at the university.

Data analysis
The data analysis was also a joint effort as already sketched in Section 1.5.1 and in Figure 1.2. I participated when the project analysed their data. In this process I helped them with several issues. I gave them introductions to a number of theories that could be useful in the analysis of their data. This included an introduction to Actor Network Theory and stakeholder analysis. The project used the method of historical reconstruction (see Figure 1.1) when brainstorming and describing their version of the joint project history early in 1999. The project gave me the official role of a "devil's advocate".

When taking part in their sessions I asked provocative questions and reported on issues I found paradoxical. This was done in the intent to trigger their continuing reflection and learning process, but also gave me additional input to my own material. I was careful not to give them instructions and answers on how the data material should be interpreted. I did the first analysis of my material by myself, but in co-operation with academic outsiders. I had worked with Professor Eric Monteiro on the overall issues of an information infrastructure in Statoil (Monteiro & Hepsø 1998, Monteiro & Hepsø 2000) using similar data and Associate Professor Stein Johansen (my adviser) to ensure an open and critical analysis of the material.

I have had close contact with anthropologists working with similar issues in the United States and collaborators in nearby domains like informatics, through the INFRAGLOBE project (Ciborra 2000). To neutralize my former expert status in the group I developed a joking, easy going type of behaviour to marginalize my importance. I used considerable time to marginalize myself. In 1997 the group was recruiting several new people, and a core group of 4-5 people were the veterans (me included). Along the grapevine these four males were called the "gang of four". The newcomers argued that the gang represented tradition and had the right answers to any problem. Most of 1998 elapsed before I was able to leave that role, and have a more neutral position. The fact that two "gang members" left their jobs in Statoil helped to make this process smoother than I expected.

Evaluate the analysis and act on the findings
My findings and the narratives that resulted from the data analysis were taken back to the project participants in order to let them evaluate them. This evaluation was done in several ways and in several steps. I circulated drafts of narratives and had discussions with those that read the drafts, thereby inviting people to participate in my own reflection process. They could read the narratives and comment on their content. I presented parts of narratives in project meetings, in colloquiums, and held a team building session with the remaining team members after the research project had come to a close in 1999. This session addressed how the remaining group should use my narratives to improve future project practice. I also double-checked the content of the narratives with insiders in Statoil that followed the project from a distance, and who were both critical and friendly to KOT and me (Statoil Data and the customers who participated in the organizational pilots of the Collaborative Workspace project).

On several instances my interpretations diverged considerably from that of the group. When this occurred I checked the data one more time, if there were still large uncertainties embedded in my narratives I accepted the view of the research team. In other cases where I could back my narratives empirically I maintained my right to be critical to the voices of the project. Later I present several polyphonic texts or native transcriptions (Clifford & Marcus 1986) where I have surrounded authorship of the ethnography to my "informants" or co-workers own transcriptions of the phenomena they have studied and reflected/acted on.

Since I had worked for Statoil since 1991 and had been a direct participant in the setting I knew that I might have unconsciously, based upon my preconceptions look for data that supported my "prejudices". I tried to address this by seeking to validate my 'findings' and discuss my accounts of the narratives with involved actors as already said, and partly by relying on varied and independent sources of data. Digital data sources related to the issue under investigation were considerable and could be used polyphonically as native texts.

1.6 Credibility, workability (reliability and validity)

The project can be seen as inspired by AR, but did not manage to live up to all the requirements that Greenwood and Levin (1998) have set and consequently became a hybrid between action research and more traditional anthropological ethnography. In the VISOK part of the project, the project was not able to create a high enough involvement in the user community, and the handling of stakeholders could have been better. The problematic end of the project made it impossible to wrap up the lessons learnt and live by the principles that were developed in the last year of the project. Still, it was possible in 1996, 1997 and most of 1998 to act on previous findings. The group spent considerable time on writing a close out experience report in 1999 where they described the major lessons learnt and plans for working with the lessons learnt in future projects. In the situation that developed in Statoil in 1998-1999, new projects were hard to find and the KOT group fell apart soon after.

I said earlier in this chapter that the fieldwork and analysis have been going on for over four years. This has been a privilege that many anthropologists do not have. You need time to evaluate what happened, and see how the situations change over time. Having stopped the Norne analysis in 1997 would have excluded important lessons learnt after KOT left the scene. Major lessons of VISOK can also be spotted long after the project came to an end in 1998.

Needless to say, I have been an insider in the setting but believe that I have given a trustworthy account how this is possible, without being blinded by my own Statoil values. In part of the work I ended up with problematic discussions and relationships with strategic thinkers in Statoil's IT division. Some of the people would not agree with my interpretations. Even though Professor Eric Monteiro and I tried several times to involve the same people in a constructive dialogue, this was not successful. The result is that most of the material that came out of the work with "the information infrastructure in Statoil 1992-1998" is not included in this thesis.

Another critique that is sound is that the small research project I have described did not have the dominant position I claimed it had. The same is true about the Norne work. I acknowledge that the Norne pilot was my baby, and that this fact may have influenced my account, but it is there that I have spent most time reviewing and checking out the validity of what I have written during discussions and meetings both in 1998 and 2001. It is most likely the case that the VISOK part of the CW project provided the most major learning lessons for those that participated in it and less Norne. I trust that this will be kept in mind when reading the two narratives. Statoil Data had efforts in the same period with even bigger consequences and I may have exaggerated the influence of the Collaborative Workspace research project compared to similar IT-division initiatives in the same period. There were major efforts in the same period (1995-1999) that I have not been able to handle in the detail I wanted.

My affiliation has always been closest to Statoil Research Centre, and the operational communities of Statoil, less exploration and development. This fact may have influenced the story that I tell as well. I am a male, and am willing to admit that my interpretation of these phenomena is not made irrespective of my sex. The research group had several women participating both as researchers and systems developers. I have tried to incorporate their perspectives. In several situations they urged the project to focus on softer social and less technological issues, since several had social science backgrounds. In other cases they were like any other male team member. They were concerned with doing a good job, were good at

maintaining relationships, and were not always listened to. If their position can be dedicated to their sex or their status as social scientists is not easy to say, but is most likely a mix.

A latent question is why the unions have not participated in the projects. The answer is that they have not collectively participated, but have done so indirectly since individual union members have participated all along. There is a major institutional reason for this. Unions take an active part in all major change projects in Statoil and there are a number of organizational bodies and rules that secure such a representation. With research in Statoil it is different. Organization development research has consumed a tiny part of the research budget. Most research is dedicated to technical expert R&D of a kind that is often irrelevant and non-understandable for lay people.

Even though collective effort/participation from the unions in the "Collaborative Workspace" project was desirable the structure of research funding in Statoil made this difficult (see Chapter 3). There were examples where the project was discussed in the institutions that govern employer-employee collaboration. Most of the Norne work happened before the unions organized their local branch. In exploration and development the unions played a less important role. It was never felt as important by the actors themselves to involve the unions. They felt they could represent themselves.

I started this chapter with the work of Akhil Gupta and James Ferguson (Gupta & Ferguson 1997) discussing "the field" as site, method and location in anthropology via the situation in anthropology of science and technology based on Diana Forsythe's ideal narratives. Like Gupta and Ferguson I tried to describe my notion of "the field" and "fieldwork" situation as an insider anthropologist in Statoil. I named this position with six facets my *praxhos*. Since a *praxhos* must be lived, you end up in problematic sitations where you have to navigate between and balance stakeholders in the organization, being a stakeholder yourself. Still, the details of my ethnographic material would have been inaccessible for most anthropological participants as observing outsiders. It is the long time frame and nature of being a reflexive insider that has made most of my work possible.

The total insider will always be lost. Via collaboration with academic outsiders and by using an action research inspired research methodology I tried to become reflexive to my own practices and Statoil practices in general. The main challenge is still that of co-optation, but there is no easy way out of this problem. In my thesis work the alternative to possible co-optation would be ignorance, because it was the form of participation (and of which co-optation always lurked in the background) that provided the most interesting field material. Having the choice between being an ignorant outsider or a reflexive and committed insider, I chose the latter.

Chapter 2 A Drama of Technology and Organizational Change

2.1 From social dramas to technological dramas

In the introduction I started my departure from the diffusion model of organization and technological development via an introduction to the anthropology of technology. From there I began to describe a perspective that can give us an alternative language to handle the dynamics of social change in relations to organization and technology development; analogies of drama and text. The purpose of this chapter is to flesh out a drama perspective in relation to organization and IT development. I give the drama analogy precedence over text and describe key elements of Victor Turner's and Bryan Pfaffenberger's dynamic perspective of the drama (2.1). Drama is embodied experience and I ask how embodiment can be related to an ecological mind and the interaction of humans and non-humans in everyday situations (2.2). I explore issues of amplification and reduction in relation to the drama perspective (2.3) as a prelude to the presentation of actor network theory or ANT (2.4). A small example is presented to invite the reader into the world of ANT with the mix of the drama analogy (2.4.1). After this example I present the conclusion of this chapter, Section 2.5.

Victor Turner developed the term social dramas (1974) to denote a dynamic theory of social change and understand social and technological change in general. Turner's social drama has four phases. It starts with a *breach* that can be initiated either calculatedly or deliberately, contrived by a person or group disposed to demonstrate or challenge entrenched authority, or it may grow out of heated feelings (Turner 1982:10). There is also a breach of regular, norm-governed social relations between persons and groups within the same system of social relations. Finally, there is a deliberate non-fulfillment of some crucial norm regulating the intercourse of parties in a given setting (Turner 1974:38).

Once this breach becomes visible and it becomes difficult to revoke it a *crisis* follows, which is the second phase. It is what Turner (1982:70) describes as:

> ... a momentous juncture or turning point in the relation between components of a social field - at which seeming peace becomes overt conflict and covert antagonisms become visible. Sides are taken, factions are formed, and unless the conflict can be sealed off quickly within a limited area of social interaction, there is a tendency for the breach to widen and spread until it coincides with some dominant cleavage in the widest set of relevant social relations to which the parties in conflict belong.

This second stage, *crisis,* is always one of those turning points or moments of danger and suspense, when a true state of affairs is revealed (Turner 1974:38-39). To avoid a crisis developing into fractions and coalitions, redressive means are taken by those considering themselves the most legitimate or authoritative representatives of the relevant community. *Redress*, the third phase, can involve ritualized action like, legal, religious or military action in order to limit the spread of crisis (Turner 1982:10): "All or some of these attempt to apply *redressive machinery* - to "patch up" quarrels, "mend" broken social ties, "seal up punctures" in the "social fabric"..." The end result can be a reconciliation of the conflicting parties, with two potential forms (Turner 1982: 92):

> The first is *reconciliation* of the conflicting parties following judicial, ritual, or military processes; the second *consensual recognition of irremediable breach,* usually followed by the spatial separation of the parties. Since social dramas suspend normal everyday roleplaying, they interrupt the flow of social life and force a group to take cognizance of its own behavior in relation to its own values, even to question at times the value of those values. In other words, dramas induce and contain reflexive processes and generate cultural frames in which reflexivity can find a legitimate place.

The social drama therefore ends - if ever it can be said to have a "last act" - either in the reconciliation of the contending parties or their agreement to differ. No social drama can ever be finally concluded: the terms of its ending are often the conditions under which a new one arises. Turner argues (1974: 42-43):

> From the point of view of the scientific observer the fourth phase -that of temporary climax, solution, or outcome - is an opportunity for taking stock...In the particular phase of a "political field", for example, one can compare the ordering of political relations which preceded the power struggle erupting into an observable social drama with that following the redressive phase...Oppositions may be found to have become alliances...New power will have been channeled into old and new authority defenestrated...Formerly integrated parts will have segmented; previous independent parts will have fused. Some parts will no longer belong to the field, others will have entered it...The bases of political support will have altered...The explanations for both constancy and change can, in my opinion, only be found by systematic analysis of *processual* units and temporal structures.

Social dramas as described by Turner are in large measure political processes (Turner 1982:72):

> Social dramas are in large measure political processes, that is, they involve competition for scarce ends- power, dignity, prestige, honor, purity- by particular means and by the utilization of resources that are also scarce, - goods, territory, money, men and women. Ends, means and resources are caught up in an independent feedback process.

They are about converting particular values and ends, distributed over a range of actors, into a system (which is always temporary and provisional) of shared or consensual meaning" (Turner 1982:75). Victor Turner saw the phases of social dramas as cumulating to a climax. Each phase had its own speech form and style, rhetoric, non-verbal language and symbolism. It is often manifested in myth or ritual, but in my use of Turner it is the drama of everyday experiences. It is often bounded in time as a project, but not viewed as a separate part of everyday life. I also intend to use the social drama as a vantage point since the ritual and symbolic dimension of technological activities are often ignored.

Where did Victor Turner get this dynamic processual perspective of social life? In *Drama Fields and Metaphors* (1974) he describes his perspective and theory to be heavily influenced by the forefather of action research; Kurt Lewin (1948, 1951). Lewin was the first to describe social change as sequential and discrete processes employing a thermodynamic metaphor of unfreezing, floating and freezing matter. Social change is a three-step process: *unfreezing* (where former structures are dismantled), *changing* (changing the structures) and *freezing*

(locking into new structures). Turner relied upon Kurt Lewin's field theory[6] in developing his own social dramas.

In the anthropology of technology Bryan Pfaffenberger (1992) has taken Victor Turner's social drama a step further into what he calls a technological drama. Pfaffenberger argues that he chooses the analogy of drama to text to describe processes of technological change (Pfaffenberger 1992: 286):

> A technological drama's statements and counter statements draw deeply from a culture's root paradigms, its fundamental and axiomatic propositions about the nature of social life, and in consequence, technological activities bring deeply entrenched moral imperatives into prominence...To emphasize the metaphor of drama, too, is to employ a richer metaphor than text. It is to emphasize the performative nature of technological "statements" and "counterstatements," which involve the creation of scenes (contexts) in which actors (designers, artifacts and users) play out their fabricated roles with regard to a set of envisioned purposes (and before an audience), and it is also to emphasize that the discourse involved is not the argumentative and academic discourse of a text but the symbolic media of myth in which skepticism is suspended) and ritual (in which human actions are mythically patterned in controlled social spaces).

Clifford Geertz (1980) and Victor Turner (1982) had an extended discussion on the use of the drama vs. the text analogy. Geertz argued that the social drama approach focused too narrowly on the general movement of things and neglected the multifarious cultural contents or the symbolic systems of the context. Geertz (1980: 175) argued that the text analogy could mend this problem. Turner's (1982: 107) answer was to argue for the proper use of both the drama and the textual metaphor:

> However, Geertz does in fact concede that many anthropologists today, including himself, use *both* textual and dramatistic approaches, according to problem and context. Some of these misunderstandings and apparent contradictions can be resolved if we examine the relationship between the two modes of acting- in "real life" and "on stage" as components of a dynamic system of interdependence between social dramas and cultural performances.

I employ both analogies in my narrative of the CW project. Drama is a more potent metaphor than text (the latter being mostly used in the STS) and I have given the drama precedence over text since it is related to human embodiment, action, lived experience and practice. All texts must be performed to be experienced. Let us now take a closer look at Bryan Pffaffenberger's use of Turner's social drama. Technological dramas have the following phases:

1. The process of *technological regularization* starts the drama. Here a design constituency (the groups or individuals who participate in the design of the technology) appropriate, create or modify a technological production process, an artefact, user activity, or system in such a way that some of its technical features embody political aims (or intend to allocate or reallocate power, prestige or wealth in social groups. This process projects artefacts and ritualized social contexts into the fluid world of social relations and it is a process that recollects the political vision of the designers.

This social vision arises reciprocally and recursively in interaction with the technological design process. Such production processes or artefacts have to be projected into a spatially defined, discursively regulated social context, which is important in order to gain focus on the constructed cultural and political aims of the technology. Technology as a political activity projects fabricated social contexts (units of technologically defined geographic and social spaces) into the social worlds of everyday life.

Regularization is a heterogeneous activity that involves more than the creation of technologies with inscribed political aims. It is also the development of social contexts and rituals that constitute political aims within the fluid field of social relations. All the technical processes and artefacts generated in technological regularization are subject to multiple interpretations or can become challenged in a discourse related to organization and IT development. In what follows I describe a research group (KOT) in Statoil and their effort to design and implement visions and application of a concept called the "Collaborative Workspace".

If this implementation had to come true, KOT and their collaborators had to develop some kind of legitimation for their concepts in the Statoil organization. If as Mary Douglas (Douglas 1986) says, institutions like KOT and their concepts must have their rightness founded both in reason and in nature KOT could ground their foundation in Statoil strategies, but they had to have examples or pilots like the Norne and VISOK examples in this thesis to prove their rightness both in reason and nature. I will present this argumentation in the chapters that follow. In the work I am describing KOT was good at picking up formal ideas, structures and concepts (and even myths) that were well aligned with formal structures in nature and reason (management and business goals, integrated organization and IT development, BPR, the Internet, enterprise modelling, the technology strategy and a new offshore installation). It is too easy to say that these concepts were cynically dramatized by KOT, that they were "buzzwords" or lacked meaning, because they signified something new in the Statoil organization.

The name and concepts of "the Collaborative Workspace" project became known and served the function of having chosen standards that people could gather around in their communication with each other. It was "sense making" for handling information systems and information technology issues. Consequently, the concepts had an important function in spite of a large amount of ambiguity related to the concepts meaning. Finally, even though the name or concepts portrayed something, that might be difficult to understand, they created attention around the project. Metaphors like "enterprise model" and "integrated organization and IT development", concepts that will be given a more thorough presentation later, were potent in themselves and could provoke strong feelings and meanings, almost mythic connotations. In the magnetic field around a buzzword like BPR, other elements of language, specialized terms, phrases and general terms were developed. However, they influenced the world of KOT and those that participated or were bystanders. Some of their attitudes were changed but what was most important was that it created a level of agreement that made a discourse possible.

Many examples of technological regularization fail to change redressive social processes. These regulations create areas of inconsistency, ambiguity and interpretative flexibility, even contradictions. The more the project tries to put regularization into social life, the more some people affected by the same regularization will try to resist it by arranging their immediate situations, exploiting the ambiguity in the situation (or generating such ambiguities) or even reinterpreting or redefining the rules or relationships. People affected use these grey areas in relation to a technology as a shelter to develop an adequate rationale to legitimate the redressive strategies of technological adjustment and reconstitution. The areas of inconsistency, contradiction, conflict, and ambiguity are open areas that are used to achieve immediate situational ends.

The technical innovations and their embedded ideologies are inherently ambiguous for another reason as well; they unite a heterogeneous design community, the concepts can

describe a myth that sounds appealing to a wide range of interested parties (Pfaffenberger 1992b: 298): "The more heterogeneous the ideology, the more susceptible it is to multiple interpretations, the better the job it is likely to do in uniting the constituency". All the technical processes and artefacts that generate technological regularization are subject to multiple interpretations or can become challenged in a discourse. Pfaffenberger calls such challenges *technological adjustment* or *technological reconstitution*.

2. *Technological adjustment* is the second phase of the technological drama. The people who are challenged when a new production process or artefact is introduced engage in strategies to compensate for the loss of self-esteem, social prestige and social power caused by the technology. These groups try to make use of the contradictions or ambiguities as they try to validate their actions. Trying to control and alter the discourse can do this. Another option is to try to change the regulated social contexts where the discourse is taking place. The key goal is to make life bearable in the face of regularization. This process is therefore a way of interpreting artefacts and contexts so that the problematic status implications of regularization are neutralized or eliminated. Adjustment strategies do not openly attack the foundations of technical regularization, and cannot expect to develop large changes in the technology.

3. In *technological reconstitution*, the third phase of the technological drama, impact constituencies try to reverse the implications of a technology through a symbolic inversion process. Impact constituencies actively reshape technological production processes or artefacts guided by a self-conscious revolutionary ideology, producing what Pfaffenberger calls counter artefacts. This ideology is produced by means of a symbolic inversion called *antisignification*. (Pfaffenberger 1992b: 506). Reconstitution can lead to the fabrications of counter artefacts that embody features believed to negate or reverse the political implications of the dominant system. To create changes counter contexts are also needed. The artefacts themselves are not enough (Pfaffenberger 1992: 304): "...we will see that successful reconstitution strategies involve not only the creation of counter artifacts but also counter contexts and even counter-regularization strategies to enforce them."

Reintegration is a sub-process of phase three, or the fourth phase in Victor Turner's drama model (Turner 1974). Pfaffenberger uses it to name the response made by the agents of regularization to the new and problematic counter artefacts. Its aim is to gain control over these artefacts by bringing them back into the controlled and ordered space of regularization and then performing technical modifications that blunt their revolutionary potential.

In Pfaffenberger's description of a three-stage drama one final outcome can be that the drama drops out of the technology. This means that the connection between technological activities and social meanings seems susceptible to erosion. Factors like competing technological systems and social change can erode the connection between activity and meaning. This phenomenon is called *designification*, similar to Bruno Latour's black boxing (Latour 1987). However, in spite of the loss of meaning that occurs in designification, the artefacts, their contexts and social behaviour remain. They become taken for granted, seen as routine and part of everyday life. Pfaffenberger says that this has worrisome implications (Pfaffenberger 1992: 309):

> Paradoxically, it is in the stage of designification that technological artifacts and systems have reached their greatest social penetration. All around us today are artifacts that were generated in the technological dramas of their time: railways, canals, aviation artifacts, radios and more. And yet their meaning, together with their location in what was formerly a deeply felt grammar or political action, is utterly lost; in their place is what appears to be nothing more than a material record of "technological progress". What was once the conscious

product of human cultural and political action, passionate and meaningful, is now a silent material reality within which we lead our daily lives, mutely acting out patterns of behavior that once had obvious connections to the root paradigms of our culture.

The theory of technological dramas has a number of weaknesses that must be addressed first. First, in his argumentation for an anthropology of technology the symbolism of technology (myth and ritual) is exaggerated leaving all pragmatic or instrumentalist aspects invisible. The challenge is to show how the symbolic and the pragmatic/instrumental aspects interact via improvization and the dynamics of knowledge creation. This must be undertaken to counterpart the closed or predefined features of action and actors in Pfaffenberger's technological dramas. Technological dramas are seldom staged in the traditional sense. Second, the theory of technological dramas needs a more sophisticated methodological granularity to understand the interactions of humans and non-humans in everyday situations.

2.2 The interaction of humans and non-humans in everyday situations

The drama analogy enables us to see humans situated in particular contexts. It also focuses on embodiment and practice, or how the individual is a part of a material world that is mediated and lived through bodily experience. In anthropology this phenomenon is increasingly related to an *ecological perspective of the mind* (Bateson 1972, Bateson 1979, D'Andrade 1995, Hutchins 1995). It emphasizes mediated action in context, grounds its analysis in everyday life events. Further, it assumes that the mind emerges in the joint mediated activity of people and artefacts. The mind is both co-constructed and distributed. Gregory Bateson (1972) describes the mind as constituted through human activity involving cycles of transformations between inside and outside. His blind man with a cane example (Bateson 1972:459) shows more of his perspective:

Suppose I am a blind man and I use a stick... Where do I start? Is my mental system bounded at the handle of the stick? Is it bounded by my skin? Does it start halfway up the stick? Does it start at the tip of the stick? But these are nonsense questions. The stick is a pathway along which transforms of difference are being transmitted. The way to delineate the system is to draw the limiting line in such a way that you do not cut any of these pathways in ways which leave things inexplicable. If what you are trying to explain is a given piece of behavior, such as the locomotion of the blind man, then, for this purpose, you will need the street, the stick, the man: the street, the stick, and soon on, round and round. But when the blind man sits down to eat his lunch, his stick and its messages will no longer be relevant-if it is his eating that you want to understand.

He places the world of artefacts in a symbiosis with the mind[7]. Michael Cole (1996: 136-37) is triggered by Gregory Bateson's example:

In short, because what we call mind works through artifacts, it cannot be unconditionally bounded by the head or even the body but must be seen as distributed in the artifacts which are *woven together* and which weave together individual human actions in concert with and as a part of the permeable changing, events of life. The relevant order of context will depend crucially upon the tools through which one interacts with the world, and these in turn depend upon one's goals and other constraints on action

If human activities are mediated and activity and practice develop through interaction with material objects, what form has mediation with technologies? To propose an answer to this question I have gone to the philosopher John Dewey and two philosophers of technology; Don Ihde and Larry Hickman that have taken up of the legacy of Dewey. John Dewey rejected both idealism and realism and his perspective was in between these, his ideas could therefore be aligned with notions of an ecological mind. Knowledge is for Dewey a mode of

doing things in the world and like all doing takes place at a time, in a place, and under specifiable conditions. Larry Hickman (1990) argues that John Dewey both expanded the purposes of inquiry and changed the locus of knowledge as each had been traditionally conceived. Inquiry and its artefact knowing were in his view not just things going on inside the cortex but events with which the entire organism and its extensions were involved:

> Hands and feet, apparatus and appliances of all kinds are as much part of it as changes in the brain. Since these physical operations (including the cerebral events) and equipments are a part of thinking, thinking is mental, not because of a peculiar stuff which enters into it or non-natural activities which constitute it, but because of what physical acts and applications *do*: the distinctive purpose for which they are employed and the distinctive results which they accomplish (Dewey MW 10: 328, EEL: 14 in Hickman 1990:36).

John Dewey, Don Ihde (1979, 1990, 1991) and Larry Hickman (1990) have developed a distinctive pragmatic approach to technology[8](Ihde 1979, Ihde 1990, Ihde 1991, Hickman 1990). I will describe three aspects of this perspective that is vital for my further description. First is *technology as a tool*. The "technology as a tool" perspective is believed to have dominated the pragmatic tradition: technology is something made to fit the hands and minds of human beings, like Pfaffenberger (1992) criticizes. This does not indicate that I am of the opinion that it is the only way of seeing technology. Still, I regard the extrinsic meaning of technology as the most important since organizational actors use technologies to attain their goals. As a consequence, it can be used to study the development of the CW project and its technologies.

Another way of seeing technologies is to focus on their intrinsic meanings, by the term *affordance*. Technologies have properties that we only experience as a consequence of use, properties that designers and engineers never imagined. The interaction among human beings and groups enables technologies to develop their own intrinsic meanings that are not directly aligned with the extrinsic features of the technology. Larry Hickman (1990:13) shows that many of those who have hurled stones at technology from the ivory towers of the humanities have misidentified all or most technology as straight-line instrumentalism. John Dewey was very specific on both the intrinsic and extrinsic meaning of technology. Extrinsic meaning or instrumentality is a primary feature of inquiry as Hickman (1990:40-41) describes it but it is far more than that:

> In the context of inquiry, a working barometer signifies something. It is a scientific instrument. But if it ceases to function in the context of inquiry - perhaps because it is broken, or perhaps because the owner does not require its services or does not know have to read it - its meaning may become intrinsic. It is then cherished as an object of beauty or as a bearer of sentimental value. It is in this way that many objects that formerly served as tools become antiques, that is, objects in which intrinsic meanings dominate... What Dewey thought significant about inquiry, and what he thought discloses its technological character, is that *every reflective experience is instrumental to further production of meanings, that is, it is technological.* In fact, this is doubtly so. Reflective experiences, including both inter and extra-organic tools, are instruments used to gain effective control of a problematic situation... and so have a practical force; but they are also instruments that make for the enrichment of the immediate significance of subsequent experiences...In other words we use tools, whether extra- or inter-organic, to do things in order to settle difficulties. But in doing so, we more often than not find that the control we have exercised gives us more than we bargained for, that there come to be added intrinsic meaning that we could not have anticipated, and that those intrinsic meanings may be the occasion for the construction of further extrinsic meanings... The principal reason for calling inquiry technological, then is that it is the means of effective control of an environment that is not what we wish it to be. Inquiry is in this way differentiated from other forms of activity. It produces something new as a means of changing situations that are not what we wish them to be.

Hickman uses Jean Gimpel's story on the development of the mechanical time telling clock as an example. These first clocks did not primarily tell time, but forecasted the movements of the

sun, the moon and the planets. Time telling was only a by-product of the astronomical clock (Hickman 1990:41):

> This is a story of technological inquiry that solved a specific problem and got, in the bargain, something else intrinsic to it that was to become expressive of novel and momentous significance. The astronomical clock, that is, had unintended meanings that were eventually to become instrumental to further inquiry, inquiry that would ultimately produce the ability to divide the day into uniform hours.

The second point that we take with us from pragmatism is that by the use and development of technologies *the active productive skills of human beings* are employed. John Dewey argued repeatedly that technology is much more than straight-line instrumentalism. Technology as an active productive skill was a central element for Dewey. He argued that human vision "handled" its objects. A vision is not inert and passive, but active and exploratory. Typical images of vision that John Dewey presents is not that of a ray entering the eye from an object, but rather that of a probing tool that moves, checks and interacts. Knowledge is the outcome of inquiry, and it is not a discovery but a making. Dewey says in *The Quest for Certainty* (1960:157): "If we see that knowledge is not the act of an outside spectator but of a participator inside the natural and social scene, then the true object of knowledge resides in the consequences of directed action".

Dewey meant that controlled thinking and inquiry is technological in so far as it utilizes tools and instruments. Some of these tools are conceptual; others are physical, like the hardware that extends our limbs and senses. In his inquiry tools of all types come into play.

The third point is that technology has a decisive role in settling *problematic situations*. Hickman (1990:19) shows how the activities that Dewey called technological were for him a busy intermediary, a liaison between the resting places we call doubt on the one hand and resolution on the other. Still, in Dewey's analysis the concept of reflection is more than the careful inspection of the traits of the problematic situation with an aim to its resolution. The reflectioner must also go outside the immediate situation to something else to get leverage for understanding it. The reflectioner is always searching for a tool to handle the unsettled situation. This tool becomes a part of the active productive skill brought to be on the situation. The tool then reorganizes the experience in some way that will overcome its disparity, its incompatibility, or its inconsistency. A tool here can be a theory, a proposal, a recommended method or course of action (Hickman 1990:22):

> Dewey says that the manner in which we judge the appropriateness of our chosen tools is by means of their concrete and overt application to the specific problematic situations for which they have been chosen. They do not stand apart from the situation, but enter into it. Tools are tested against a set of resistant circumstances, and the circumstances are tested against the tools. A screwdriver may be too large, judged in terms of the circumstances... If the situation is resolved, the tool, the proposal, has performed satisfactorily with respect to the other circumstances. That particular process or inquiry ceases.

Dewey argued in *The Quest for Certainty* that experimental knowledge is a mode of doing and like all doing takes place at a time, in a place, and under specific conditions in connection with a definite problem (Dewey 1960:82). Human beings have needs and desires that clash with their surroundings and lead to problematic situations. A human organism responds by trying to reconstruct problematic situations by using thought and instruments to change this reconstruction. A reconstruction always changes the environment, the organism and the forms of its interaction with its surroundings.

To sum up some lessons to take with us further: inquiry is the process by which human beings transform problematic situations. Inquiry is technological in the broad meaning of the term[9]. In this human beings use their active productive skills in the extrinsic use of tools but a number of intrinsic features, or affordance, come along in the interaction in mediated situations with other human beings and artefacts. If the individual is the active user of tools that creates his world, the theory of technological drama needs stronger focus on improvization and dynamics of knowledge creation. This is necessary to counterpart the more narrow features of action and actors in Pfaffenberger's technological dramas. It is apparent from my position both within an ecological mind perspective and that of the pragmatic Dewey tradition that man is an active problem-solver not a cultural dope (Garfinkel 1967). A drama perspective should incorporate how organizational actors are culture creators just as much as adapters that follow roles and rules. Improvization denotes this drama and it is not staged with clear roles and plots as a traditional theatre drama.

2.3 Amplification and reduction in relation to social and technological dramas

Kenneth Burke (1945) argued that drama, conversations and action could be seen as enacted narratives. He proposed that drama was the genre that best was suited to explore the relationship between language and action that constitutes social life. In his dramatistic theory Burke (1945:xix) argued that it was in areas of ambiguity that transformations take place, and without such areas change would be impossible. Paradoxes constituted the dynamics of a drama and accounted for its transformations: no paradoxes, no changes. A dramatistic method gives people a dialectical stance in the face of paradoxes; in order to achieve dissolution of the paradox induced drama. The paradox is an opportunity for the regeneration of language and the transformation of institutions. In many of my later examples in this thesis action resolves paradoxes. Still, it is a short-lived consummation, since reflection has a tendency to reinstall the paradoxes. Barbara Czarniawska describes how action resolves paradoxes but reflection reinstates them (Czarniawska 1997: 168-169):

> ...action resolves paradoxes, whereas reflection reinstates them... reflection produces paradoxes whereas action requires that they be removed...Paradoxes are irritating not because they go against "the essence of things" but because they ruin the conventional order of the surface that is our life.

Many people feel unease when dramatistic aspects of action are described, since they tend to see this metaphor as "unreal". Barbara Czarniawska responds to this (Czarniawska 1997:34):

> It is not, however, the stagy character of the performance that makes politics dramatic. It is its tendency to *dramatize* certain chosen problems in order to gain the attention of the public. The number of issues the spectators are able to identify and attend to seriously is limited, regardless of the degree of their sincere interest. The issues that become the topics of discovery and discussion are those presented in a dramatically appealing fashion.

In Chapters five and seven I will present how technologies inhabit inclinations for amplification and reduction of given phenomena when they are integrated in social action. Don Ihde is very specific about the dramatic character of amplification and reduction mechanisms in the way we use technological instruments (Ihde 1979:21, 41 and 45):

> This aspect of the use of an instrument is *dramatic*, it stands out. And it is one of the sources of the fascination and amazement we experience in technological advance...As the drama of amplification unfolds at the hermeneutic end of the instrumental continuum, the temptation to forget the hidden reductivities implicit in instrumental use arises. Here the confusion is an exact counterpart of the 'subjectifying' confusion in that the

'quasi' of quasi-otherness is forgotten. What is needed is a critical reflexivity which interrogates the process of 'reading' so that instrumental transformations are noted to have two dimensions rather than one... The instrument, in use, is non-neutral and this non-neutrality takes specific shape through the inquiry...While it is easy to understand the fascination and drama which accompanies the amplificatory dimension of instrumental technics, phenomenologically it remains the case that the other dimension of instrumental transformation is reductive. But, as previously noted, instrumental reductivity is frequently a background aspect which may be 'forgotten'. The features of noema which 'drop out' in the instrumental investigations may be ignored.

In the examples in Chapters five and seven I show that the reduction is not perceived as dramatic as the amplification. Reductions often have a recessive character and tend to become invisible and forgotten. Reductions and amplifications are important issues in the discussion concerning technological-social determinism that has concerned the STS-community for decades. I follow Don Ihde (1979: 42-43 and 48-49) in his denouncing of the two forms of determinism. He shows that there are latent telic *inclinations* which are made possible through the use of instruments, inclinations that favour certain rather than other directions:

The telic inclination made possible by the instrument does not cut off any human aim through itself, although it does call for varying degrees of effort on the part of the user to counter whatever may be the implicit rhythm of the instrument in its normative and functionally optimal use...over time, over practized use and in general, the telic inclination made possible by the instrument creates a path of least resistance or of highest functionality which *may* be followed and often is followed. The instrument provides the condition of the possibility of an *instrumental style* through its latent telic inclination...I have suggested that a straight forward social determinism such that *instruments might be* thought to embody just any human aim or interest is not adequate. Instruments embody human aims and interests in certain ways, ways in keeping with the necessarily transformational characteristics of the amplification-reduction structure... Neither of these parameters, however, preclude what may appear as a center of gravity which allows a direction to be followed from the inclined possibility structure of technics.

Inclinations in Ihde's terminology are close to my use of the terms inscription and translation that will be presented shortly. In the technological drama various organizational forces employ inscription and translation by taking out relevant amplification and reduction inclinations through sense making to meet their programs. I will come back to the notion of inclination, amplification and reduction.

The link between a Deweyan perspective and that of social drama can be found in John Dewey's (1934) *Art and Experience.* Victor Turner (1986:35-39) states directly that Dewey influenced his notion of *an* experience[10]. An experience stands out from the evenness of passing hours and years through its initiation and consummation (Dewey 1934: 35-38):

...we have an experience when the material experienced runs its course to fulfillment. Then and only then is it integrated within and demarcated in the general stream of experience from other experiences. A piece of work is finished in a way that is satisfactory; a problem receives its solution...is so rounded out that its close is a consummation and not a cessation. Such an experience is a whole and carries with its own individualizing quality and self-sufficiency. It is an experience...If a conclusion is reached; it is that of a movement of anticipation and cumulation, one that finally comes to completion. A 'conclusion' is no separate and independent thing; it is the consummation of a movement.

Victor Turner describes a social drama as a specific kind of experience (Turner 1986:39):

If a social drama runs its full course, the outcome (or "consummation " as Dewey might have called it) may be either the restoration of peace and "normalcy" among the participants or social recognition of irremediable breach or schism.

I employ the drama metaphor to portray the phenomena that developed in the CW-project from 1995 to 1999. In Victor Turner's original four-phased social drama and in Pfaffenberger's technological drama amplification and reduction of certain phenomena are

important elements in the constitution and life cycle of a drama. Turner is not discussing the role of technology, but he describes how phase one *breach* depends on some political assemblage to portray, describe and challenge elements of a status quo into a new situation, thereby amplifying particular aspects of a situation. The second phase *crisis* is only possible after an amplification of particular aspects of phenomena, and fractions or oppositions develop as a consequence of this.

In Pfaffenberger's technological drama his first phase *technological regularization* is an example where a design constituency amplifies particular aspects of a technological production process, an artefact, user activity, or system in such a way that some of its technical features embody political aims (or intend to allocate or reallocate power, prestige or wealth in social groups). In his second phase, *technological adjustment*, the people who are challenged by the new amplification engage in strategies to compensate the loss of self-esteem, social prestige and social power caused by the technology. Phase three, *technological reconstitution* is a discussion or struggle between those that do the amplification and those that feel reduced. Turner's *redressive* phase is only possible when mechanisms are used to reconstitute or institutionalize given amplification and reduction mechanisms. In Turner's last phase, *reintegration* these mechanisms have found their form and are up and running smoothly. In Pfaffenberger's last phase, *designification* the struggle over amplification-reduction has found its resolution, it becomes a black box, meaning that the connection between technological activities of amplification/reduction and social meanings seems susceptible to erosion. They become taken for granted, become routine and part of everyday life. Still, in a world of repeating cycles, like the world of Turner, the black box might become material for future social dramas, and consequently additional amplifications and reductions.

2.4 Actor network theory

I argued earlier in this chapter that the notion of a three-phased technological drama needs additional theoretical concepts. Given the special characteristics of technology in general, and IT more specifically we need a theory with the necessary granularity to understand the intricate mechanisms, some technical and some not that shape social action (that is, how specific elements and functions of an information system relate to organizational issues). These forces or factors are called 'actants' by actor network theory (ANT)[11]. It is anything that does some work, or acts, or to which activity is granted by others. An actor network is a concept that tries to link the act together with the influencing factors or forces. The totality of the forces and the acts comprise the actor network. Actor networks are found in contexts and are situated.

Monteiro (2000) argues that actor networks are the context, or the network of heterogeneous materials that make up the context. The actor network is those elements in a context that shape action. A key issue related to these networks is their heterogeneous character, meaning that they bring together both technical and non-technical elements. Actor network theory consequently grants all entities of such a heterogeneous network the same explanatory status (Akrich & Latour 1992). Giving artefacts the same explanatory status, as humans will not necessarily lead to commodity fetishism, anthromorphism and animism.

This symmetric position is foremost an analytical stance and not an ethical position. ANT claims that if you tear down the border between the humans and the non-humans you can increase the level of detail and precision. Such a principle of symmetry (treating humans and

non-humans as equals in descriptions and explanations) means that you can increase your understanding of the socio-cultural web, by describing which social and technical elements that turn out to be influential.

Punctualization is a situation that develops when an actor has gained the privilege of representing an actor network. In this situation we see order instead of a complex network. Punctualization makes it possible for social actors to serve as spokespersons for a complex network of humans and non-humans. In the context described in the chapters that follow, participants in the setting of the CW project speak on behalf of the complex network of human and non-human actors comprising work practice. When a social actor (KOT, Norne, Statoil Data) want to develop or change a work practice in VISOK or Norne, negotiations must develop to make sure that the collectives of social actors come to an agreement, then work practice can be changed. They must discuss; what facts are the most critical and what actors must be enrolled? Let me present an example that shows the interaction between humans and non-humans. It can also be seen as a drama with arguments and counter arguments, and has the phases of Turner's and Pfaffenberger's drama.

2.4.1. An example of ANT

In a short essay, "A Door Must Be Either Open or Shut: A Little Philosophy of Techniques" Bruno Latour (1995:272-281) described the essence of technique through the mediation of the relations between humans on the one hand and things and animals on the other. The small drama consists of the famous Belgian cartoon figure Gaston Lagaffe, his boss Prunelle, a cat and a seagull, see Figure 2.1. This small comic strip, or problematic situation starts with a cat mewing in the office of the Magazine *Spirou.*

The cat wants Gaston's boss Prunelle to open the door. Prunelle complains that he has become a doorman for cats, being indignant at having become mechanized, instrumentalized, co-opted by a door, by a cat and by Gaston. Prunelle does not like to imitate a machine and act like a robot. A point of crisis is soon reached because the cat wants the door to be open all the time in order to come and go as it pleases. Gaston is annoyed by his boss' ignorance and asks him if he does not know that cats needs to be free, that they do not bear closed doors. Gaston is speaking for the rights of the cat, and the cat that is mewing wants an open and shut door mechanism to be on the guard at all times to respect the rights of animals. This is unheard in Prunelle's view since he is afraid of draught and of getting a cold. He demands that the door be closed all the time. Cats and subordinates must obey. Gaston immediately finds a way to go around the requirements of Prunelle. With his active productive skills he finds a trick to make him the strongest, with his toolbox and saw. He redefines and invents the cat flap, a practical opening at the bottom of the door that lets cats come and go. The hinges replace our Prunelle and he no longer needs to act as cat doorman, and the mechanized human gives way to an automated mechanism (Latour 1995:273):

> The translation through which the human groom became a machine groom was done by the mediation of the hinges. Instead of the continuous presence of Prunelle, Gaston only had to install the hinges once for the function of the groom to be delegated forever to the cat flap. That's the genius of a technical detour. A little time, a little steel, some screws, some sawing, and a function which made Prunelle a perpetual slave became the plan of action of a being which no longer resembles a human.

However, the consequence of innovations are always conflicting interpretations. Prunelle calls the innovation a destruction; arguing that all doors are ruined. Gaston argues that at least Prunelle's right to a good health has been respected since the draught has disappeared.

The cat flap is a compromise, the cat can come and go and the draught has come to an end. In most innovations somebody pays the price. In this example it was the door that got ruined and was redesigned.

Figure 2.1 Gaston and the door-closer (Latour 1995)

Latour argues that the dispute between cats and bosses is first displaced and then removed by the adjunction of saw, screws and hinges. However, additional issues have been forgotten. There is in Don Ihde's language an amplification of certain aspects of the door, meaning that other aspects have been reduced.

This reduction can be spotted and is visible in the reaction of the seagull. The seagull is complaining and its cries are more piercing than the cat. Gaston believes that it is jealous, and that it also wants to be free. What should Gaston do with the seagull? He loves him too much to kill him and Prunelle will not accept to become a doorman for seagulls. The cat flap is improper for a bird. Gaston then goes back to the door, takes up his tools and refine the door one more time. He adds a seagull gap on the top of the door. For Prunelle "RAAH" is all he can say and Gaston argues: "Come on, you can't be serious: the door's closed: right or wrong"? It is closed to draughts and open both to cats and seagulls. (Latour 1995: 276):

> Who could be unfair enough to pretend the contrary? Who could be ass enough not to recognize a door- admittedly a renegotiated one- in the innovation offered by Gaston? When his apoplectic crisis is over, Prunelle will be forced to realize that the innovation pacifies all the cries and that the right of cats, of seagulls of flu-y bosses, and of errand-boy friends of the animals are all respected provided the door takes on certain modifications. The door bends itself, complicated itself, to take on the conflicts between people and animals.

Latour then draws up a map of alliances where he replaces the impossible opposition between humans and techniques by association (AND) and substitution (OR) see Figure 2.2. He gives each being a program of action and considers everything that interrupts the program as anti-programs, similar to Pfaffenberger's (1992) arguments and counter arguments in a technological drama. Based on this he draws a map of alliances and changes in alliances where the assemblies mix things and people.

Latour starts with the drama from the perspective of the cat and also present it from the perspective of the door, but I will do with Gaston's perspective here. Gaston has to reconcile several interested parties. The cat looks after itself and Prunelle wants to keep its health. Gaston wants to keep everything around him, his boss, his cat, his seagull and his work. Since Gaston does not want to denounce anything he has to devise some compromises between things, beings and people. He must reconstruct the door, incorporate both gaps and also renegotiate Prunelle by offering him qualities that he seems not to possess. Latour argues (1995: 277-78):

> This is the big lesson of the philosophy of techniques: things are not stable, but people are much less stable still. Prunelle the journalist becomes a doorman. Prunelle is not a unity but a multiplicity. He is at one and the same time docile and exasperated, and it's on this multiplicity that Gaston is playing. From the bossy, grumpy Prunelle, Gaston imagines a Prunelle who will acknowledge that "there are no drafts" as Gaston says...Each redefinition of the door redesigns Prunelle's psychology and carries in its wake the acquiescence of the animals.

Latour shows that it is important to move on the practical realm of inert things. Prunelle could have been more persistent and have remained a pest (demanding Gaston to repair the doors, remove the animals). The doors could have been of steel, which would have caused considerable extra work for Gaston, and the animals could have been more fragile. The pragmatic element (or test) of Gaston's innovation is then as follows (Latour 1995:279):

> Innovation is the test that permits the solidity of all these links to be tested. It's the trials of innovation, and they alone, that allow us to learn if the idea of a door is flexible, and if Prunelle is multiple....What is a technical innovation? Modifications in a chain of associations...

Latour (1995:279) then asks where do these modifications 1-6 (in Figure 2.2) come from? First, by means of the introduction of new beings, saw, cat flap or seagull. Second, the modifications come as a consequence of the passage of an actor from a program to an anti-program, or vice versa, meaning that the open door conspires with the cat but also with the draught against Prunelle.

In this way the ally of a program of action becomes an adherent of the anti-program. Consequently, something that conspired against the program becomes favourable to it. Third, there is a change of state of an actor that finds itself endowed with new properties. Gaston's furious cat and seagull become happy. Prunelle becomes furious, then unfair, then sincere and Gaston becomes ingenious instead of indignant. Fourth, all modifications develop from a substitution between things: Prunelle as a cat doorman is replaced by a cat-flap (same function, different material). Fifth, from a packaging or routinization of the actors who have become faithful to each other. Fragile existences become stable essences once again, black boxes, or "reintegrated" in Victor Turner's and Bryan Pfaffenberger's language.

The connections between the program and the anti-program developed into a durable network. Still, this development had its price. Going down the front line means enriching the action or programs with series of cunning translations. Through Gaston's actions Prunelle is losing his resistance, he gave up his anti-program and capitulated within the program of Gaston. As Latour argues, it is the front line that we see (Latour 1991:110):

> But for us, who wish to observe the mobilization of non-humans into a human assembly, the only interesting reality is the *shape* of the front line. Whereas the asymmetry between the feasible and the unfeasible, the real and the imagined, or the realistic and the idealistic dominates most studies of innovation, our account only recognizes *variations of realization and de-realization.* The front line traced by the exploration of what holds and what does not hold together records the compatibilities and the incompatibilities of humans and non-humans - that is, the socio-logics of the world in which we live.

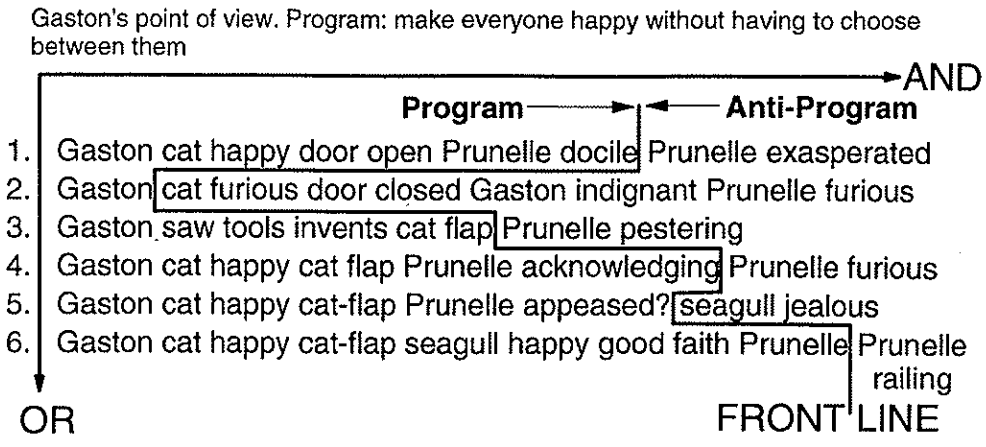

Figure 2.2 Program and anti-program, with front-line in the light of Gaston's action (Latour 1995)

Latour's summary is important. If he had focused simply on the evolution of this door as an isolated technological phenomenon, he would have understood very little about innovation and nothing about conflicts in offices either. When the object is given to us together with the beings that hold it in place we can better understand the world in which we live.

Actor network theory is the major source of inspiration in defining new additional concepts that can be used together with social and technological dramas. *Inscription, translation* and *irreversibility* are three additional concepts that must be given a proper presentation. Instead of presenting a phenomenon as social or technical, ANT urges us to ask: has a non-human replaced a human, or has a human replaced a non-human? In the CW project, a design of new work and organizations enabled by new use of IT should have a number of such replacements on its agenda. This question leads us to *inscription* (Akrich and Latour 1992:205-208) that denotes the way technical artefacts embody patterns of use:

...how technological objects simultaneous embody and measure a set of relations between heterogeneous elements...Designers thus define actors with specific tastes, competencies, motives, aspirations, political prejudices, and the rest, and they assume that morality, technology, science, and economy will evolve in particular ways. A large part of the work of innovators is that of "inscribing" this vision of (or prediction about) the world in the technical content of the new object... The technical realization of the innovator's beliefs about the relationship between an object and its surrounding actors is thus an attempt to predetermine the settings that users are asked to imagine.

An inscription is a scenario of use. Gaston inscribed: "cats are meant to be free" in the cat flap he invented. The strength of an inscription is related to the irreversibility of an actor network, something I will come back to later in this section. In most cases it will be difficult to know if the inscriptions work. It is trials of strength, or pragmatic tests that will prove their workability and this can only be seen retrospectively. Gaston had to develop the cat flap and try it out before he could confirm that the inscription worked. His boss was furious but gave up.

In Chapter five I describe how Norne tried to develop a new organization by developing a number of new work routines, by means of a number of inscription efforts. In order to inscribe these new routines Norne preparations for operations used a number of inscriptions. They developed a text based operational philosophy document. This was not enough in order to describe a new practice. They ended up with an operative digital enterprise model, combined with training and a number of process owners with specific routines. In addition, management were given numerous responsibilities to follow up the work.

When the inscriptions brought forward by the operational philosophy were not strong enough, a number of additional inscriptions were added on top of the original inscription. In Chapter five I show how a number of work routines in planning for operations were inscribed into a material (operational philosophy in paper) or different materials. There were several different materials. The enterprise model was in a digital form and process owners were of flesh and blood, both humans and non-humans. The inscriptions ranged from work routines, artefacts, legal documents (project-contracts), existing norms and habits, written manuals like mandatory documents or operational philosophy, methodologies (BPR and flowcharting) and a number of organizational arrangements. All these components were linked together into a socio-technical network around Norne. When these inscriptions were added and imposed on top of the existing ones they accumulated strength.

ANT asserts that actors pursue different interests; therefore stability is dependent upon a systematic *translation* (in the sense of re-presentation or re-interpretation) of others interests to one's own. Translation is the key term here, a term we have to describe in larger detail. The following are the key aspects of *translation.*

First, ongoing processes of translations are the *key sources of social order* because they create ordering effects such as: devices, agents, institutions and organizations. Bruno Latour (1987:108) defines translation as the interpretation given by the fact builders of their interests and that of the people they enrol. Second, this means, with a translation, *one and the same interest or anticipation can be brought forward in multifarious ways to create broader support.* Third, the total set of actors in a network can be complex. In order to act in this complex reality *some aspects of it must be amplified and others reduced.* Fourth, translation is therefore a process where *complicated sub-networks become represented by actors* and where the complex underlying structure often becomes a *black box* for many practical purposes. Michel Callon (1991:143) says:

"We have to define the medium, the material into which it is inscribed: roundtable discussions, public declarations, texts, technical objects, embodied skills, currencies - the possibilities are endless. Nevertheless the elementary operation of translation is triangular: it involves a translator, something that is translated, and a medium in which that translation is inscribed.

The centre of translation tends to become a point of power and control, and effects caused by translated sub-networks become resources that can be controlled. This is a process of translation where a punctuated network can be visualized as if the actor who does the translation owned it. Fifth, translations lead to *punctualization* of complex sub-networks, meaning that they start behaving like a unified entity (seen from the perspective of those that interact with the sub network). These translated sub networks can also use existing resources. In the chapters that follow KOT is dependent on using the existing IT infrastructure and this can be done without considering all the processes and knowledge that was invested in the development of this infrastructure. Translation means that *complex networks can be taken for granted.*

The materials become the willing executives of the translations, or their supporters (for example: the police translates traffic surveillance to photo boxes, Gaston delegates the open-close mechanism to the cat flap). Sixth, translation can be seen as a *mediating device between the local and the global, the micro and macro* and still be localized in time and space. IT systems development, or design in general, must be seen as translation. In later chapters we see how users and others' interests in the CW project, were translated into specific "needs,". These specific needs were further translated into more general and unified needs so that these needs might be translated into one and the same solution, the IT applications built in the CW project. When the IT solutions were up and running, they became adopted by the users who translated the system into the context of their specific work tasks and situations". Seventh, in the CW project some translations or inscriptions were strong, others were weak, opening up for *flexible or non-flexible programs for action.* In order to play an influencing factor most inscriptions must be inscribed and embodied into a durable material, like an IT system.

Finally, translations can become *irreversible.* Stability is the end product of a social process, where a non-aligned group of interests are aligned under the umbrella of one acceptable truth. It is then the consequence of an alignment of interests. Socio-technical design, like the Norne application and work processes in Chapter five is moulded into a stable social fact through complex socio-technical negotiation processes. The core of the argument is that nothing is done automatically by itself, but it must be kept alive continuously to avoid dying. Bruno Latour (1996:86) describes how hard continuous labour is needed to keep a decision or a computer system alive. It needs continuous re-confirmation, if not, commitment will fade away. Given stability, what does it take to change this situation? The effort involved in changing an actor network, that is, changing translations and inscriptions, can be understood by Michel Callon's (1991:149) concept of the *"irreversibility of an aligned actor network".* This term describes the level of stability of an inscription, or how translations between actor networks are made durable by inhabiting an ability to go against competing translations. Callon (1991,149-150) argues:

> I will say that the degree of irreversibility of a translation depends on two things: (a) the extent to which it is subsequently impossible to go back to a point in time where that translation was only one amongst others and (b) the extent to which it shapes and determines subsequent translations.

This process of irreversibility is a kind of institutionalization that go two ways: Monteiro (2000) argues that an increased degree of irreversibility is signalled by a firmer institutionalization and, the other way around, the construction of institutions functions as a way to align the network and make it increasingly irreversible.

2.5 Summary

I started my drama perspective with the work of Victor Turner and Bryan Pfaffenberger that can give us an alternative language to handle the dynamics of social change in relation to organization and technology development. I also showed that Turner was influenced by Kurt Lewin's three phases of social change: de-freeze, change and freeze. Then I explored important aspects of this drama perspective and added some new aspects. First, that the drama analogy enables us to see humans situated in particular historic, situated settings and contexts. It also focuses on embodiment and practice, or how the individual is a part of a material world that is mediated through lived bodily experience. Second, I showed how embodiment can be related to an ecological mind and argued how this mediated position required that I put more efforts into describing human use or being with technology. I took with me additional

concepts (like amplification and reduction, telic inclinations and others) and presented an introduction to the thinking of actor network theory (ANT).

The Gaston narrative summed up my use of the drama analogy in the light of ANT. This gives me an overall perspective that I intend to take with me in the chapters that follow. Human beings act, collaborate and compete in a material setting. Through their mediated action problematic situations are initiated and consummated, in the terminology of Dewey. In order to resolve these problematic situations they use their active productive skills based on schema that are both material and idealistic. The materialization of these productive skills in action lead to arguments and counter-arguments in the language of Turner-Pfaffenberger and programs and anti-programs in the language of Latour. It starts a process of amplification and reduction that is further enhanced by the goal oriented and mediated action of humans and non-humans in given fields by means of arenas and numerous situations. This process is further developed through the various phases of the drama (see the summary of the phases of the drama in Figure 2.3).

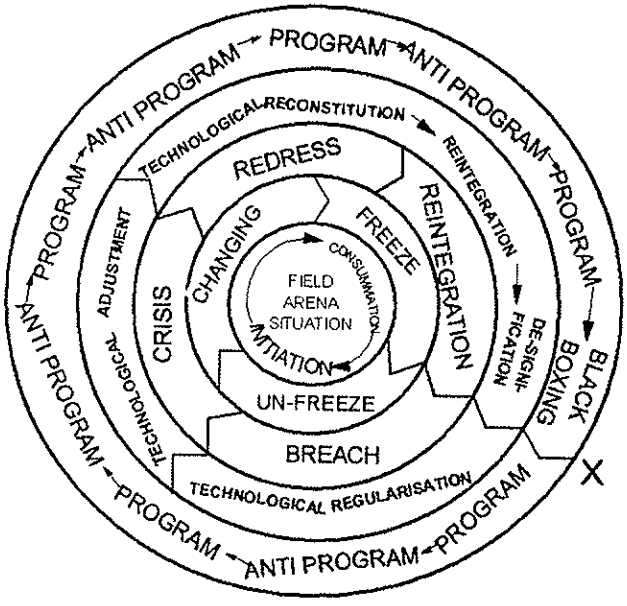

Figure 2.3. The drama analogy of Victor Turner and Bryan Pfaffenberger seen together with John Dewey's structure of experience, the black boxing perspective of Bruno Latour and the temperature metaphor of Kurt Lewin

In this figure I have tried to show that these different perspectives all portray the cyclic process of change in various ways. The placing of the different perspectives is arbitrary, but they all start and end at the cross-point. They are cyclic and the end point of one is merely the starting point for another.

Given that we employ the analogy of a social or technological drama to understand organization and IT development, we need a more thorough understanding of the phases that have been discussed here, but also describe in more detail the mechanisms at work to enable a new concept of organization and IT development to become translated, not diffused, in the organization. This will become more apparent in the empirical chapters to come.

Chapter 3 A Short History of Statoil, KOT and their Naturalization

3.1 The setting

In the end of 1998 Statoil had around 18 000 employees and operated in 23 countries. The main area of business development is still northern Europe (UK, Germany, Denmark, Sweden and Norway) but growing internationalisation is taking place with respect to parts of Africa (Nigeria, Namibia, Angola), the far east (China), Latin America (Venezuela and the Gulf of Mexico) and the former Soviet Union (Aserbadsjan, the Caspian Sea). Statoil is a functional organization, with extensive use of project and matrix organization forms. It has an executive board with a president on the top, with sixteen business areas (resultat områder). Eleven corporate staff functions support the organization with functions such as human resources, legal affairs, and corporate strategy development. Business areas are divided into business units (resultat enheter) often located at different geographical locations. In Norway the major sites are Stavanger, Bergen, Trondheim, Oslo and Harstad.

To decrease functional focus Statoil has developed extended use of projects to deal with cross-functional issues. Formal competence networks across organizational borders and extended use of organizational rotation of both management and personnel are other examples of cross-functional collaboration. The organization has also defined the major horizontal value adding processes from the reservoir to the market. Statoil's main business processes are simplified in accordance with value chains (Porter 1985) that describe the physical and sequential flow of products through different parts of the organization, see Figure 3.1. Exploration, development and production will be the main focus in the Statoil R&D pilot examples in this work.

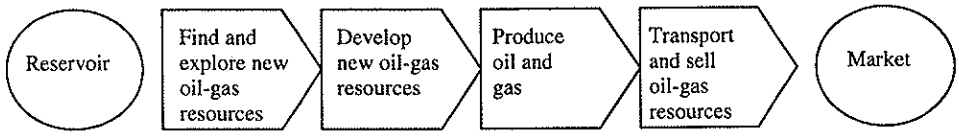

Figure 3.1 Statoil's value chain from reservoir to market

Oil and gas operations are a key industry in Norway representing 15.5 % of the GDP (1996 figures). Statoil is the largest producer in Norway and the second largest exporter of oil worldwide. The net profit after taxation of Statoil has been around NOK 5 billion (USD 1 equals NOK 8 in 2000 rates) in 1995-1996. It decreased to NOK 4.3 billion in 1997 and fell to NOK 271 million in 1998. The operating profit before taxation has increased from NOK 12,7 billion in 1993 to an all time high of NOK 18,3 billion in 1996, a slight decrease in 1997 to NOK 14 billion to a fall to NOK 4.7 billion in 1998. The largest part of Statoil is related to exploration and production (E & P). It contributed with over NOK 15 billion of the result leaving refining and marketing with NOK 1,3 billion and petrochemical with NOK 0,4 billion. Crude oil sale represented nearly 50 % of income but is decreasing. Natural gas accounts for around 10 % but is steadily growing and is expected to double over the next five years. Refined products represent around 30 % while transport (pipelines) and various smaller activities represent the rest.

Statoil of the 1970s and early 1980s had a history of governing the Norwegian State's interests on the Norwegian Continental Shelf (NCS). Statoil was in this period very much a governmental organization and the product of negotiations in Norwegian politics. From the outset, Statoil relied heavily on an array of different favourable encouragements and measurements aimed at tilting the competition. Reliance on political negotiations has made Statoil particularly responsive and sensitive to signals in the political environment. The rapid growth of Statoil in the 1980s meant building up a new organization to handle the new operation licences from scratch and had to take time.

However, the broad, political obligation in Norway to systematically and aggressively favour Statoil gradually faded away as the tide of liberalism rose from the mid-1980s. This has step-by-step forced Statoil through a metamorphose. Through a sequence of small steps it has been transformed into an internationally competitive oil and gas producer. Over the years a number of organization development projects have streamlined the business and made the corporation more efficient, often a response to external factors of which Statoil has no control. The main factors determining Statoil's business are the price of crude oil and the dollar rate.

When the oil price has been low, as in the late 1980s, during the post Gulf War recession of 1991-94 and the collapse in NIC Asian economies in 1998-1999 the focus on change has been considerable in the company. The crisis of 1998-99 led management to pursue the aim of developing a profitable organization with an oil price of USD 12 a barrel. In the period after this decision the oil price (Brent blend) went from 9 to 26 US$ a barrel. The average price of Brent Blend reference crude declined from USD 19.1 per barrel in 1997 to USD 12.7 in 1998.

To manage Statoil with the expectations of USD 12 would secure a more stable foundation for the future irrespective of ups and downs in the oil market. In addition to this Statoil had high exploration costs and substantial write-downs and provisions. Net profit of only NOK 271 million in 1998 led to a number of actions. Favourable deals were made available for those who wanted to leave the organization. Global exploration activities were cut drastically and a number of cost reductions processes were started to reach the goal of USD 12. At the same time Statoil is changing into an internationally oriented, competitive enterprise focusing on core areas in its exploration and production. Statoil is learning to operate in a competitive market at the same time as it diversifies. It is no longer just an oil producer, but supports the whole chain from exploration of oil and gas fields, development of field installations and transport systems, operation and maintenance of a number of offshore production platforms and pipeline systems.

3.2 Research and development in Statoil

Statoil Research and Development (R&D) was until mid-1999 a business area of around 350 people situated in Trondheim. The research centre was after a long internal controversy moved to Trondheim to ensure good co-operation with the Norwegian University of Science and Technology (NTNU) and the large research foundation SINTEF. A co-location with these institutions should develop synergies between the university and the industrial company. Up to 1998 the research centre had a functional organization that reflected the organizational chart of Statoil, a mini-company that was able to support functional customers in the larger Statoil organization. One sector or unit was dedicated to exploration, another to development and operations, a third to refining and finally the sector of "leftovers" who worked with research related to multifunctional agendas (i.e. health, environment and safety; co-ordination technology; energy; materials technology) After 1998 and into 1999 the Research Centre became project organized and the number of hierarchic levels were reduced. Overall espoused funding and the structure for research had the following structure when most of my work was done upto mid-1999.

The executive board in Statoil has founded the technology board (teknologi styret) as a forum to work, reflect upon and create anchoring in the organization before major technology decisions are taken. A member of the executive board is also the head of the technology board, ensuring that decisions taken in the technology board are also executive board decisions. The board of technology has an overall budget framework for all research and technology development in Statoil. The main tool for management within the domain of technology is the technology strategy. The technology strategy of Statoil defines a number of core areas of concentration (or technology ambitions). Statoil is a small company compared to BP and Shell, and can only focus on research areas that are of particular importance in relation to long-term company ambitions. However, high ambitions are needed in the defined areas.

These areas were in 1996-99: *Holistic competence* with: co-ordination technology and information technology, *market competence*: with oil refining, gas refining, electric power, *realization competence*: with development and operation of production facilities, development and operation of transport and distribution systems, health, environment and safety, *resource competence* with: exploration technology: petroleum technology, drilling and well technology. These four areas each have a core competence group (KKG) that consists of key business stakeholders (senior managers and technical experts) and representatives from Statoil R&D. These groups should arrive at overall proposals for strategies and responses to the proposals. The KKGs are to agree upon what strategic ambitions Statoil will follow in the future.

To operationalize the ambitions two kinds of programmes are initiated in each KKG. Strategic programmes are established to move the company competence and the front-line of technology. Technology programmes are established to develop and bring technology the last steps to application in the organization and are the formal responsibility of the technology division (TEK), with the help of R&D. Due to maturity a programme that was started as a strategic programme has developed solutions that must be implemented in large scale, it then becomes a technology programme. Statoil R&D is responsible for the strategic programmes.

The main aim is to develop competence within the field and create a basis for new technology programmes. Strategic programmes should have high ambitions aiming at challenges that are 5-10 years ahead in time. Each strategic programme consists of a number of research projects. Technology development in addition to these two forms of programmes (with their sub-projects) shall only happen as tasks/projects paid by the licences or Statoil sub-units themselves.

These tasks should also ideally be within the core areas that the technology strategy addresses. A new programme or project will have a high KKG-funding rate, but as the programme develops its business application, more money is given from outside the company's research budget. Each project has historically had 50-80 % basic research funding and 20-50 % funding from organizational units directly. This description depicts the formal organization of research as it was in 1998 and parts of 1999. We leave it with the espoused version here. The actual day-to-day operation of the system is far more complex, but it gives a fair description of the formal funding process of research in Statoil until 1999. The more informal mobilization process for funding is described in the chapters that follow. The group of people that is the main focus of this study derive their funding from the holistic KKG. The funding for their projects is partly research and partly direct funding from Statoil organizational units, in this case from 1996-1999 the Norne offshore installation and exploration and development. Holistic competence and the development of new ways of working with IT have traditionally taken up 2-3 percent of the total R&D budget. We will now give a brief introduction to the history of the "co-ordination technology group".

3.3 The Co-ordination Technology group (KOT) at Statoil R&D

I now intend to go through the history of the group. Bear in mind how the work of the KOT-group is a part of the change in Statoil that has taken place, especially the role of IT in the 90s. Narratives are described that are representative of KOT's history and give more situated descriptions of the complex social system and major organizational actors in Statoil the group has worked with over the years.

"IT + ORG = SYNERGY? is the equation of our group. Our mission is to remove the question mark to develop new forms of collaboration in Statoil by combining reflecting and learning processes with the support of enabling information and communication technologies".

(The KOT-manager during the visit of Statoil CEO Harald Norvik to KOT in October 1996)

3.3.1. The early phase of experience transfer and ERGODESIGN 1990-1993

Research in Statoil had traditionally been a technological endeavour. A small group of researchers that had worked with subsea and diving research saw that most of the challenges facing the application of new technology in Statoil had little to do only with technological issues. The problem was to find funding for research related to information technology in Statoil. In the strict functional organization of the late 80s information technology was not something Statoil research should embark on. Under the name AIT (applied information technology) this small group of researchers came under pressure from Corporate IT (KIT) who refused them to use such a name, because IT was their functional responsibility. R&D management in Statoil gave AIT half a year to prove their viability in Statoil and develop new customer relations.

At the same time as they changed their name to KOT or "Department of Co-ordination Technology" they embarked on a strategy of trying to combine IT and organization development in their slogan "ORG+IT=Synergy". Thereby overriding the alleged threats from KIT. The concept "co-ordination technology" was a buzzword that was growing in use in the United States in the early 90s. Mainly to create more internal Statoil credibility and improve internal skills and expertise, KOT developed a relation to the newly founded MIT Centre for Co-ordination Science in 1991. Paying them a yearly fee, literally bought credibility in the internal market in Statoil. A good working relationship with MIT (icons of outstanding business school research in organization development and IT) was established and MIT was enrolled as an ally of KOT. To give co-ordination technology a foothold in Norway, the KOT-manager and two university professors also established a research programme at the Norwegian University of Science and Technology (NTNU). For five years, from 1992 to 1997, this research foundation was partly financed by Statoil via KOT and established a firm academic basis for co-ordination technology. This academic contact played a positive role in legitimating co-ordination technology as an important area. In the years to come the academic staff of the research foundation would become important allies for KOT in the legitimation of new use of IT in Statoil. In the first years the department worked with experience transfer. Statoil had a problem with the "transfer" of experience from one installation to the other and from operations back to design and engineering of new installations. A number of articles related to experience transfer in the internal company newspaper *Status* from June 1991 describes this rather vividly:

"Tear down the fences" the folk singer Jan Kleveland song a few years back. The researchers in the project ERGODESIGN truly agree. Mechanical foreman Hans Hansen from Gullfaks A, is an important part of the research team that develops a systematic method for experience transfer from operations and maintenance of offshore and onshore plants to new development projects. ERGODESIGN was tested on chosen source experience at Gullfaks A in 1990 focusing on access and transport problems related to maintenance. These experiences are systematized and are the basis for a method that in principle is applicable for all technical domains in the company... Hansen tells Status that collaboration between researchers and the operative environment is something he and his colleagues have waited to happen for many years... And it is due time, he thinks. At least the mechanical department at Gullfaks is in the lead. Enthusiasm has been created. People were disappointed when they arrived at Gullfaks, many from older installations. The personnel expected that experience from earlier platforms should have been used. Too much was swept aside as unimportant- even though expenditure cuts could be proven. I think we have to blame the system and the culture of the company more than individuals. Hansen says that in Statoil many people on the installations have important knowledge. Maybe an old merchant marine machinist has met resistance when presenting his ideas and perspectives. In the end he gives up "hangs his brain away" at the same time as he puts the helmet on his head.

Status describes an example:

Shit, the water injection pump stopped again. The engine that operates the pumps harks and stops again. Destroyed. The people in mechanical maintenance despair, it's going to be a tough job to move the engine that weights 13 tonnes. Especially when the crane at this module only can lift 10 tonnes. And it is narrow and difficult to find room for your elbows in order to get the engine up and running again. The people in mechanical maintenance also know that it takes time to bring a new engine offshore to the installation. In the development phase of the installation, nobody considered the possibility that the engine had to be replaced. Why not? The situation is widely known on the drilling decks on earlier installations. This is not a new problem. 1300 work hours later, a new engine is installed. Around 1000 hours have been used for transport and to create access to the engine. The question is, how long will it take before the circus starts again: And why are not the messages from the mechanics listened to when they say: the system is not appropriate?

The concept that was called ERGODESIGN tried to deal with the weaknesses that the people at Gullfaks felt in their daily work. The company policy of the time was to write paper-based

closeout reports after each large project and there were no systematic ways of handling experience except the rotation of skilled project engineers and operational people to new projects. A new "quick fix" of databases should develop the final solution of experience transfer. The division of Statoil responsible of developing new onshore and offshore installations in Statoil believed in building experience databases to solve the problem. KOT did not believe in a quick-fix database solution. In order to bring tacit knowledge to bear in design they found it necessary to create situations in which the users in a concrete way were allowed to trigger and apply their knowledge. They knew that experience with technical systems was a kind of knowledge acquired by humans through their work and given a subjective interpretation based on their prior knowledge and local organizational context. In order to make work-related knowledge available, conceivable and applicable to others within the organization, they believed specific work-related reflection processes were required to support the spread of knowledge from sources to potentially new receivers.

The group saw during the intensive offshore fieldwork of 1990-91 that the work context was the fundamental starting point for experience transfer, and that work tasks had to be seen together in order to find out how groups interact in multifarious ways within complex organizational contexts. Skills were usually performed and made available only within the context of specific work situations. Participation from what was called primary knowledge sources, i.e. sources that were directly exposed to consequences of organizational practices and platform design, was therefore particularly important in experience transfer. Seen from the management theories of 1999-2000, veterans in the group see this as an initiative of knowledge management, a term that did not exist in the early 1990s. This early phase of KOT was a period when basic assumptions were built up; the belief that anybody regardless of organizational position had something to contribute, that research was a collaborative and a mutual learning process between researchers and operational people and had to take part during intensive fieldwork in the context of the user organization. Further, it had an emancipatory agenda to improve the quality of working life of offshore workers, that all important research questions/issues were multidisciplinary in nature and that with multidisciplinarity came certain possibilities and synergies.

3.3.2. The organizational operationalization of experience transfer 1993-95

The work that had been done with the Gullfaks and Troll installations in 1991 and 1992 made it evident for KOT that work methodologies for experience transfer and organizational work routines were needed. To develop company databases and hope that people would use them was not enough. It was not that KOT detested the use of databases but it was more that they stressed the elicitation and reflection process in combination with new organizational routines. Information technology was only one tool among many.

How then could experience transfer be kept on the agenda in E&P? KOT received an invitation to take part in the cost containment processes that started in 1992. E&P's goal was to cut expenditures by NOK 2 billion within 1995. KOT tried to lobby for experience transfer as a key instrument to reduce the costs and succeeded in this. In the concretization and implementation of the project in 1993, the PES project, experience transfer was picked out as one of three E&P key improvement areas. Improvements of standards and work procedures became the other important domains. These also had to have important elements of experience transfer if they were to succeed.

A new department in the TEK division was given the responsibility for this work in E&P. The KOT manager accepted a one-year rotation position as the first manager of this new unit. In 1993 KOT participated in the PES project acting as facilitators in relation to a group of operational people who should describe the new overall work processes of operations. 18 groups tried to develop mandatory descriptions of E&P functions like maintenance, health environment and safety, operations, logistics, finance, project development. In addition, KOT was given the responsibility to develop a mandatory description of experience transfer based on the ERGODESIGN methodology. Here they had to operationalize concepts originally used in research projects and try to give simple descriptions of how to make the methodology applicable and adjusted to everyday routines in the company. In the autumn of 1993 KOT had serious problems. Most people in Statoil were unfamiliar with problem-solving techniques and it was the general impression in E&P that the new operational descriptions, methods of experience transfer were both rigorous and academic.

At the end of 1993 KOT was facing a big challenge. They knew very well that experience transfer was much more than mandatory documents and written espoused work procedures. The core competence group that funded much of this work decided that continued focus on work procedures and mandatory documents was necessary to help to get the new organizational unit in TEK up and running. An internal discussion started in the group, how should the more important issues of ET be handled, like technical system experience as in the example from Gullfaks? The conclusion was that this had to be taken up again later. By focusing on mandatory documents KOT had an arena to improve the methodology and believed they could shift focus along the way and be able to present the methodology to most operational environments in E&P.

If systematic experience transfer was to be implemented they believed that one had to start somewhere and it was not possible to cover all issues at the same time. Mandatory documentation improvement could be a pilot for the new practice KOT were hoping to develop in E&P. To say NO to the focus on documentation would have meant a terrible loss of face and funding and was no real alternative in the light of the expectations developed.

After the PES project in 1994 there was a perceived need for electronic distribution of mandatory documents, strategies, best practice or ISO 9001 descriptions in Statoil. One of the main goals was to establish a better system for sharing "best practice" within E&P and improve experience transfer throughout E&P. The idea that emerged in the operationalization of ERGODESIGN was to have a number of operational networks of people that were connected via LOTUS NOTES and could give electronic improvement proposals related to a number of best practice documents that were shared electronically via the pull functionality in NOTES, i.e. a more advanced digital bulletin board.

Before 1991-1992 there were few commercial solutions available that could be used as an enabling tool in experience transfer processes. KOT started to use LOTUS NOTES sporadically in the experience transfer project in 1992 and developed a database for experiences related to materials (corrosion, weaknesses). NOTES became the official project communication tool of KOT from the winter of 1992-93. While Corporate IT (KIT) and later Statoil Data in most cases envisioned the use of NOTES as an office administrative tool, KOT's vision was to develop its use within offshore operations in E&P. The infrastructure of LOTUS NOTES servers was growing fast in 1993, and others than the IT-division could use

this new infrastructure as well. For the first time it was possible to get a prototype up and running rather quickly due to the (at the time) advanced development environment in LOTUS NOTES, and the server infrastructure already in place. KOT embarked on a strategy to quickly work out a prototype to support experience transfer that was perceived as useful. Then to try it out in real-life settings and gradually improve the functionality of the application, when the work processes of experience transfer started to materialize.

Early in 1994 KOT and TEK STI standardization started building a concept they called DELPHI. Full-scale LOTUS NOTES implementation in Statoil was not yet decided. In order to get a heads start, KOT and STI gambled that this decision would be taken within the year. They were right (or lucky) as in September 1994 E&P management went along with a full-scale implementation in E&P. With their basic skills in LOTUS NOTES, KOT were able to develop a working prototype of DELPHI that was used among a small number of users from autumn 1994. KOT and STI standardization asked Statoil Data for help to develop the DELPHI application further. Statoil Data were then busy with planning the implementation of LOTUS NOTES in E&P and were not willing to put resources into such a project. They were also building a competing concept SAREPTA (which is different from the product that came later marketed by IBM).

The first SAREPTA was supposed to be one of the key NOTES applications that Statoil Data should sell to its customers. The key idea behind the DELPHI concept that was to make mandatory documents available via pull functionality (making the documents available online in a company database), introducing the possibility of giving improvement comments and handle deviations (related to ISO 9001) related to the documents in a structured manner. Some support (names and addresses to the members of the network representatives and plan and schedules for the work in the networks) for the new operational networks were also included in DELPHI. In the winter of 1994-1995 DELPHI still had problems matching the technical sophistication of SAREPTA, but it had a simpler user interface. Since extensive prototyping on top of existing functionality was done in DELPHI, the system lacked good system architecture and was difficult to maintain.

In the long run SAREPTA would have won based on its sophistication and Statoil Data's position as obligatory passage point in developing and spreading NOTES applications. This however, was overthrown by an unforeseen organizational change in February 1995, namely that E&P was dissolved in a new reorganization process. The dismantling of the E&P division into smaller organizational units came as a large surprise, and the organization sat waiting for new directions from management, new functional responsibilities and mandates. Statoil Data was very dependent upon E&P and had problems orienting themselves in the vacuum that resulted in this dismantling process. KOT and STI foresaw that DRO (the key organizational unit after the dismantling of E&P that organizes all the production of oil) had to take over E&Ps ISO 9001 certificate, and took steps to align DELPHI with this initiative.

A number of translations were undertaken to secure DELPHIs position. This ability to read the political signals more accurately, translate these along with their own interests and act accordingly gave DELPHI more strength vis a vis SAREPTA. KOT and STI developed an alliance with the quality improvement department of the old E&P in the vacuum that developed after the dismantling of E&P and took the challenge to develop a new overall steering model of the ISO 9001 system. Here much of the old experience transfer

methodology was implemented. When DRO was rewarded their ISO certificate in autumn 1995, DELPHI was so aligned with this ISO certification process that it became the "killer application" for distributing electronic documents, experience transfer and deviation control. Internal marketing was also used actively to market DELPHI as this example from the internal company newspaper *Status* 18 May 1995 where the manager of STI standardization stands bent over a PC with 40 metres of empty bookshelves in the background:

> Over 40 metres of empty bookshelves carries a message of a cost reduction of several million NOK, thanks to the implementation of electronic distribution of mandatory documents (...) In 1994, STI had 9000 shipments of the paper documentation. Computer technology has not only made it cheaper to distribute the documents. In addition they are more available. Up to now there are 20 000 accesses in the database every month.

To sell the new concept, KOT and STI visited Statoil offices and installations; around 1000 people attended these presentations in 1994-95. DELPHI was looked upon as a huge step ahead when it came to the distribution of mandatory documents, and in these terms it was a successful translation. Mandatory documents that regulated operations offshore were necessary due to health, environment and safety reasons. Much of the work offshore has to be regulated by strict rules and procedures due to the potential health hazard. But the revision of these documents created large amounts of paper. Each person that had such a handbook had to have a new copy of the revised procedure and this new paper copy had to be sent by ordinary mail to this person's location.

A large technical library spent considerable time keeping track of and feeding the user with updated documents and these librarians were given jobs elsewhere in the company. On the offshore installations there were always old copies of mandatory documents in the bookshelves. Version handling was a big problem. STI stopped the manual distribution. DELPHI made the last version of the mandatory document digitally available, and changes in the document was immediately available to the users on the installations. In the first year much of the printing costs were moved to the computer printer rooms of the installations. When offshore personnel were becoming used to read digital documents, these printouts decreased substantially.

The digital distribution of mandatory documentation was considered a success; in late 1995 there were 30 000 to 40000 monthly accesses in the DELPHI database. The pragmatic test of the rest of the work was not so positive. As Karina Aase (1997: paper II: 20) says DocFlow (or DELPHI) ended up with little focus on experience transfer. The operational processes that the project implemented were seen as too rigorous and problematic in the functional organization of Statoil in the mid 1990s and never played any substantial role.

The handling of experience transfer in relation to KOT's original extrinsic ambitions was a failure, but the consequences of the distribution of mandatory documents, the unforeseen intrinsic effect, was substantial. Consider the following example from maintenance: It was the intention to use the oil installations' "communities of practices" to receive valuable feedback to improve maintenance and operations. By establishing contact with key people in these communities and using their informal networks KOT hoped that this would secure the "flow" of experiences up to a more aggregated level. One basic lesson learned was that these "communities of practice" had problems aggregating their knowledge into abstract formulations because their work experience was situated, tacit and embodied.

The strategic and aggregated formulations in the mandatory handbooks were often too obscure for the workers to handle and too abstract to comment on. A consequence of this was that specialists and middle management often became the key sources instead of the offshore workers themselves. However, these sources were also important in the transfer process. The business units found out that if they were well prepared and presented their views in a good manner via the network representative. This was an important channel to get their perspectives through, and also to receive feedback for further improvements. The new networks worked, (but not satisfactory), the first and second year after the project had come to an end in 1995 but then died slowly due to reorganizations and rotation of personnel.

KOT tried several times to allocate resources for experience transfer on technical systems and take up the gloves from 1991-92, but the KKG and management that gave the funding continued their argumentation for mandatory documents. The old ambition of developing systematic experience transfer that covered more than mandatory documentation was dead. One of KOT's main goals initially was to mobilize the "communities of practice" at the lowest level in the organization, mainly because past fieldwork and projects on experience transfer from 1990-93 could be regarded as a grassroots movement that mobilized these resources.

However, the nature of the project and the mandate made it difficult to continue this line. KOT was sceptical to ISO thinking believing that it only encapsulated espoused theory and said little about actual organizational practice. However, the methodology was officially incorporated as important guidelines for all continuous improvement in the most important parts of the company. The hope was that the organization would gradually adopt the new descriptions through continuous improvement work and by means of active improvement of the ISO system. Still, this never happened.

For Statoil Data, DELPHI was problematic. First, because they wanted to implement their own concept SAREPTA. Second, because KOT messed up their functional responsibility for delivering IT products and services, felt challenged by people with lay IT backgrounds, obscure facilitator and fieldwork skills. Third, they were faced with a steadily growing DELPHI application. After the 1995 reorganization process an increasing number of organizational units wanted to place their digital mandatory documentation in DELPHI. Statoil Data had no control over this development.

Statoil Data system developers described DELPHI in the following manner: "DELPHI is rotten inside and is a nightmare to maintain..." With the increasing amount of data that was loaded into DELPHI, something had to be done to prevent the database from collapsing. A project to redesign DELPHI was started in late 1995. STI took over the responsibility and initiated the development of a new application named DELTA, (taking letters from both DELPHI and SAREPTA).

At that time the funding for experience transfer was depleting and the project came to an end in the autumn of 1995. Needless to say, the DELPHI/SAREPTA-controversy created tensions between Statoil Data and KOT and it was no good example of intra-organizational collaboration. In the autumn of 1995 a more open discussion between KOT and Statoil Data was developing. This is described in the following chapters.

KOT's help with the building up of the new offshore organization of the Heidrun oil installation was following up the traditions of 1991-92. Here KOT people worked as facilitators in the process of helping Heidrun personnel to describe operational and maintenance processes in their preparation for operations. This project that Heidrun called "Safe and efficient production" set the standard for operations and maintenance in Statoil in the mid 90s and was vital in the work in Norne in 1996 as we will return to in Chapter five.

3.4 The Naturalization of KOT in Statoil

Many large projects had changed Statoil from the bureaucratic organization it was in the late 80s and early 90s. It was not done overnight but via many small steps. I have elsewhere described how this effort was pursued in many phases from 1991-1998 (Monteiro and Hepsø 1998, Monteiro and Hepsø 2000) and how it was a complex socio-technological negotiation process where both internal and external forces worked (see Chapter one for details). We looked at the development of an information infrastructure, related to important information technologies (LOTUS NOTES), the key information and communication tool of the company. In this work we found out that business strategies and development of IT was not aligned in the traditional sense as the management literature says it should be. New ways of using IT developed unconnected to business strategies but they met in given moments in time. The rise and fall of organizational units within Statoil was a key contributor in the relation between organizational development and IT. Strong individuals and organization units were bargaining, translating for powerful visions and images of IT and lobbying for specific organization and technological solutions.

The functional separation of responsibility for IT and organization development hampered the synergetic possibilities of integrated information technology and organization development for a long time, but it paved the way for organizational actors that could manoeuvre between these lines. The prevailing and general attitude towards IT use and investments in Statoil throughout the early 90s was that IT was an expense. Within relatively few years, by the mid 90s, there had been a substantial change in attitude towards IT in general and NOTES in particular. LOTUS NOTES and other major IT artefacts were redefined and improvised in order to gain benefits from the more general redefinition in Statoil's attitude towards IT. This redefinition was partly a result of trends in the outside world, the Internet. Still, information technology needed spokespersons and allies within Statoil to gain momentum. These spokespersons existed on shattered islands in the company, but were not powerful enough in the early 1990s to mobilize vital support for strategic use of IT in business development.

The single most influential factor contributing to this change of attitudes in relation to IT was that the revenues surplus in 1994 reached an all time high, it almost doubled from 1993. The principal reason for this was the increase in production volume and reduced costs for the running operations. Had not the profit margins in Statoil improved as dramatically as they did during this period, it would have been very difficult to lobby for the strategic use of IT in general and for continued and extended emphasis on LOTUS NOTES. In the current situation, with a newly gained space for action, the actors lobbying for the communicative abilities of IT as illustrated by LOTUS NOTES were listened to more carefully. They were more visible and made the headlines more often. In this sense, the strategic content of IT was perceived as a "luxury" concern that Statoil could not afford during the years of (relative)

economic hardship in the early 90s. Only with the more comfortable profit margins of the mid 90s did "luxury goods" become legitimate and acceptable.

From the mid 90s and onwards, there is a growing awareness and accumulating pressure to use IT in a more communicative and strategic manner. To an increasing degree, business strategy documents emphasize how IS/IT should support information exchange and sharing by focusing on co-operation with customers, partners, vendors and governmental agencies. The technology strategy of Statoil from 1996 defines information technology and co-ordination technology as a key area of future concentration. This core symbol of the belief in IT was the gift of a free PC to all employees in 1997 (if they went through a training course in the major Statoil PC applications). However, the alignment between IT and high oil prices crashed when the perceived crisis reached in peak in the reorganization effort that followed the USD 12 a barrel agenda in 1999. All IT investments were frozen until 2001 with the exception of important ongoing implementation projects like SAP and LANDMARK.

Above I have provided some situated information about Statoil related to organization and IT development. The growth of KOT must be seen in the light of the organization that Statoil was in the early 1990s. Information technology was mostly considered an expense. Statoil was a corporation organized according to functional principles where technology development (IT included) and human resource development was not properly aligned. This created a number of examples like the experience transfer problems that I described. One aspect of this problem was the functional separation of IT from organizational development. Human resource (P&O) had the functional responsibility for organization development and knew little about business use of IT. The IT division had the responsibility of IT development but were perceived by operational environments to know little about the application of IT in core business processes. Finally, the technology division should develop and maintain the overall technical systems on Statoil's offshore and onshore facilities without taking organizational and IT development into much consideration. Actors that saw organization, technology development and IT development as an integrated effort existed on small shattered islands in the company, but it took time before they gained strength.

KOT developed a niche since it claimed that it worked with both organizational development and IT. Since they had considerable knowledge of technological and operational issues they represented a challenge to organizational units with functional responsibilities. In addition, it was not difficult to mobilize groups that were not pleased with the status quo, like the Gullfaks experience transfer example from the internal newspaper *Status*. The drama of KOT's history in the early days can be briefly sketched as a long socio-technical negotiation process where both human and non-human elements had to be aligned for KOT to become naturalized.

KOT started establishing a firm base of relations among people that worked with the core value adding processes: offshore installations like Gullfaks and Troll. They recruited people that had mixed backgrounds both in the engineering and the social sciences and they had operational personnel working together with them. The multiple background of the group also enabled them to come up with new ideas that could provide solutions that functionally organized units hardly envisioned. In this enrolment process KOT had to handle reactions from Corporate IT (KIT) and the technology division (TEK). Pressure from the operational

environments of Statoil, like Gullfaks, enabled KOT to receive basic funding from the KKG financing structure.

Vital support that was needed in bargaining for budgets in a context where KKG stakeholders regarded KOT's work to be unimportant. Along the way a number of new forces were aligned and translated to meet the agenda of KOT: the support of MIT, the ERGODESIGN methodology and the university research programme and its staff. New situations and new management agendas needed new allies and TEK was aligned as a supporter from 1993 along with the PES project, mandatory documents and LOTUS NOTES via DELPHI.

The alignment of LOTUS NOTES created a new controversy with Statoil Data that forced KOT into enrolling ISO-certification, electronic distribution of mandatory documentation and the new DRO organization into their network. The drama ended with the integration of DELPHI and SAREPTA into DELTA and the establishment of a working order between KOT and Statoil Data. What became naturalized, as a black box was the electronic distribution of mandatory documentation. However, what all these translation efforts left in the shadow of amplification and reduction were the original ideas of experience transfer, the offshore grassroots movement. It was to some extent taken further in the Heidrun work. However, the focus on mandatory documentation and ISO 9001 left the original philosophy of ERGODESIGN unfinished. Even though the ERGODESIGN methodology became the ISO 9001 improvement methodology it had little if no effect. In the eyes of Statoil Management ERGODESIGN was formally implemented in the E&P organization and no further effort was needed. Since Statoil management would not support further input in the area of experience transfer KOT had to turn around, go elsewhere and develop new ideas. This is the topic of Chapter four.

3.5 Legitimating KOT in "reason" and "nature"

In *How Institutions Think* (1986) Mary Douglas tries to describe how a system of knowledge develops. Following Emile Durkheim (1915) Douglas (Douglas 1986:45) believes that the collective nature of knowledge is the question that must be addressed first. For human discourse to be possible at all, basic categories of interaction have to be agreed upon. Institutions create the sameness that makes this possible. She (Douglas 1986:45) continues related to the entrenchment of an institution:

> A focus on the most elementary forms of society brings to light the source of legitimacy that will never appear in the balancing of individual interests. To acquire legitimacy, every kind of institution needs a formula that founds its rightness in reason and in nature.

Even though Douglas'system of classifications is that of a static structural functionalist type, her work provides insights that I take with me. If the visions and concepts in relation to IT based collaborative technologies (read analogies) are to succeed it will have to go through a naturalization process. To use other terms, designification in the language of Pfaffenberger, or black boxing in the language of Latour.

Let us dwell a little longer on institutions. In this thesis I follow a group and a project within a large organization that want to design and implement new ideas related to organization and IT development. Douglas claims that in its most minimal form an institution like KOT and its

projects are only conventions, but in order to let a convention grow into a legitimate social institution it requires a parallel cognitive convention that sustains it. Her definition of an institution is a legitimized social grouping. It can be a family, a game, a ritual, a concept like ERGODESIGN, vision of a new IT product or a group like KOT in Statoil. Douglas argues that institutions cannot be explained with reference to instrumental arrangements only (i.e. KOT as a functional part of Statoil Research and Development).

Let us dwell at this important statement. Conventions in organizations related to perspectives on IT and organization development can develop as a consequence of a given division of labour when KOT works with projects in the Statoil organization as it did in the work with ERGODESIGN and DELPHI. However, Douglas argues that institutions like KOT and its projects "are likely to be challenged all the time unless its justifying principle can be grounded in something other than conventions" (Douglas 1986:48).

Most established institutions will, if challenged, be able to *ground their legitimacy in relation to nature.* What is regarded as "nature" in modern organizations differs from the conception of "nature" in Douglas' tribes. Her point is there has to be an *analogy between principles that seem "natural" on the one hand and institutions, concepts and ideas on the other side.* In business organizations like Statoil, "Nature" will often mean applicability in relation to core business or value adding processes, that it secures the survival and further growth of the organization.

Customers also tend to "represent" nature, like the Gullfaks offshore personnel. Their claim, in relation to keeping the production up and running, is so strong that they must be listened to. Many of the principles that grow out of this business thinking or these capitalistic principles are so strong that its principles seem to be given by nature. I will later show how the machine is the root metaphor for most nature-like conceptions. KOT's use of the same organization and IT development principles over and over again in the organization might amplify them, and finally, the whole system of ideas might seem to be given by nature if KOT was successful.

Douglas argues that institutions like KOT must use shared analogies. This is a tool to legitimate fragile social institutions and a foundation in "nature" is necessary because social conventions are too transparent. They need a naturalizing principle to transfer a spark of legitimacy. *What seems to be placed in nature can then be aligned with reason,* which is the next step. Groups that work with organizational development and IT must take their legitimacy from somewhere: scientific methodologies of ERGODESIGN, cyclic prototyping and systems development.

They can develop relations to other institutions that are known to follow successfully the principles aligned with "nature" and reason: General Electric, the LOTUS Corporation, NETSCAPE, some of which are mentioned in the narratives that follow. Or finally, develop working relations with persons and environments that seem to have good understanding of "Natures" principles and consequently those of reason: the Boston academic environment at Harvard and MIT of which KOT established a sponsoring relationship in 1991, the university program that gave an academic foundation for co-ordination technology, consultancy companies like Anderson Consulting and Gemini Consulting and trend analysers like META-group and Gartner group.

All these environments will at any given time describe the essential features of "nature", and as a consequence of reason. To transfer an analogy from these principles to local institutions

like KOT in Statoil puts KOT firmly in place both in "nature" and "reason". The link between Coordination Technology in Statoil and the Centre for Coordination Technology at MIT is direct as in Mary Douglas (1986:52-63) more exotic example. It refers to the same mechanism:

> The analogy from nature goes as follows: as natural progenitor (saw wolf for lion) is to natural offspring (cubs, whelps), so live father is to live son and dead father's father and between dead father' s father's father with dead fathers father's fathers father and dead father, according to the scale of the living persons ready to be involved in the legitimated social arrangements.... Thus the institutions survive the stage of being fragile conventions: they are founded in nature and therefore, in reason. Being naturalized, they are part of the order of the universe and so are ready to stand as the grounds of argument... Individuals, as they pick and choose among the analogies from nature those they will give credence to, are also picking and choosing at the same time their allies and opponents and the pattern of their future relations. Constituting their version of nature, they are monitoring the constitution of their society. In short, they are constructing a machine for thinking and decision-making on their own behalf.

Douglas (1986:53) asks where analogies from nature reside and how agreement related to things' 'sameness' are developed? Sameness is conferred on the mixed bundle of items that count as members of a category; their sameness is conferred and fixed by institutions". In our case it is KOT and those that participate in their projects that develop this sameness (Douglas 1986:59-60):

> We would add that institutions perform the same task as theory. They also confer sameness. Once a theoretical scheme has been developed, elements that in the pre-theoretical stage were of dubious standing lose their ambiguity. They acquire definition when their regular functioning within the system is demonstrated... Sameness is not a quality that can be recognized in things themselves; it is conferred upon elements within a coherent scheme... The idea of a quality of similarity keeps resurfacing because sets of similar things are so well established within a particular culture that their sameness has the authority of self-evidence

Douglas claims that institutions must be developed through cognitive tools like systems of classifications. The mutual convenience of multiple social transactions do not create the necessary safety and trust related to interaction with other people. The cognitive tool settles the institution in nature and reason at the same time, when one discovers that the formal ideas and structures of the institution are aligned with formal structures in nature (management and business goals in industry or the market as an objective and fixed reference point). In KOT's case, when KOT can argue that they are working according to principles of organization development and IT in collaboration with MIT and core offshore installations, this is a very powerful argument founded both in reason (MIT-based new ways of using IT) and nature (supporting core offshore business processes).

This construction of sameness is an unconscious activity. Douglas describes how this activity necessarily involves drawing boundaries (1986:60):

> To recognize a class of things is to polarize and to exclude. It involves drawing boundaries, a very different activity from grading. To move from recognizing degrees of difference to creating a similarity class is a big jump. The one activity can never of itself lead toward the other, any more than institutions can evolve toward a complete organizing of information by beginning from spontaneous self-policing conventions.

It is the daily social interaction in KOT's projects that forms the basis for the construction of the world into classes. Survival is dependent upon sufficient emotional energy to carry this elementary enterprise of classifications through all the hard labour necessary to create a workable world.

To sum up, any institution that wants to keep its structure needs to develop credibility by linking this existence to nature and reason. It gives its members a number of analogies to

explore the world. These explain the "nature given and reasonable" related to the institutionalized rules in order to keep its present identifiable form. It then starts to control the memory of its members, makes them forget experiences that are incompatible with the right image and brings forward occurrences in the world compatible with the image of the institution. This will provide the categories for the thoughts of its members, define terms for self-knowledge and fix identities.

3.5.1. Classifications and a workable world?

In the light of Mary Douglas we can say that systems of classification are material and symbolic objects that institutions like KOT can employ in its co-operation both within and across social worlds in Statoil. Geoff Bowker & Susan Leigh Star (1999:321) in their book *Sorting Things Out* argue that classification systems in modern organizations are tools of the same character as those of John Dewey described in Chapter two. These tools are large-scale information systems that are used to communicate across contexts.

> The importance lies in a fundamental rethinking of the nature of information systems. We need to recognize that all information systems are necessarily suffused with ethical and political values, modulated by local administrative procedures. These systems are active creators of categories in the world as well as simulators of existing categories... Similarly, we need to consistently explore what is left dark by our current classifications ("other" categories) and design classification systems that do not foreclose on rearrangements suggested by new forms of social and natural knowledge.

A rich body of literature documents the clever ways people organize and improvise when the local circumstances of their activities do not match the prescribed categories or standards (Garfinkel 1967). People learn categories as members of communities of practice. A community of practice is a unit of analysis that cuts across formal organizations and institutions (Bowker & Star 1999). It is basically a set of relations among people that do things together and it is the activities with their stuff, their routines and exceptions that constitute the community structure. People learn to become members through socialization and learning the ropes and rules of practice in any given professional or organizational community. It entails a series of encounters with the objects involved in the practice: texts, symbols and technologies. It also means managing encounters with other people and with classes of action for this purpose.

Through the socialization, organizational actors acquire an increasing familiarity with categories that apply to all of these, and as their familiarity deepens so does their perception of the object as strange or of the category itself as something new and different (Bowker & Star 1999). The more you are inside a community of practice, the more you forget the strange and contingent nature of its categories seen from the outside. Membership can increasingly be described as the experience of encountering objects and increasingly being in a naturalized relationship with them. Developing and maintaining coherence or working arrangements across intersecting communities is important when different naturalized classification systems collide as they did in the history of KOT in relation to TEK, KIT and Statoil Data. A community of practice can to a given extent be defined according to their co-use of such objects since all practice is so mediated. (Bowker & Star 1999:299):

> A better way to describe the trajectory of an object in a community is as one of naturalization. Naturalization means stripping away the contingencies of an object's creation and its situated nature. A naturalized object has lost its anthropological strangeness. It is in that narrow sense desituated-members have forgotten the local nature of the object's meaning or the actions that go into maintaining and recreating its meaning. We now longer think much about the miracle of plugging a light into a socket and obtaining illumination, and we must make an effort of anthropological imagination to remind ourselves of contexts on which it is still not naturalized... Objects exist, with respect to a community, along a trajectory of naturalization. This trajectory has elements of both ambiguity

and duration. It is not predetermined whether an object will ever become naturalized, or how long it will remain so; rather, practice-activity is required to make it so and keep it so. The more naturalized an object becomes, the more unquestioning the relationship of the community to it; the more invisible the contingent and historical circumstances of its birth, the more it sinks into the community's routinely forgotten memory...Commodity and infrastructural technologies are often naturalized in this way. In a sense they become a form of collective forgetting, or naturalization, of the contingent, messy work they replace.

Once different communities of practices have naturalized their world differently, coherence can become difficult as the examples in KOT's history showed. Star and Griesemer (1989:392) define *boundary objects*, which can help us here. These are entities that translate different meanings among actors and help these meanings to become more coherent. Star and Griesemer (1989:393) argue that it is an analytic concept of those objects that inhabit several intersecting social worlds and satisfy the informational requirements of each of them:

Boundary objects are objects which are both practic enough to adopt to local needs and the constraints of several parties, employing them, yet robust enough to maintain a common identity across sites...The creation and management of boundary objects is a key process in developing and maintaining coherence across intersecting social worlds.

Star and Griesemer say that these objects are weakly structured in common use, and become strongly structured in individual use, and they can be both abstract and concrete. These characteristics enable boundary objects to have various meanings in different social worlds, but their structure is common enough to more than one world to make them recognizable, as means of translation.

A boundary object is an object that lives in multiple social worlds and has different identities in each. I will not discuss boundary objects in detail in this chapter, because they will be thoroughly discussed in later chapters. Still, I must mention that there were a number of boundary objects in the history of KOT. ERGODESIGN developed coherence between Gullfaks and KOT. DELPHI and later DELTA also became a boundary object that united many diverse organizational units in Statoil.

Why are boundary objects important in the chapters that follow? They are important because they enable a kind of communication between diverse social groups or communities, for instance that of KOT and those taking part in their projects. If integrated organization and IT development should come true, it will be the consequence of new boundary objects and boundary infrastructures (Bowker 1994, Bowker & Star 1999) that will develop between the groups that are participating in the CW project.

Boundary objects cannot be engineered (Bowker & Star 1999:305); they grow out of the situations of the formal and informal communication between groups. ISO 9001 was tried, engineered as a boundary object, but did not succeed. It is only possible to describe the features of the boundary object *after* it is manifested among social groups. Through use an IT system can build relations between intersecting social worlds like DELPHI, but use of the application and changed action is the pragmatic test.

Chapter 4 The Collaborative Workspace Project, the Birth of a New Concept

4.1 Background

In mid-1995 KOT had to develop a new concept to make a living. Within a few intensive weeks the group managed to develop a new concept of integrating organizational and IT development. This development was connected to a number of internal and internal factors that I touched upon in Chapter three. However, a number of new forces were building up; the growth of the Internet, realization of new work practices in operations, more focus on IT as an enabler, a consequence of growing profit margins in the company and a mature IT infrastructure that made professional use of collaborative technologies across geographical borders easier (for more background on these issues see: Monteiro & Hepsø 1998, Monteiro & Hepsø 2000). KOT named this new vision the CW project which emerged as a consequence of the work that I have already described in the history of KOT: the experience transfer project. The group tries to depict key ingredients of future work based upon the lessons learned in the experience transfer project in which they had participated the last 4 years. The new concept is described in two internal research reports dated July 1995 and December 1995. Let us take a look at how the concept that was called "The Collaborative Workspace" emerged.

4.2 The birth of a new organizational and IT development concept

The situation around mid-1995 was the following. The group was busy winding up the experience transfer project but set aside time and resources to develop a new concept for future work. Most project participants were spending a few days a week in the operative environments of Statoil in Stavanger (2 hours flight from Trondheim) or at the new methanol plant (a 2.5 hour drive from the Research Centre in Trondheim). At the methanol plant the concepts that had been developed at the Heidrun installation's "Safe and Efficient Operations" project was taken further, and a simple flowcharting methodology was also further developed. This flowcharting methodology is given more attention in Chapter five. Those working in the KOT group in mid-1995 maintained that at least one day every week should be kept sacred for developing a new KOT concept. Mandatory project meetings were held on this day every week. In one project meeting in May the go for the new project was set. The group had KKG-funding from the experience transfer project that lasted to the end of 1995 and KOT had to

use some of this budget to finance the new concept. Hans the previous offshore mechanical foreman, Ola the project manager, Peter the KOTmanager at the time, Christian, Frank from Statoil Data and myself made a plan for coming up with a new concept in a research report, with the deadline of 1 July. All quotes that follow are from this 1 July research report.

A number of scheduled meetings were set and initial responsibilities assigned. The group worked in the following manner. They started out brainstorming and discussed an overall framework for the new concept. The first working definition of a workspace focused on both the products and the means: A united dynamic model of essential aspects of an enterprise like: goals, strategies, products, roles and tasks, customers and work methodologies, but also more informal aspects of an enterprise like communication, development of relations, learning and collaboration. This dynamic model is to find its shape through a process of inquiry, together with use and development of information technology, and be understood and accepted by management and employees.

The group then started with the product and the means (or the process of developing the product) Some were given tasks to define the visions of the product itself (that is both its functions and its realization in technology) and others in the group the process of construction and implementation (the efforts needed to implement such a new vision in the organization). In a number of half day sessions different participants presented their ideas. I bring an example from the discussion the group had on metaphors. Hans, Ola, Christian, Frank and myself are located around the creativity zone the group has outside their cell offices.

We sit around a round table. Nearby are whiteboards, large paper sheets, PCs and an overhead projector. The PC is turned off at this stage. Ola as project manager starts: "In this part of our workshop we should discuss our use of metaphors and models in the new concept we are developing. You have prepared something here Peter that you have shared with the group in NOTES already. Can you present your main arguments?" Peter says: "Yes sure, I have been thinking about the way we use the words metaphor and model. We should be more strict when using these terms". He showed a slide on the overhead projector, where he had defined metaphor and model and says: "I see a metaphor as a parable, where I can use a known situation to illustrate and analyse another phenomenon. The aim must be to recycle competence and knowledge related to rules and connections and to challenge the imagination in order to increase the understanding of the phenomena you are working with. The metaphor 'football team' can be used to describe interplay in organizational teams. Metaphors will always have limitations when it comes to sameness with the phenomenon that is compared. If we draw the parallel too far a number of unwanted characteristics comes along. I believe we need a number of phenomena to achieve a good understanding".

Peter presented one metaphor for this new workspace: the common land or the outlying field: "In Norwegian common land there is freedom of movement and utilization of natural resources within given limits. Different organisms can develop their ecological niche in this field, related to properties, interests and needs. Through a free interplay mutual needs are met without any controlling function. The Internet has much in common with commonable land and a workplace can be organized accordingly. Instead of rigorous rules concerning who participates in what tasks, which have access to what information. Such a process will be self organized according to whose competence, resources, interests can contribute in working with common tasks. In the commonable land I believe paths will develop that are comparable to methods and channels to get work done, but it should also be possible to go outside of the defined paths. The common land is not for exploitation and without rules. There have to be

common goals and values, and sanction mechanisms if these are not respected." The group responded to Peter's presentation, gave small additions. Ola said: "I agree that we have to have a number of metaphors, especially in this early phase of the project, if not we might be closing our space of opportunities too soon". The others felt that this was a good metaphor for a workspace.

Peter continued showing another slide: "A metaphor is different from a model. I define a model as a physical, graphical, textual of mathematical depiction of a phenomenon or system that describe the properties. The model can be used to predict future action. It will always be a simpler representation that the real phenomenon, the key properties or parts of these in given moments in time. Compared to the metaphor I believe the model is contrasted to portray a particular object. The metaphor uses an existing system with a life of its own. Christian interrupts: "Dynamic process models can do a lot these days. Should Frank and I take a closer look at them? Ola responded positively. Triggered by Peters interesting metaphor and ideas on models, I ask: "Are we talking about computable models here, or mental models, and how do we work with both? I am sceptical to the dynamic object oriented process modelling tools; they are so complicated that only IT experts can use them. If we are to use work process models these must be extremely simple, and we must be honest on what they leave invisible".

Ola asks: what becomes invisible? I reply: "Where are the humans? It only shows the formal processes of an organization and not work as a social activity, teamwork and organizational learning. There is much more in organizations that just products, and value adding processes. How far would we had come in the experience transfer project if we only focused on these formal espoused issues?" Ola agrees and the others are nodding, Ola replies: "You have an important point Vidar, we must address that point in our concept! Peter comments: "We can use the model as a reflection object, even though it is a simple representation. Representations must be very simple if people in operations are to find them helpful. We must however make sure that the processes we are running take the criteria that Vidar mentioned seriously".

The lively discussion over the same theme lasted for another hour. The group concluded by developing a structure for the internal research report, and assigned responsibility for which people should write what sections. Each person wrote their parts and made it available electronically in LOTUS NOTES for comments. In a sequence of meetings they discussed the individual contributions and created a joint product following discussions in the group. The main idea of a Collaborative Workspace project had begun to take its shape, in terms of two main concepts: the visions of the product itself (functions and its realization in technology) and the process of construction and implementation (the efforts needed to implement such a new vision in the organization). I now intend to describe the concepts the Collaborative Workspace more in detail. I spend that much time and resources on these issues in order to let the readers see the visions compared to what it became. I start with the visions of a product. Quotes and pictures that follow are from KOT's July 1995 research report.

4.3 The Collaborative Workspace project, visions of a product

The overall Collaborative Workspace was defined as follows:

The name the 'Collaborative Workspace' is chosen because the term signals something new, but undefined, and is something that arouses curiosity, invites reflection, gives many associations and possible interpretations. The term opens up a possibility to break out of traditional views about the application of information technology, and *space* to use imagination and creativity to develop new organizational use of information technology....The word 'workspace' is used because it describes properties and possibilities related to future information technology

made predictable today because of research and commercial developments. The term 'work' heralds that new applications of information technology must be grounded on a thorough understanding of the work processes of the business and how the quality and efficiency of these can be improved with the help of information technology. The word *space* can give associations to flexibility, freedom of motion, closeness, overview, presence and visibility... We believe that these associations catch many of the properties that should be built into the application of future information technologies... If we imagine Statoil as a large room or a space, with many doors in between units, that all employees can access, with necessary furniture and artefacts to do daily tasks, it will give a *space*-like perspective on the prospects of the future. We believe that applications of future IT will make it possible to reduce the multitude of obstacles or barriers of present work processes and IT solutions. The point is that it should be easy to move around in the organization, meaning the *space*, in relation to the demands of every individual work situation. Further, future information technology will provide *space* for ways to visualize structures and connections that up to now has not been apparent or possible to create. It can then lead to added value for Statoil.

More visions on the workspace metaphor are defined:

We have regarded it as important to use metaphors and symbols that have a concrete meaning in daily operations...A desktop is a desktop, a book is a book... The idea is that users should find the important tools they need to do their work. There are several images this metaphor denotes. Everybody has their space and wants to decorate it with the artefacts and tools they need in their daily work. The workspace can have shared areas with mutual areas or spaces for all activities in an organization. Work processes can be executed from this space... You do not send information, but the information has its given place in the space and people seek out the information because they know the space and where the information is. A precondition in order to take out the effect of a workspace is that the *organization that will be using the workspace has developed mutual images and interpretations on how the enterprise should do its operations, and that these images are retrieved in the space.* In this sense the workspace can be viewed as a dynamic operationalized enterprise model.

4.3.1 Perspectives

The workspace was seen as consisting of a number of perspectives, that could present different ways of seeing Statoil activities and be adjusted to the needs of groups and individuals in the organization. *Models of the enterprise* was the first perspective that was addressed:

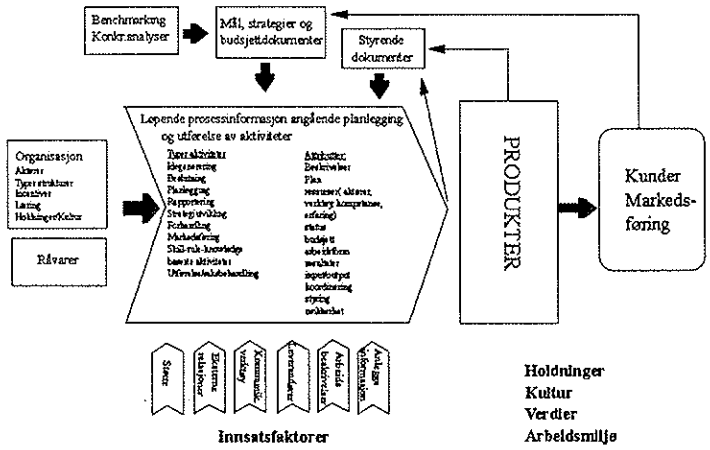

Figure 4.1: Elements in a generic enterprise model (referred to as 3.1 in the quote)

The development of electronic workspaces that should actively support the execution of activities must have its foundation in a thorough understanding of the business. An integrated model of essential aspects of an enterprise like goals, strategies, products, roles, tasks, expectations and demands can be communicated in an enterprise model. We have made a sketch of an enterprise model in Figure 3.1 based on our understanding of what an enterprise that delivers products in a market consists of... The model is generic and can serve as a conceptual framework for our purposes... The product in the model can be a material commodity or services, and the market can be both external and internal. In addition to the product and market element the model consist of other elements that must be present in order to let the production activities to be carried out in a purposeful

manner. In addition to the product and market element the model have elements that must be present in order to make the production activities goal oriented. These are: the organization with its actors, raw materials in the production and a number of input factors to support the production. In the core of this model are the production activities that can be categorized in accordance with activity type and be described with a set of attributes.... The model as it is described in Figure 3.1 can visualize the enterprise as a whole or can represent smaller parts of the business". It should be mentioned that the concept we have sketched has its limitations. The model is a rational description of an enterprise as a production process or 'shop floor' of a type found within BPR (Business Process Reengineering). The model does not cover vital elements in a corporate culture, the quality of working life, and various social aspects of work: attitudes, values, incentives, motivation, well being etc. It is important to acknowledge that such factors will be of decisive importance for optimal 'production'. Therefore, the model is a tool to communicate demands and expectations in team building and in the development of social relations... We believe that the workspace should include work process maps showing the main work processes of the business and the most important support activities. The process maps must be connected using hyper links. This will make it easy to move from overall work processes to detailed processes just by clicking/pointing on parts of the work process maps.

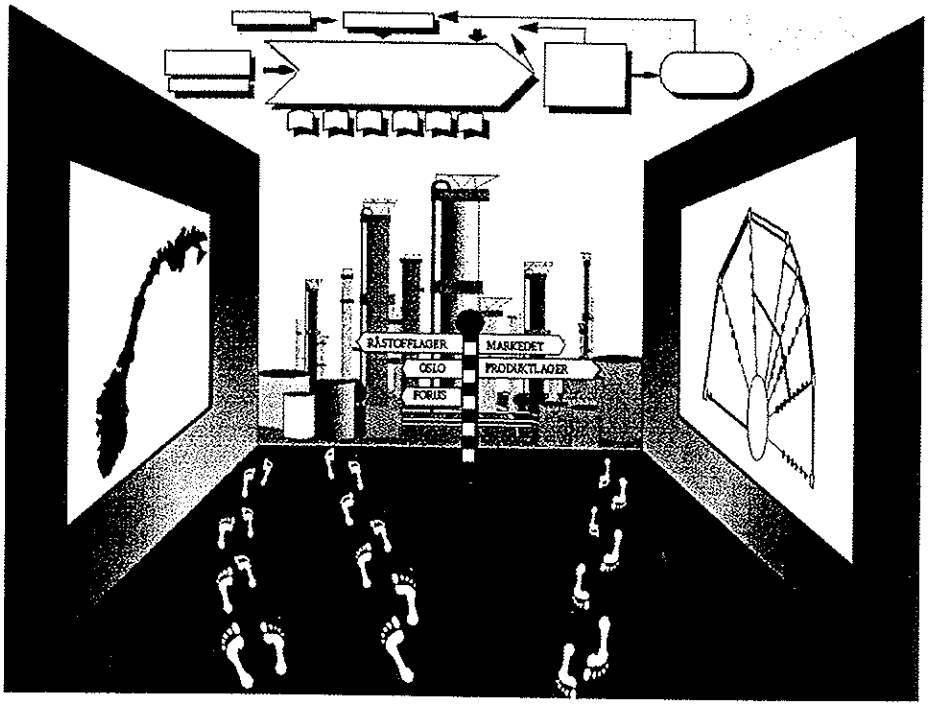

Figure 4.2: The first visualization of a Collaborative Workspace from June 1995 with trails, signs, a geographical navigator of the infrastructure, the spider web organization, the work processes of the enterprise and a physical representation of a Statoil plant

The *infrastructure* (Figure 4.3) was to be the second perspective. A graphical description of Statoil infrastructure customized to local organizational and individual needs was a key vision:

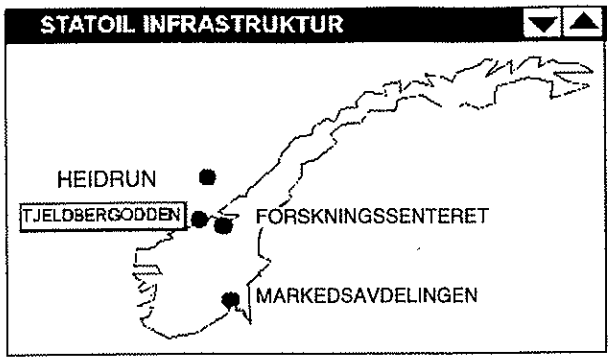

Figure 4.3: Geographical navigation in Statoils infrastructure

The totality of Statoil's infrastructure should be visualized through the workspace. This will make it easier for units that use the workspace to see their parts in the whole business. On a long-term basis this can lead to improved communication and collaboration across organizational borders. We suggest using a map metaphor to lie out Statoil's facilities and resources in Northern Europe, where clicking on the locations activates different parts of the organization. The granularity of the organization and the physical location of organizational units should be adjustable by "zoom" functions... All screens and workspaces must be adjusted to the individual PC-user. On the screen the tools people need in their working situation should appear, and these should be tailored to each user's preferences. When other computer systems are started up, they should also be tuned for the actual user, with the biggest level of inheritance of other entry parameters from the workspace that called up the specific computer system. ...Since the workspace is intended to be some sort of a superstructure on top of other computer systems people need in their daily tasks, this superstructure must be able to access and communicate between these different computer systems. Since these computer systems will be of different types, this is a challenge to implement.

The *organization* perspective was the third perspective. To illustrate the organization the group played with the idea of using a spider web metaphor. The idea behind this web metaphor was that it might provide a total representation of different organizational forms like networks, teams, projects, meetings, hierarchies and how different people take part in these forms.

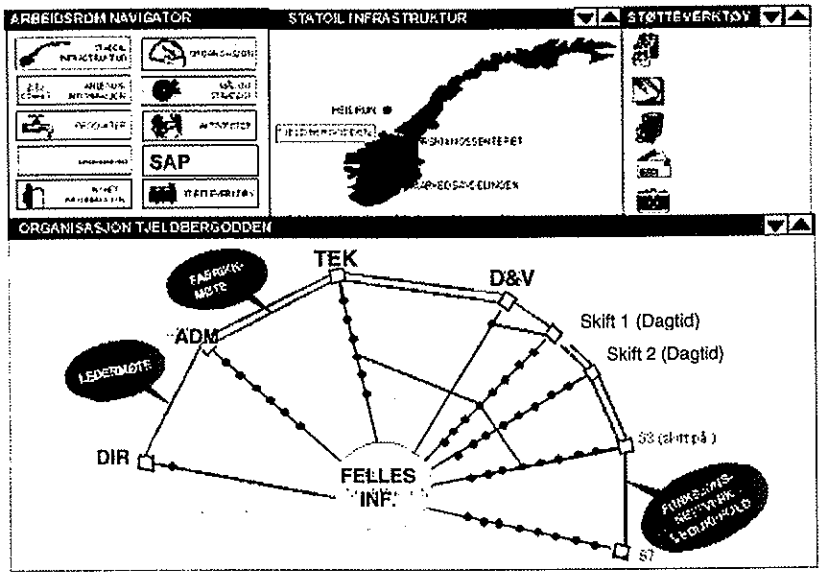

Figure 4.4: Illustration of spider web and infrastructure navigation with necessary work tools

We believe that the organization perspective should be activated from the workspace metaphor. Further, we believe that the user should be able to activate parts of this spider web. Information related to what is beneath the nodes in the web and the webs are indicated by moving the mouse over the map and reading the bubbles that appear, and consequently obtain more detailed inform-ation about the organization... With a carefully considered colouring code of the web we assume that this perspective can become a very powerful entry point to information about the organization, and can become a central place in the workspace.

In late autumn 1995, KOT had a mock-up of a simple Collaborative Workspace, made with Multimedia Toolbook where they showed hyperlinked text and graphics, active spider web-organization charts. They had start-up engines in the prototype that could call up external IT systems (OLE links and script call) animations and clickable graphics. This prototype was meant to be a demonstrator, and nothing else.

4.3.2. The process towards realizing the visions

The project strategy tried to implement the lessons learnt from the experience transfer project and key issues that had fallen in the implementation process of 1994-95, *use of pilots*:

> Our strategy is to use pilots, that is, organizational units in Statoil to test our ideas in relation to real organizational actors and focus on practical ideas that must be solved.

The project addressed the following principles for this to come true. The first they defined as *closeness to the customers and potential users*:

> We shall work directly towards customers that see the potential in these types of activities to improve their own operations. Genuinely interested customers are the main target group. We regard it as an important criterion for success that we move within a limited domain of the Statoil organization. This will make us less vulnerable in organizational restructuring efforts and other hindrances that may create obstacles in the course of the project. The research will be done in tandem with practical service work or help in the customer organization. This will provide results along the way, creates trust in the operational community in addition to insights into the daily work practices of the operational community of which we are collaborating. In sum, this gives us insights to the needs that can nourish the realization of our concept further. Everybody in the project will have to take part in fieldwork activities, since this is critical to acquire an understanding of the context in which we are working. Actual presence is important. We will stay in the user organization several days every week to ensure that they maintain the pressure of our project in a busy working day.

The second principle was *organization in core teams*:

> Researchers, computer programers from Statoil Data and local organizational actors will take part in the team as peers. We will work according to mutual goals and fill complementary roles. The challenges in this kind of project are of a multidisciplinary character: related to computer engineering, strategic, organizational and cultural issues. There is a need for a complementary, multiskilled project group where project participants with complementary skills can supplement each other. In this there is a need to accept each person's skills and competence and accept that we need time to develop a mutual understanding of what goals can be realized.

The third principle was an *iterative development of IT concepts and new work practices.*

> We have said that this is not a systems development project, but a project where the aim is to present illustrations on how new IT will create synergy for organizational units in Statoil. We intend to create an illustration/ prototype of a workspace tool. This development will take place in an iterative process in dialogue with the users, and is a process that is difficult to plan in detail where it will end. This process has the following steps. It must have fieldwork activities, pilots, have practical problem-solving activities in the pilot organization, invite to dialogue and focus on good enough solutions.

At the end of 1995, KOT had a number of abstract ideas and concepts. The challenge was now to find an environment in Statoil that was willing to try out the new concepts.

4.3 Metaphors: analogy and abduction

KOT focused strongly on the use of metaphors in developing their new concept. Metaphors can convert tacit knowledge to explicit knowledge and that was exactly how they were used. Project participants were asked to describe metaphorically properties of a Collaborative Workspace, and metaphors ranging from the common land to the spider web emerged. As a

method for sense making the metaphors used in these discussions were dependent upon fantasy and intuitive learning through symbols more than the analysis or synthesis of common attributes of concepts. IT prototypes and mock-ups like the figures in Chapter four created a mechanism to show the maximum level of information through the least amount of energy, as I will come back in later chapters.

The metaphor was not just the first stop in converting tacit to explicit knowledge, it provided an important method to develop a network of concepts that might create knowledge about the future by using today's knowledge. Out of the original workspace metaphor KOT developed a number of new metaphors that could be put together with the overall space metaphor. When two concepts are presented in a metaphor it will be possible not only to look at their similarity or contradictions, but it will also be possible to create the basis for new meaning. Contradictions put into a metaphor (oxymoron) can become harmonized by the use of analogies. They reduce the ambiguity by pointing to the sameness between two different things. In their discussions KOT mixed the use of analogy and metaphor. The associations of meaning driven by a metaphor are more intuitive and consist of images.

Metaphors tend to cover parts of phenomenon, something that often increase their attraction and rhetorical force. They are more open for interpretation, association and discontinuity. The association of meaning through analogies, i.e. a computer system as a virtual workspace, are led by rational thinking. When we use analogies we are aware of the difference between the two expressions. Analogies let the functional operation of new concepts or systems become explored through reference to things already understood. The personal knowledge of the KOT members had to be externalized, the language they used with its analogies and metaphors were the key ingredients to help with the development and translation of ideas concepts and solutions related to IT-based collaborative technologies.

How are new perspectives conceptualized from shared tacit knowledge? While science has tended to believe that induction and deduction have been the most important ways of developing new concepts, Charles Peirce (1878) and later Gregory Bateson (1979:153-155) have shown the importance of abduction:

> We are so accustomed to the universe in which we live and to our puny methods of thinking about it that we can hardly see that it is, for example, surprising that abduction is possible, that it is possible to describe some event or thing (e.g., a man shaving in a mirror) and then to look around the world for other cases to fit the same rules that we devised for our description.

While deduction and induction are vertically oriented reasoning processes, abduction[12] is a lateral extension of the reasoning process that centres on the use of metaphors. It is an unconscious mode of reasoning that produces hypotheses. Reflection in action triggers the development of more unconscious abduction and the ability to see new potential patterns. Imagine you have never seen a wolf, and do not know what it is. Suddenly one jumps out at you. You would immediately perceive the essence of "wolf"-ness. This ability to grasp what a wolf "essence" is despite never having seen one before nor having the abstraction to work from is a faculty that is different from the reasoning between known individuals and known abstractions.

Peirce called this faculty abduction and he made a fundamental contribution when he connected the abduction that gives us hypotheses with sign making. Charles Peirce asserted that neither induction nor deduction could unveil the internal structure of meaning. Abduction plays a role of explorer of viable paths to further inquiry in the development of new concepts.

In abduction, the goal is to explore the data, find out a pattern, and suggest a plausible hypothesis; deduction is to refine the hypothesis based upon other plausible premises; and induction is the empirical substantiation. Induction and deduction can be used to raise a pre-existing concept or assigning a new meaning to a concept. Abduction is needed to develop new radical concepts.

It is possible to look at the brainstorming and creative activities in the KOT group in mid-1995 to be of an abductive character. They developed a number of new concepts (call it hypotheses of a future potential pattern) that they had no idea would work and it would be future inductive and deductive processes in the Statoil organization that would be the ultimate pragmatic test of their viability and utility. If we look at the concepts that KOT developed, some of the metaphors were contradictory, meaning that they might not fit together. Still, the Collaborative Workspace worked as a boundary object for professionals with different backgrounds. Let us take a closer look at the metaphors that KOT used and try to relate them to the logic of information systems development.

4.4 The CW project in the light of IT systems designs

IT systems design is the move from an abstract idea and concept like the Collaborative Workspace, to a solution in terms of IT artefacts and work practices. Such a process will tend to move in several steps that will inhabit their own logic and which can provide a fruitful addition to the dynamic drama perspective I developed in Chapter two. I intend to give a short description of this internal logic. When we want to move from an idea, to a concept and end up in a material realization of some sort, (i.e. IT product) we have to transfer somebody's embodied knowledge to information and information to data. We have to make explicit what in many cases has been hidden or tacit in each individual and situation. In order to transform knowledge to information and then information to data we have to model the concepts and practices of which knowledge consists.

Why is it difficult to create definitions of the most ordinary concepts? Bo Dahlbom and Lars Mathiassen (1993) argue this is because concepts are not just packages of information defined and structured with simple and original concepts. As Harold Garfinkel (1967) argues, many words and concepts have an indexical[13] nature. Concepts are foremost defined through our practice, and our communication of these concepts happens through prototypes and illustrative examples. You can tell if something is a bike by comparing it with a prototypical instance available in our knowledge. I do not need to define it by providing a list of properties that added up constitute the bike.

Digital and analogue concepts give two different possibilities to make knowledge and experience explicit. Analogue and digital coding is vital to understand the nature of categorization and naturalization in relation to use and development of information technology. These two forms of coding are important if we want to understand the dynamics of creating categories of an outside world and are of large importance in relation to organization and IT development.

Analogue phenomena are created by a continuous mapping of contours and a direct translation by analogical transfer between one medium and another. It differs from digital coding in that its variables are continuous rather than bounded and discrete (Shore 1995: 153). They are formed by projections of whole patterns from one medium to another rather than by approximations of forms through the assembly of regular building blocks. An analogue clock

projects the earth's rotation on its axis symbolically on a set of pointers that rotate on a circular plane surface. Such a clock bears a perpetual link to the movement of the sun across the sky. Digital clocks are different; here time becomes an information unit. Numbers and digits represent time abstractly by changing combinations that in no way mimics the solar movements by which time is experienced naturally. Analogue becomes comparable to what Don Ihde defines as low contrast in Chapter six, and digital is comparable to high contrast (Ihde 1979). Bradd Shore says that no echo of the sun's passage exists in the digital representation. Only digitalized time reckoning allows for direct addition and subtraction of time units. Digital coding therefore has a great advantage; it is free from fidelity to pre-existing forms. Digits can orchestrate an infinite number of patterns programmable from simple blocks to complex.

Digital distinctions are the precondition for generating categories and consequently also important for externalizing organization and IT development in organizations. Modular strategies in systems design show characteristics of digital coding, as I intend to show in numerous examples in this thesis.

By using digital concepts we formalize our knowledge by making rules and criteria for the potential applicability of concepts, algorithms are examples of this. By using analogue concepts we develop prototypical examples, which can become associated with specific phenomena to evaluate similarity and difference. Digital definitions give clearer borders by asking: does the concept inhabit the properties defined as belonging to that object or not (Dahlbom & Mathiassen 1993)? Analogue definitions will create more vague distinctions and we end up concluding that we cannot say if a certain phenomenon is part of a specific concept. Attempts to define similarity and differences between the idea/prototype[14], the phenomena and the personal background to those that participate will influence the decision on how to categorize the system.

Many of the phenomena we meet in organizations like Statoil are of digital and analogue characters. This is the internal logic I wanted to address. If KOT wants to go from concepts to IT systems and integrated organization and IT development in the CW project they have to go from an analogue to a digital form. Dahlbom & Mathiassen (1993) say that programming languages are Aristotelian by nature.

Systems design means transforming Platonic concepts to Aristotelian concepts, from analogue to digital coding in continuous cycles. The challenge for KOT is to understand and respect the Platonic or analogue nature of human knowledge and communication and grasp that the computer is less a machine processing data based on digital concepts than a tool that should support peoples use and communication of analogue concepts. Could KOT combine both worlds even though the two perspectives tend to be in tension? Let us dwell at this internal logic a little longer.

If Dahlbom and Mathiassen are right in their argument that IT development must combine analogue and digital concepts, then development and translation of new ideas, concepts and solutions related to application of new collaborative technologies will have to follow some possible trails. What would these trails of IT systems design look like?

4.5 Wicked problems in the knowledge creation of IT systems development

In the narratives from the CW project in this thesis we follow the vision from an idea to its materialization in an IT product or a work practice. In various phases different types of skills and competences are needed, that we have referred to as developing digital and analogue concepts. The possible ways that new IT systems and work practices could be realized though a project organization are limited. There are three ways (or ideal types) of organizing such activities (all with their weaknesses and strengths, thereby the denotation wicked problems). Such "logic" will be basic components in organization and IT development specialist's life worlds, and must be presented here in order to understand the drama of the CW project. It will also be vital as input to understand the methodologies or strategies that was used in both the Norne narrative (Chapter 5) and the VISOK narrative (Chapter 7) in this thesis.

The three systems development practices are: *construction, evolution* and *intervention*. In what follows I show that the CW project had elements that could be linked to all three practices, but mainly the evolutionary approach. Bo Dahlbom and Lars Mathiassen's *Computers in Context: The Philosophy and Practice of Systems Design* (1993) is the main reference here because they raise the most important questions in the field of IT systems development.

The *construction approach* is the first practice perspective. What does it mean to construct? In this perspective a well-defined computing problem is given (a basic condition for this approach) and the challenge of the systems developer is to create a computer program that solves the problem, through a process of stepwise refinements. The idea is to create *the only* solution. This is the simple instrumentalism that I criticized in Chapter two. Terry Winograd and Fernando Flores in their critique of this approach say it has the following properties (Winograd & Flores 1986:15):

> 1. Characterize the situation in terms of identifiable objects with well-defined properties. 2. Find general rules that apply to situations in terms of those objects and properties. 3. Apply the rules logically to the situation of concern, drawing conclusions about what should be done.

The programmer starts a thorough and systematic analysis of the given problem. Different problem-solving techniques are explored and a strategy is chosen for meeting the challenges in the program. The program is then constructed in a sequence of stepwise refinements. In each step an operation is analysed in relation to a number of smaller operations. Each refinement involves a number of decisions related to given design criteria like storage economy, response time, maintainability, stability and others. The modularity achieved this way will influence the extent the program is easily understood, extended, changed or adapted to changing requirements. The process is in most cases top-down. The programmer stands on the outside and receives information through observation, or imagines it, and the most important task is to represent these observations in the best possible structured way.

Dahlbom and Mathiassen describe them as photographers. The key character as systems developer here is a rational thinker that finds solutions to complex abstract problems. He or she is the ideal manifestation of Claude Levi-Strauss's (1966:19-20) designer or engineer. The engineer cross examines his resources and questions the universe. He starts with making a catalogue of previously determined sets consisting of theoretical and practical knowledge, of technological means that will restrict the possible solution. However, the engineer is always

trying to make his way out of and go beyond the constraints imposed by a particular state of civilization and works by means of concepts.

Programmers are given information about the problem and must relate to large amounts of information. To handle this complexity programmers use abstraction, that is, negation to focus their attention. They decompose to structure their understanding and end up in smaller sub-problems. Each of these sub-problems are solved and aggregated in the final version of the system. This construction process is driven by specifications. The problem is described, analyzed and formulated in a requirements specification. The requirement specification is used to remember and communicate thinking about the task, to make design issues externalized. The task of programming is seen as the gradual transformation of these specifications into a product (down to the nitty-gritty binary details of the software). Stepwise refinements in combination with structured techniques are employed in the process from a specification to a finished product.

Another name for this perspective is software engineering. Software engineering is closely linked to the rationalism of the 18th century, with its belief in a rational world and mathematics as a foundation for science. The other two examples I present are also rational, since they give rational reasons for their choices, but describe a different rationale. Peter Checkland (1981) defined the term "hard systems thinking" that matches much of this construction rationale to systems development.

The periodical system is an example of this system, and there are numerous examples in the natural sciences. A system in this framework is functional, like a machine with a given function. A functional analysis of a machine splits it up into pieces, level by level in relation to parts and functions. Parts with no apparent function are removed. Those that are materially different but functionally equivalent are treated as equal properties. A functional analysis is done to handle complexity. A system is defined and separated from its environment by its function. The system itself is analyzed through the functional roles played by its elements and properties. By seeing what this thing does we abstract the properties that are unimportant and reduce complexity. Functional systems are built from the top with objectives that can be derived from this top. This is the perfect instance of Bradd Shores (1995:118) decomposition schema applied in action:

> Modularity is a design strategy that breaks complex wholes into elementary units that are understood to be re-combinable into a variety of different patterns. A modular orientation to reality views a wide range of phenomena as assemblages, subject to decomposition and recombination.

Functional analyses are important in systems development; stepwise refinement and top-down development are core concepts that can be taken back to this idea. When you take it for granted that reality is a stable given system, the aim is to find the true representation of the world. The role of the developer is to map the world and secure that truth, consistency and holism are maintained in the system. The world plays the role as a source to create the specification. A functional study will result in a specification. Hard systems thinkers perceive the system to be out there, in the world, and its borders and functions are objective, thereby analysable and exploitable. The job will be to explore this system cognitively in the head by making a similar symbolic system in a computer. This symbolism can be treated through tree structures or by giving each element a name. Dahlbom and Mathiassen say (1993: 52):

> When systems developers conceive of a work process as represented by a data flow diagram, the powerful dream of a language in which everything can be said easily turns into a barren vision of what the world is like.

Practicing hard systems thinking, we have to be constantly aware of this danger of getting trapped by our current means of representation.

In the CW concept we find a number of traits that bear some resemblance to this perspective, which is mainly mechanical. This is one example of a *machine like notion of nature* that still is strong in most organizations. See the model of the enterprise Figure 4.1 (goals, strategies, roles, tasks and products. Further, concepts like a generic model of the enterprise, the totality of Statoil's infrastructure, the spider web metaphor (Figure 4.4) and features that should capture both the formal and informal organization. Finally, it was to become a tool that should be a superstructure on top of existing infrastructure.

Dahlbom and Mathiassen argue that stepwise refinement in the development of a computer system is analogous to finding scientific proofs in mathematics, and to find a proof is to solve a problem. It is formed by a precise formulation of an abstract problem often defined by two states (the initial state and where you want to end up), and to solve it you have to find a path that leads you from the first to the second state. The construction approach is rationalistic in the sense, that it makes the fundamental assumption that systems development is a rational activity (meaning, picking the optimal choice of action given the objectives). The rational modus operandi is to analyse and think, then decide and act.

The simplicity of this approach and its strength is apparent: By employing this strategy we can economize with the resources and optimize solutions. The problem is that this perspective needs a number of conditions to work smoothly and of which KOT was very much aware. In their eyes, Statoil Data of 1995 represented this way of thinking. First, the objective needs to be evident or the problem narrowly defined. Second, we need information about different ways of solving the problem. Third, we must be able to evaluate and compare the consequences of each alternative. Finally, we must be liable in relation to solving the problem and have the necessary resources. KOT did not know of a situation in Statoil where such conditions were given.

This leads us to the next paradigm that is the praxis perspective KOT mostly adhered to, both based on the work with experience transfer and DELPHI and of the examples which abound in the new CW concept. With an *evolutionary perspective* the best we can hope for is Herbert Simons bounded rationality (Simon 1997) and that the system has a satisficing performance. This method aims at creating a *good enough* solution.

...Whereas economic man supposedly maximizes -selects the best alternative from among all those available to him- his cousin, the administrators, satisfices-looks for a course of action that is satisfactory or "good enough". Examples of satisficing criteria, familiar enough to business people, if unfamiliar to most economists, are "share of market", "reasonable profit", "fair price"....Because administrators satisfice rather than maximize, they can choose without first examining all possible behavior alternatives and without ascertaining that these are in fact all the alternatives. Because they treat the world as rather empty and ignore the inter relatedness of all things (so stupefying to thought and action), they can make their decisions with relatively simple rules of thumb that do not make impossible demands upon their capacity for thought. Simplification may lead to error, but there is no realistic alternative in the face of the limits on human knowledge and reasoning.

In the language of Dahlbom and Mathiassen the programmer in this perspective is more a researcher than an economic man. He or she moves around in the context and in this second perspective the systems developers are a part of, or embodied in the situation they are observing. Often they are called for as facilitators, or consultants, and can be organizational actors themselves. They learn about the situation by explicitly forming relevant perspectives and by discussing these perspectives by comparing them to the situation. The most important

task will be to make learning possible and create engagements from the people taking part. They are facilitators. Interpretations and decisions are taken without really knowing the full consequences. They resemble Claude Levi-Strauss' bricoleurs[15] (Levi-Strauss 1966:17):

> The 'bricoleur' is adept at performing a large number of diverse tasks; but, unlike the engineer, he does not subordinate each of them to the availability of raw materials and tools conceived and procured for the purpose of the project. His universe of instruments is closed and the rules of his game are always to make do with 'whatever at hand', that is to say with a set of tools and materials which is always finite and also heterogeneous because what it contains bear no relation to the current project or indeed to any particular project, but is the contingent result of all the occasions there have been to renew or enrich the stock or to maintain it with the remains of previous constructions or destructions. The set of the 'bricoleur's' means cannot therefore be defined in terms of a project (which would presuppose besides, that, as in the case of the engineer, there were, at least in theory, as many sets of tools and materials or 'instrumental sets', as there are different kinds of projects.)

Levi-Strauss argues that the first practical step for the bricoleur is retrospective. He turns back to an already existing set made up of tools and materials. Then he considers or reconsiders what it contains and, finally before choosing between them, he indexes the possible answers that the whole set can offer to this problem. What develops is a re-indexing of already existing elements, meaning that the elements the 'bricoleur' collects and uses are 'pre-constrained'. Bricolage is the continual re-constructions from the same materials. It is always earlier ends that are called upon to lay the part of means. *Bricolage builds up structure by fitting together events or remains of events.*

Possible combinations of which are restricted by the fact that they are drawn from the language where they already posses a sense which sets a limit on their freedom to manoeuvre. The engineer also has to cross examine his or her resources, but he/she questions the universe, while the bricoleur addresses himself to a collection of oddments left over from human endeavours. The engineer also has to start with making a catalogue of a previously determined set consisting of theoretical and practical knowledge, of technological means which will restrict the possible solution (Levi-Strauss 1966:19-20). While the engineer is always trying to make his way out of and go beyond the constraints imposed by a particular state of civilization, the 'bricoleur' by inclination or necessity always remains within these constraints. Consequently, the engineer works by means of concepts and the 'bricoleur by means of signs. In practice concepts and signs are not as easy to separate.

Donald Schön (1983:39-40) describes how a skilled and reflexive practitioner must inhabit both engineer and bricoleur traits. There is also a similarity between bricolage and the pragmatism of John Dewey, Don Ihde and Larry Hickman presented in Chapter two because lived experience and knowledge is always situated. As Edith Wyschogrod (1981) reminds us, John Dewey described the bricolage mode of inquiry over thirty years before Claude Levi-Strauss.

In the evolutionary approach, problem formulations, possible solutions and decisions are of a more hypothetical nature. Some problems are neglected while others are followed. IT prototypes and different types of experimental artefacts are often used and the programmers spend considerable time identifying and experimenting with possible solutions and less time with analysing problems. A bottom-up approach is used and the idea is to identify and evaluate concrete solutions to sub-problems and gradually approach the system as a totality. Stakeholders or problem owners are needed to negotiate and take decisions in relation to a problem definition and evaluate the quality of the product. An agreement must be constructed on the evaluation of the quality of the product, more than create proof.

In the first perspective the programmers were able to find the best solution to a computing problem themselves. In an evolutionary perspective they will still be experts, but they must also function as facilitators. They suggest and develop technical solutions, but through this process they communicate with problem owners and users. They engage these people in evaluations and decisions. In addition to being technically competent, the developer must be able to explain and discuss problem formulations and technical solutions with users and problem owners. He or she will have to be both a technical and a communicative expert. The evolutionary approach also has a set of given characteristics (Dahlbom & Mathiassen 1993:105):

> Due to the very nature of the evolution approach, it is difficult to plan and design the development process in advance. The project structure reflects the learning process rather than the structure of the system, and it is designed and developed in parallel with the system. Proportionally less effort is spent on planning the process and designing the system, and proportionally more effort is spent on fixing the process and testing and modifying the system.

The construction perspective uses a mechanical metaphor, the evolutionary approach develops around an organic metaphor. However, it is still an organism that shares many properties and analogies of a machine. There are a few permanent rules guiding actor's interaction. To communicate and co-ordinate actors taking part in projects will have to maintain an explicit communication. Important information related to the organization of the development work will only be visible when the activity is in operation. Making good estimates are difficult.

The environment is perceived as dynamic, problems and solutions are developed and found along the way as a part of the inquiry. Things cannot be anticipated in advance, only through pragmatic tests in real settings. The process itself creates new opportunities because most future users of a computer system do not know what they want, or the functions and the interfaces of the end product. IT prototypes are used to convey this development and embody the learning process in an externalized material shape. Examples of evolutionary thinking in the CW concept abound: use of pilots, research and practical service work in the customer organization, fieldwork activities, core team with users and developers, cyclic prototyping, testing and practical problem solving, processes in dialogue with users and "good enough" solutions.

To what extent did KOT see construction and evolution not as alternatives but as complementary perspectives? They organized their thinking into projects and tried to find means and tools according to the goals of the CW project. Consequently, KOT first set the objectives and then started to develop the tools to meet the objectives. At the same time the project is made possible by the tools that are taken into use and some of the tools are taken up along the way because they seem proper to use. In the CW concept KOT wanted to engineer expert tools that were optimal for their purpose, but at the same time they wanted to tinker by using what was available and what in the end would create a satisfying result.

One aspect of the CW concept was part of the engineering tradition, wanting to optimize, seeing function first and form later, to construct from top to bottom within something functional: a virtual workspace. This perspective will focus on the function of an artefact like the CW concept. Like bricoleurs KOT also saw the concept in terms of its shapes or forms, and after that they focused on function. This bottom-up perspective might eventually find new functions to this given form. However, the form is the essential, the bricoleur will look at the form, he will remember its details in case the artefact can fill multiple roles and functions in the future (Dahlbom & Mathiassen 1993).

Dahlbom and Mathiassen argue that both construction and evolutionary perspectives promise too much. If KOT employs the construction perspective based on abstraction and decomposition their version of the Statoil world will be reductionistic and introduce new uncertainties. Do the properties of the CW concept coincide with the organizational terrain of Statoil? Complexity and uncertainty are intrinsic aspects of all problem-solving situations and both perspectives are needed to compensate for the weaknesses embedded in each perspective.

If we go back to the history of KOT in Chapter three, and the development of DELPHI we see an IT application that evolved in a context where a clearly defined problem was not at all given. Sometimes it will be impossible to say what the problem is before a solution is found, if there is an ideal solution. Morten Kyng and Lars Mathiassen argue in the introduction to *Computers in Context* (Kyng & Mathiassen 1997:xv) on the future design of computer systems and applications:

> For some time, we have known that there is no one best solution. Now we must realize that there is no one best question, no one best process and no one best worldview. The belief in rationalistic solutions have evaporated and the professions involved in research and development in computing are looking for new landmarks... Neither is it a question of better theories. The current dynamics in our fields do not arise mainly from theoretical work, but from practical development and use. Better theories form a necessary step towards advancing our field, but the major challenges to established ways of thinking come from their failure to provide guidance for the development and use of computers.

In KOT's work with experience transfer and DELPHI problem-solving and problem-identification was mixed with process identification. This leads us to the third perspective of Dahlbom and Mathiassen. I will use the experience transfer project from Chapter three to flesh out their arguments.

In an *intervention perspective* there is a given organization with a multitude of perspectives of possible problems, disagreement about products and a number of stakeholders with different interests. It shares the pragmatic basis of John Dewey, Don Ihde and Larry Hickman, but it is more concerned with political issues than the evolutionary approach. I use the *trial or the court of law* to describe elements of this perspective. The challenge is to intervene in problematic situations, such as addressing the poor technical design of oil installations, face and fight established management traditions that argue engineers and managers know more about future design of oil installations than mechanics. Then come up with new approaches like the experience transfer methodology ERGODESIGN to change this, and generate "useful" computer applications that are better than DELPHI.

In Chapter nine I describe this as containing elements of a *due process.* It will be extremely difficult for the involved actors to agree on a general formulation of the problem and people like KOT are brought in because there is a perceived need to improve the organizations information processing abilities. In Statoil and in most companies IT is chosen as the standard solution to this problem. The developers are however invited into an organizational game as Dahlbom and Mathiassen describes it, or in my language an organizational drama. The challenge does not only grow because of the complexity and uncertainty related to data processing but also because of uncertainty related to organizational change. DELPHI "won" over SAREPTA because KOT and STI were better able to read the signals of the new evolving Statoil organization after a large reorganization process.

Different actors like KOT and Statoil Data had different interests and perspectives (questions/solutions) as a consequence. In such an intervention process it will be difficult to isolate and make explicit data processing problems, because organizational phenomena have a holistic character and because of the strong dynamics involved. Those that work with systems development here have to be consultants and change agents. They are on the inside and outside at the same time and are as Dahlbom and Mathiassen say, arrogant enough to try and combine the two roles of insider and outsider (Dahlbom & Mathiassen 1993:67). They receive information by analysing contradictions in the situations, but are also involved as participants and stakeholders. As change agents they are engaged in debates about interests and perspectives and negotiate possible actions as KOT did in the development of DELPHI. They are brought in because of their technical skills but they need to be just as good to handle organizational challenges (Dahlbom & Mathiassen 1993:119):

> Systems development projects are parts of wider organizational efforts, and the resources and contractual arrangements related to a project have to be constantly nursed and defended. The challenge is not merely to cope with bounded rationality. The systems developers must take part in organizational games with mixtures of cooperative and opportunistic behavior...The systems developer is no longer an expert solving the problems of other people. The problem owners and users are themselves active and responsible participants in the process. The users have become designers, and the task of the systems developer is to facilitate learning and give technical advice.

The end result of such an intervention process is not a computer system with a solution to a given problem. It will result in a changed organization. DELPHI solved the problem with electronic distribution of documents, but DELPHI and a growing LOTUS NOTES infrastructure created new problems that I will describe in the chapters that follow. The best we can hope for is that more useful tools and routines for information processing have developed in the new situation that has emerged. The situation is different (meaning old problems may have been resolved) but new problems will soon develop. In the light of John Dewey's insight the aim is "to keep the conversation going".

Contradictions denote an intervention perspective. There will be contradictions within the project related to uncertainty, vague project objectives, different interests and lack of experience handling organizational issues. There will be contradictions between the project and the resources available, between the project and the users and between different user groups (Dahlbom & Mathiassen 1993:122):

> The professional challenge is not merely to choose the right combination of approaches. The challenge is to understand and change established traditions in the user organization as well as in the project group and in the development organization as a whole.

These contradictions will create nuisances for the development process, but they will also provide possibilities for the intervention processes. In that sense it is more than noise waiting to be eliminated. An intervention perspective accepts the ambition of hard systems to try and "map" the world, but it questions harmony, order and shared interests. By mixing in an element of conflicts, differences, interests and power struggles, interventionists still try to continue doing business as usual.

To resolve these deeper problems hard issues must be addressed, like distribution of resources, organizational structures, technical systems and power and not only perception. In a dialectical systems approach like that of Dahlbom and Mathiassen contradictions do not only appear in our minds and through our thinking, but reality itself is a totality of related contradictions. The most dominant feature is change and flux. In every situation we have to

face a number of contradictions, some surface problems but often more basic problems. In each development phase of a computer system there will be a number of contradictions that might provide a chance for possible interventions.

These contradictions will also be found in the technical area, not only in the social area. The contradictions are then analysed in detail. Major areas of conflict, interests of involved actors and the dominating side of each contradiction are identified. Negotiations, compensations or compromises are employed that might open up the context. Different intervention strategies are sought and suggestions for changes examined and evaluated. Considerations are then used to select a strategy. Action will be performed and the situation will change, and then also our conceptions and beliefs.

4.6 Summary

In this chapter I have described the birth of a new KOT concept and key features of the new Collaborative Workspace. I addressed how the development of the concept can be seen in the light of theories related to metaphors, analogy and abduction. I then discussed the CW concept in the light of IT systems design. This discussion started with seeing design as the systematic transformation of analogue concepts to digital concepts in terms of a materialization of an IT system. I then presented several ways of handling the materialization of new IT systems: construction, evolution and intervention, taking up some features from the CW concept and the history of KOT presented in Chapter three. I have now presented the necessary background material on the Statoil setting and the overall concepts I tend to use in the later chapters. It is now time to go to Norne, a new offshore installation, and see what happened when the CW concept met the user organization of Statoil.

Chapter 5 The Collaborative Workspace Project in Statoil Operations (1996), the New Concept in Action

This chapter looks at the CW project as it unfolded in 1996 in collaboration with Norne, an offshore installation under construction. In Chapter four I presented the main content of KOT's new CW concept. I presented the visions of a product, the different perspectives and the process KOT depicted to realize the visions. Let us follow KOT in action and see what happened with the Collaborative Workspace in the Statoil organization. Norne is the pilot in 1996. This chapter starts with an introduction to Norne seen in relation to the larger Statoil organization. I then describe what was called an "integrated organization and IT development". Here I go through a number of issues related to this process, the building of a collaborative IT application, and I give a detailed example from maintenance. The maintenance process will be related to the concepts of business process re-enginering (BPR) and value chains. I will have to present these concepts because they are vital to understand the construction of the Norne work processes. Further, I discuss the aspects that BPR rendered invisible, and how this invisibility was handled in Norne. Finally, I describe the main concepts of the CW project seen in relation to KOT's experience report and the close out workshop between KOT and Norne at the end of 1996.

5.1 Norne as a symbol of the new Statoil organization

Statoil discovered Norne in 1991, being the first major oilfield Statoil found alone (and not taken over from others with the help of governmental licence contracts). Norne was important in boosting the self-confidence of Statoil, to document Statoil's position as a capable actor also in the discovery of oilfields, not only their subsequent exploitation after another multinational oil company had found them. For Norne to be commercially interesting, operational activities had to be radically restructured. In addition, traditional offshore engineering and development solutions would be too expensive.

At the same time, the Norwegian government introduced the NORSOK report on the future competitiveness on the Norwegian Continental shelf in February 1994. The report concluded that development costs of new installations should be reduced by 40 % — and that cutting costs was not enough. Just as important was the development of new collaborative work practices that would enable the industry to reduce development cycles of new installations. Implications of NORSOK included new ideas about vendor co-operation and new

development concepts like vessels and subsea well systems. In Statoil, the Norne project started to live by these new principles that seemed ripe at the time. A company initiative called BRU (Cheaper, faster development projects) was initiated in 1994, taking up the challenges from NORSOK. New concepts for co-operation were developed, shifting from a strict customer-contractor relationship to broader focus on core teams with contractors, sharing of risk, integrated groups of contractors and Statoil employees. The actual development costs for Norne were reduced by 40 %. This gave NORSOK a real life manifestation and transformed some ideal concepts into working practices. Norne became an icon of the new times and was to act as a powerful vehicle for mobilization in Statoil. Norne was perceived as a success and being associated with it was advantageous.

At the turn of 1995-96 the Norne project entered a new phase. Most of the engineering was completed, and the ship was being constructed in Singapore with the help of company representatives from Statoil. The hull of the vessel, traditional ship functions and systems were built in Singapore. The vessel would be towed to a shipyard on the Norwegian west coast by early September 1996, where the more specific oil related technical systems would be installed. In January 1996 the Norne project was in "planning for operations", which is basically a phase in the project where the new organization plan and describe how to operate the new installation. It is an important phase since major decisions on future operational practice will be settled, like number of employees, collaboration in and between teams and various organizational routines.

Since the ship arrived in September there was a window in time (January-September) where Norne personnel could spend much of their working days planning and reflecting on their future practice. The recruitment of operational personnel was done over time. Key operational staff had taken part in the Norne project from the start to ensure that the needs of operations were handled. Some personnel were recruited from other Statoil installations in 1995, but the recruitment of new personnel would gradually escalate as 1996 passed. Norne would only recruit the number of personnel they needed. When September 1996 came the new staff would become busy working at the shipyard on the newly arrived ship. The last phase "commisioning" meant checking and preparing the onboard technical systems, and should last until the summer of 1997 when the ship would be towed to its permanent position in the North Sea.

Let us take a closer look at Norne and its key properties. Norne was the first production vessel Statoil operated. The company had no former experience with operating this type of vessel. The onshore organization would be located in Harstad, described as very far north in Norway. The latter's location was a result of a long political struggle (discussions about placing industry in the periphery and districts) in the Norwegian Parliament, which would create extra operational costs for Statoil. The same goes for the supply base in Sandnesssjøen and the helicopter base in Brønnøysund over 200 km from the Norne oilfield. Because of high costs and because of their location most production engineering expertise would be served from Stjørdal, Bergen and Stavanger (see Figure 5.1). Such a wide geographical distribution of the back-up crew would present challenges and be difficult to live up to without extensive use of information technology. The Norne field had approximately the same size as the Heidrun field, but should operate with considerably less staff because of some important preconditions that had been taken care of in Norne (see next page).

The onshore organization in Harstad has around 20 people, and the offshore organization is below 40. A group of around 110 works offshore during three 14-day shifts. Norne field

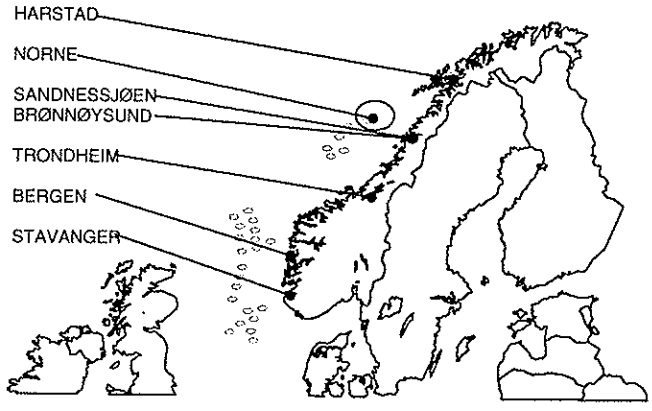

Figure 5.1: The location of Norne in the North Sea and onshore support locations

development cost around NOK 8 billion or around USD 1 billion. Its estimated production was 170 000 barrels a day in 1997. Two years later Norne's production had rose to 200 000 barrels. With production costs of around USD 5 a barrel it is the most profitable oilfield operated by Statoil.

The low staffing on the installation demands close collaboration. Responsibility must be delegated, e.g. delegated budget responsi- bility and a high degree of autonomy, flexibility and internal control is accorded to the various teams. Attempts should be made to develop work practices similar to that of the Norwegian merchant marine. Norne should move away from speciality-based and discipline-based organization.

The work teams (consisting of process technicians, shift mechanics and shift automation engineers) should control and monitor all on-board systems. They should have operational and maintenance responsibility for certain parts of the ship and are assigned system and area responsibility. The maintenance team (mechanics, telecom/data engineers, automation engineers, electricians, crane operator/storekeeper and a combined nurse/laboratory assistant) should only operate in the daytime. The specialist groups within this team should have system and operational responsibility for a number of utility systems. Much of the maintenance work should be distributed between the operations team, the maintenance team and equipment suppliers. Contractors would carry out major modifications and corrective maintenance tasks like modifications, painting and larger maintenance projects.

Implicit in the new espoused work practices lay some preconditions for low staffing, which were not at all present at older installations like Heidrun. At Norne the following preconditions were laid down for pursuing a safe and efficient operation with a minimum staff. No oil drilling would be performed onboard the vessel, only oil production. The Norne project had worked considerably to reduce the complexity of operating the production ship. This meant that they had conducted a study of automation requirements and introduced variant restrictions on equipment, standardization of type and supplier so as to simplify maintenance and a reduced requirement for the keeping of spare parts. Adequate access for the operation, maintenance and replacement of equipment had also been taken care of with expedient siting of transport routes and lifting devices. Workshops, offices and communal rooms were planned with a view to close and informal collaboration.

While past Statoil installations employed proprietary Statoil technical standards, Norne adopted Norwegian and international standards as the underlying basis. Spare parts stores; volume and location were determined on the basis of a criticality assessment and through collaboration with other units within Statoil. Norne had a clear target to reduce the scope of detailed requirements for technical information and documentation and to use the Internet for supplier documentation on standard equipment. The technical information and documentation

requirements for ship and process were harmonized. Contractors and suppliers became responsible for updating necessary technical documentation for the start-up and operation (DFO) of Norne's equipment/systems.

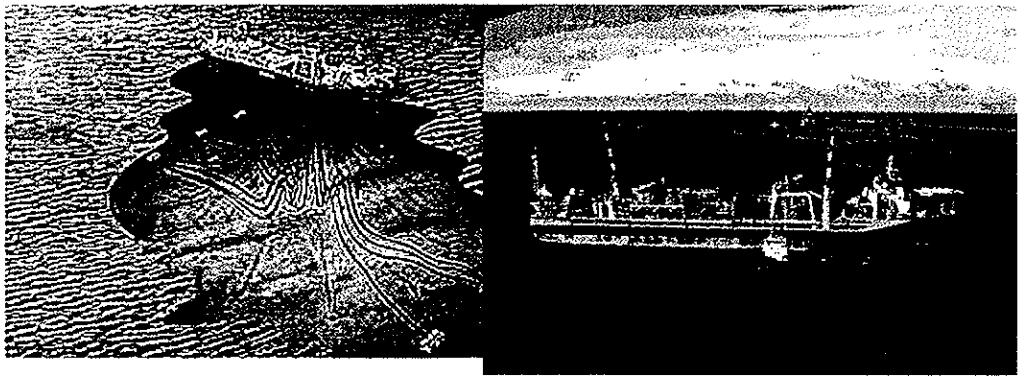

Figure 5.2: The Norne installation with risers, anchoring mechanisms and underwater well systems

Norne is a vessel of 100 000 dead-weight tonnes (see Figure 5.2). It's 260 meter long and 41 meter wide. The depth to the oil reservoir is approximately 2500 metres. The installation is a combined oil production ship and storage tanker. It has no traditional drilling tower but a number of underwater well systems that are connected to the vessel by a number of flexible tubes (risers) that pump the oil up to the ship. From there the oil is separated, oil, gas and water are extracted. The oil is stored on Norne and offloaded by shuttle tankers. The water and the gas (for the time being) are re-injected into the reservoir. Norne is anchored to the seabed by chains. Mid-ships Norne has a turret, which is the endpoint of the chains. The turret is stable and enables the vessel to turn according to the wind.

In January 1996, Norne had an operating philosophy document that gave overall requirements to a new organization: maximum number of staff, location of the onshore organization and key principles for organizing work in operations. This document contained much of the information I have presented in this section. Statoil management had placed considerable pressure on Norne to exploit new information technologies in operations but only overall ideas existed at the time. For Norne the challenge at the time was as follows: how the development of a future operational structure or practice could become an organization development process where the organizational members themselves should describe the ideal "to be"-situation in operations.

5.2 Building an integrated organization and IT development process in Norne

In this section I go through KOT's development process towards Norne in 1996. I start with the development of a relationship between KOT, Norne and Statoil Data, and then describe in detail the development of the IT application. Further, I present the functionality of the application. The Norne maintenance process will be used as an example to show how this process was brought to life, and I relate the development of this process to that of BPR by which it was influenced. Here I also present what BPR rendered invisible and how this was addressed in the project.

5.2.1 Introduction

At the turn of 1995-96, KOT needed a new pilot for their CW project. The methanol plant personnel and management were not willing and too busy to participate actively in the research project. In KOT's morning discussions the members argued that a new pilot had to be a part of Statoil that was willing to try out new ways of working and at the same time be interested in trying out new collaborative technologies. The KOT manager had done some work in the Norne project in its initial phase and knew key Norne project people. Several people in KOT knew newly recruited operational personnel.

Two representatives from Norne management came to visit KOT in Trondheim one dark winter day in December 1995. They knew that KOT had worked as facilitators at Statoil's new methanol plant under construction in autumn 1995. This new plant had the company's newest ideas about self-organization, teamwork and new ways of working in operations. They also knew that KOT personnel had helped the Heidrun installation in developing their concepts on "safe and efficient operations". The Heidrun concepts had been important in developing new ways of doing maintenance on Statoil operated installations. These managers needed input on future use of IT in Norne. One of the Norne managers knew KOT well since he had collaborated with them in the last two years and could guarantee their ability: "both to come up with new ideas and create necessary deliverables", as he said it. The sketch of a project was set up between Norne operations and KOT, giving KOT two major deliverables:

- To help Norne develop their most important work processes in operations, by acting as facilitators in the Norne organization, i.e. providing a method for describing work processes and perform process support during an organization development process
- Develop a groupware application that would be used as an operative enterprise model, including an overall description of Norne's main work processes and products down to the daily checklists in operations, in order to develop some shared representations of Norne's operating philosophy

The two Norne managers saw no problems in becoming the pilot of "the Collaborative Workspace" project, believing it would be easier to gain access to promising new information technologies. In addition, it meant that KOT would be able to do more work in the Norne organization (because of R&D funding) than would have been the case if Norne was to pay KOT for all the project work.

To start up the project KOT initiated two seminars with key stakeholders in Norne operations, both managers and operators/technicians. The first was held in Stavanger where most personnel would be located from January to September 1996. Another follow-up meeting was held in Trondheim in February. In these two workshops Norne was able to define the overall structure of its work processes. Norne personnel defined three main physical processes, with defined outcomes: There is an oil reservoir, with special characteristics that contains oil with specific properties. Norne has a production and injection system that offers possibilities and restraints based on its technical construction. They also defined a product shipment process since Norne must export the oil that has been processed onboard to a market. These three main physical processes were perceived as the main conditions under which the Norne organization had to operate, and comprised their value chain (see Figure 5.3).

In order to operate the physical processes in the most effective manner, Norne personnel developed sixteen main work processes in the workshops. These processes were: operations, maintenance, modifications, technical support, accommodation (on board), logistics, marine

operations, emergency preparedness, human resource, finance/accounting, quality, reservoir management, health, environment and safety (HES) and procurement, these being the most important. Figure 5.3 captures what Norne described as their overall enterprise model. Norne defined an *enterprise model as a model of what they want to accomplish, and of how to function when in operations.* It contains basic elements and the necessary decomposition of activities, roles and specifies information requirements to activities. This model was refined throughout 1996, but the overall structure was in place after these workshops. I will come back to this process later in greater ethnographic detail.

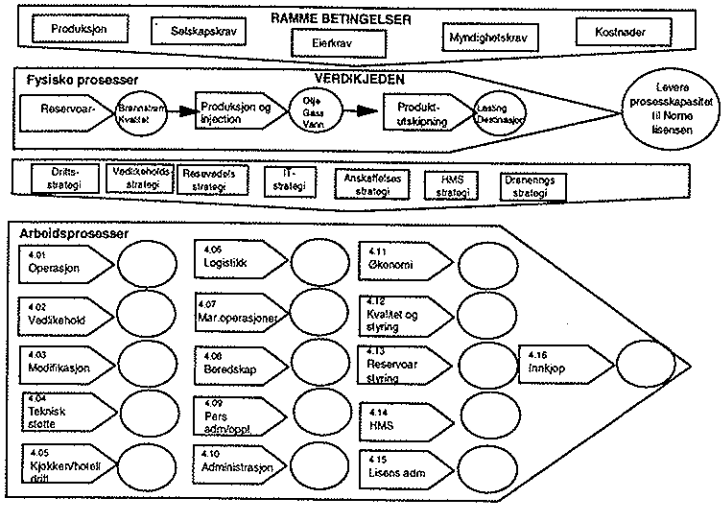

Figure 5.3: Norne overall enterprise model

KOT used a BPR definition (see Section 5.4.1) in the facilitation in Norne and defined work processes as a collection of activities that takes one or more kinds of input and creates an output that is of value to a customer.

The main challenge was perceived as follows: to discuss which of the processes did not have any proper products and customers and question if Norne had to do these activities at all? Given the challenges of Norne these questions had to be raised, and it enabled the organization to consolidate the most important business objectives. However, it had to be accompanied with additional questions related to the nature of work, as we shall see later in greater ethnographic detail when we deal with maintenance. The two workshops in January and February ended up with a plan for the further work and a collection of overall requirements that committed both the Norne management and the operators/technicians. It was agreed to stick to the following value statements and address these issues continuously throughout the process when or if they were violated:

- Norne wants to remove as many of the detailed procedures as possible that regulate work offshore, standard Statoil mandatory procedures which only give minimal requirements are sufficient
- Norne has competent personnel on all levels that are eager to take responsibility, therefore supervision is not an issue
- We will not tell competent people how to do the work they are skilled to do. As a consequence, we make aggregated descriptions of work flow, and do not go into details
- Automation-no, quality of working life-yes

These value statements became a value standard that the project wanted to evaluate its results against, believing that action and practice was the only proper evaluation. Part of KOT's job was to follow up and evaluate the use of these standards in the Norne organization during the

project. To make the involvement of Norne stakeholders manageable, a number of Norne employees from various hierarchical levels were chosen as process owners.

The process owners had heterogeneous backgrounds. When several middle managers were not ripe enough for the task, the project picked skilled technicians with large credibility and experience. These people had to have potential facilitator capacity and find such a job inspiring. All process owners were to work with issues they would have to live with when in operation. Each of the sixteen work processes had process owners, and some process owners became responsible for several work processes. These people were given the assignment to involve other people in the Norne organization in order to describe the defined process(es).

These reflection or process groups had delegated responsibility (from Norne management) to articulate the future work practice of the vessel. There were a number of interfaces between the groups and they had to co-ordinate the activities between themselves, develop their own self-justice, without appealing to management. These were trained by KOT in basic facilitation and KOT helped them in their reflection sessions. A basic introduction to a flowcharting methodology was a part of this, and these flowcharting symbols were combined in order to create the Norne work processes. I will present an example from maintenance to show how this was done.

KOT personnel conducted weekly fieldwork and participated in many Norne activities that were of relevance to the work processes throughout 1996. The workform was multi-layered. At its core were Norne process owners (which also had their own teams) and KOT facilitators. These key facilitators filled different functions. There was Stuart, the expert on maintenance that had taken part in the Heidrun installations "Safe and efficient operations" project. Hans, the former mechanical foreman was vital in the latter project and worked in Heidrun in 1993. These two in particular were important in developing trust among the operational personnel in Norne. Ola was project manager of the Collaborative Workspace project. Both Hans and Ola had been important in the work at the methanol plant. Further, there was Frank the programmer from Statoil Data that did much of the work on creating the LOTUS NOTES application and finally myself, the project manager of this pilot. I had participated in the methanol project and had to combine an administrative and facilitating role. In addition, as the project manager of the pilot I had a special responsibility for documenting what happened in the work with Norne. I was the only one with a non-technical background. In the outer circle was, Robert, the KOT-manager who did the lobbying for support towards divisional and corporate management, several important gatekeepers from Statoil Data and the key Norne managers.

5.3 Building an IT application for the development process

Statoil management had set tough requirements for Norne to use information technology, and it was perceived as evident by those participating that Norne had to develop skills in using these collaborative technologies, if collaboration with the vessel and the dispersed production engineering community should function properly. World Wide Web for technical documentation and desktop conferencing systems were perceived to be the future. In addition, Norne relied on an installed base of LOTUS NOTES that was vital in their daily operations both for e-mail and document sharing. Norne also had a number of NOTES databases for access to technical data and logs. In future operations Norne would access a number of Statoil legacy systems of accounting, plant maintenance, production control, technical information systems and others. Norne management asked if it would be possible to link these information

resources into one interface? Bear in mind that this was also one of the agendas of the CW project, so an alignment of interest was established. Let us go back to a meeting in Stavanger in February 1996, between two Norne managers, three technicians and four KOT people, myself included.

Robert presented some overhead slide sketches of a future Collaborative Workspace, where access to all information resources was possible via a navigation layer. This navigation layer was something that the organization had to develop themselves based upon their work processes and daily operating routines. It had to be familiar so that everybody in the organization could navigate in the workspace, and consist of some shared images that captured the essence of the business. The Norne personnel were intrigued by the idea and one of the managers asked: "This workspace you are talking about is interesting, can we develop this navigation structure and link up all the necessary Norne information systems to this structure? "Robert said yes, but were followed up by Ola that stated: "we have to take small steps and not do something that will lead to a costly systems development project".

The Norne manager answered: "Yes I agree, Norne does not have money to sponsor large systems development projects. Can we use Internet technology here, can it be the navigation structure we are talking about?" Ola replies: "Yes, in the long run, but we have to look at what is commercially available technology. Since Norne wants to employ the solutions during prototyping we have to consider Statoil's installed IT infrastructure and in what direction it moves. Statoil Data still cling on to LOTUS NOTES and we have to look at what LOTUS will offer in future versions of NOTES".

The Norne manager replies: "Yes, we have a lot of information available in NOTES and people are getting familiar with using it, but I don't see how NOTES can function as a navigation layer on the top of our information systems. With a NETSCAPE browser I can understand it since Internet technology makes it possible to create images and clickable navigation interfaces. I consider myself to be a competent user of NOTES but I have problems finding information in the many databases, imagine the problems of a new beginner". Ola ends the discussion: "We have to look at what is possible in terms of commercially available technology and come back to Norne with an answer".

As the start-up discussion around the IT collaborative tool indicated, very few requirements existed. It should be a clickable system that made it possible for Norne users to navigate in a number of information resources and from there start up a number of IT systems. This navigation structure should represent images that were familiar for Norne personnel and made it possible to intuitively navigate in a jungle of information resources.

How does one design for this flexibility with a number of stakeholders in Norne coupled with large uncertainty on how the groupware application should look like? A construction approach, described in Chapter four, would have made little sense since in February 1996, the users in Norne had few references as to what such a system would look like. After the meeting with Norne, KOT gave Norne a replica of the LOTUS NOTES discussion database that KOT had used at the methanol plant in the autumn of 1995. It should help Norne with the most urgent needs in the description of their work processes, but a more sophisticated solution was indeed needed. Norne personnel were familiar with LOTUS NOTES, release 3 and it seemed appropriate for KOT to start there, employing the skills Norne already had, and also to use FREELANCE GRAPHICS (a slide presentation tool equivalent to MS POWERPOINT). Statoil had a solid LOTUS NOTES infrastructure in 1996, that had what Norne and KOT perceived to contain the necessary flexibility to support groups working

together at this time in the project. KOT felt that it was vital to start with an existing system if the project should follow up use under real working conditions, and see how the system could improve Norne's work processes along the way, and train for operations. Statoil's existing computer network infrastructure was therefore used to minimize technical support during the prototyping process. At the same time Norne stakeholders said directly that they wanted something more and that they were not satisfied with what NOTES release 3 could provide.

Database structure, access control and the metaphors of paper-based workflow gave NOTES both advantages and disadvantages in use. LOTUS NOTES like all information technologies had voices inscribed via the "canned action" of LOTUS programmers. Another problem was platform proprietarity, which was perceived as an increasing problem with the growing popularity of Internet technologies. NOTES could not communicate easily with WWW at the time. The pro's (using a familiar platform, existing infrastructure) and con's (proprietarity, uncertainty about Internet migration of NOTES, existing mental models based on NOTES) had to be compared, and NOTES was in the winter and spring of 1996 one possible alternative for the development prototype in Norne.

To meet a demanding customer half way, KOT developed a Norne home page and put it on an external WWW server. This home page could be developed further. In addition, it consisted of general Norne information (on the vessel and the organization), standard vendor documentation, and a few work process descriptions. The idea was that Norne could develop this home page further and link up sub-processes of the work processes, technical drawings, vendor information and mandatory documentation. It was half a year before the official home page of Statoil was released.

At the same time the operational engineering environment was developing a HTML search engine for Norne that should make it possible to access technical information on standard vendor/supplier equipment on a WWW platform. They claimed that a navigation structure in VISUAL BASIC could be developed with the necessary links to NOTES databases and a number of ORACLE (relational) databases. Could VISUAL BASIC replace FREELANCE GRAPHICS as the main drawing tool?

By early March a storm was blowing up. KOT tried to maintain that the reflection process and the development of work processes was more important than the interfaces of a future IT system, but they had problems mobilizing Norne personnel in these tasks. In a meeting between KOT personnel, headed by Robert, and Norne personnel, the discussion became intense the first week in March. In the minutes of meeting and after a long internal discussion in KOT, Ola wrote a mail to Norne:

> Based upon the meeting yesterday with Robert, Vidar and Stuart we question that the activity between Norne and KOT has the right focus. We know from past projects we have run that it is not the technical solution that will be alpha and omega to realize what the customer needs. The process is of most importance and research indicates it is here you take out 60-80 % of the effect. A future IT tool should be more a consequence of the process and not vice versa. The way the Norne-KOT collaboration has turned lately KOT feels that it is the technical solution that is in focus and not the work with the processes in the organization. We feel it is wrong of Norne not to put full efforts on the organization development process before we have a realizable technical solution. The reason for this is that we know that the main challenges are on the interpersonal side and not in technology. We in KOT have had a thorough discussion. We feel that we have helped Norne develop a NOTES application that will cover Norne's immediate needs and we are also willing to develop some prototypes as to how the wanted clickable functionality can be realized. This does not mean that we will develop a production system in HTML and develop stable links between NOTES and WWW. Such a hasty solution will have the following consequences: It will lead to a heavy systems development project that will be difficult to realize without use of unreasonably large resources. Further, it will be difficult to maintain without unreasonable large

costs, and finally such a project will take so much resources that the activities with the work processes cannot be finished within the given time frame. Until we have a new technical platform the work process descriptions are made in FREELANCE GRAPHICS without clickable functionality. NOTES references can be made as usual using doc links. Release 3 has the necessary functionality, and can be developed further according to Norne needs.

KOT's recipe was to intensify the process of describing work processes, by activating the Norne process owners, and continue to use the release 3 NOTES discussion database. Norne gave an immediate answer by mail on 6 March:

It might happen that KOT does not have the same understanding that the end products are important, if not most important. A process without an end product has only an academic interest for Norne. To start a development of work processes without a technical solution related to end products is out of the question. Process maps on paper and in isolated NOTES databases is not a solution in the electronic world of Norne, where all documentation is saved and distributed electronically. The fact that KOT wants to 'save' Norne management by more work process methodology will not lead to practical solutions and outcomes. You have to see that new ways of working also require new and better ways of handling data. From our side (Norne management), we have taken the decision to stop the project if we don't find an acceptable technical solution. Since you are experts in the field we advise you to come up with a proposition for a technical solution that is realizable. After our telephone conversation with Robert my understanding were that clickable interfaces was within reach in NOTES release 4.

KOT knew that NOTES release 4 had the necessary clickable functionality, and that it was possible to develop navigation images on the top. In a meeting the Norne process owners were presented VISUAL BASIC, and how it could be used to describe work processes. The system was far too complex for ordinary users. FREELANCE was perceived as simple to use and KOT had developed a number of templates that made it easier to draw work processes. Since one of the key principles was that personnel in Norne should draw their own work processes, VISUAL BASIC was out of the question. Both Norne management and the personnel that took part in the meeting concluded that VISUAL BASIC was unacceptable as an end user tool for creating work processes. KOT perceived it as more and more pressing to look at NOTES release 4. Frank from Statoil Data had worked with NOTES for several years and he knew the people in the Statoil NOTES team. The NOTES team was responsible for the further development of NOTES in Statoil.

NOTES release 4 scheduled implementation in Statoil was December 1996, which would be too late for Norne. Statoil Data was not willing to let KOT have access to the new release. They had the DELPHI incident in mind (see Section 3.4.2), and did not trust KOT, being afraid that KOT might implement new versions of NOTES in pilots that would create problems for the present IT infrastructure. Even though collaboration between KOT and Statoil Data was improving, additional talks and collaboration was needed in the autumn of 1995 and winter of 1996. Taking Frank into the team helped considerably, he became a communication node between Statoil Data and KOT. The breakthrough in the relation came after the development of close working relationships with key gatekeepers in Statoil Data. In March 1996, KOT had gained sufficient trust to take a new step. Robert started to lobby for Norne.

If Norne could be defined as an operational pilot for new collaboration enabled by IT in Statoil, it would be easier to gain access to NOTES release 4. This pilot status would make it easier to try out new promising technologies in Norne. With his large informal network, Robert managed to mobilize support for a Norne corporate pilot among corporate management. Divisional management accepted the proposition, and Statoil Data also saw this as an opportunity. Robert appeared in tandem with Statoil Data. KOT and Statoil Data's

interests became more and more aligned towards helping Norne. A meeting on the 25 March 1996 in Stavanger ended the technological controversy.

In this meeting Norne had several claims. One of the Norne managers presented the ambitions of Norne's future operational practice seen in relation to use of collaborative technologies. Norne wanted an application that made it possible to create clickable graphical process maps and link up various information resources. They wanted an answer from Statoil Data within a week; what type of software could provide such functionality? Within a week Norne got their answer, Frank having made most of the groundwork. The e-mail answer being sent to Norne from a major Statoil Data gatekeeper concluded that everything Norne requested could be implemented with the use of NOTES r 4. It was more difficult to estimate how fast Norne could get hold of NOTES r 4. Norne had requested a solution before 1 May. 1 June was a more likely date, which Norne accepted. Statoil Data also set up an additional requirement in the same answer:

Before NOTES 4.0 is established as part of the ordinary IT portfolio in Statoil (around December) the users of this solution will have to run it in a "closed" environment. Because of incompatibility with applications developed in NOTES 4.0 (these cannot be run from release 3 clients) it will be necessary to protect this environment. This means that this application cannot be made available for others than the Norne users.

This Norne accepted, and a test environment of the 35 Norne personnel could be set up. The idea was that the test environment should be gradually enlarged as the new personnel arrived. In mid-April the sketches for the work were taking shape. One activity had to be the development of clickable graphical process maps with doc links by using LOTUS script. The other task was to create start-up engines with the necessary parameter settings to gain access to legacy systems (plant maintenance, technical information system INREG/STID) from NOTES.

What about the WWW connection that Norne requested? It turned out that LOTUS had developed a product called INTERNOTES that gave access to the WWW and this functionality could be implemented with release 4 of NOTES. It was immediately implemented in the application.

Norne was now confident that the technical solution was in reach and started to invest resources in the work process modelling activities. May and June were important months and KOT personnel helped as facilitators. All process owners defined work plans and it was KOT's task to help the process owners. In April a respected offshore middle manager, Tommy, came back to Norne. His support increased the credibility of the project considerably and made it easier to mobilize support in the operative community. The challenge of KOT was still to convey to the operational community in Norne what they meant by clickable work processes. Norne personnel knew LOTUS NOTES, but had problems seeing what this release 4 application could do differently.

In a meeting in late May 1996 the new application was presented. People from KOT, Statoil Data gatekeepers and most Norne personnel available in their offices were present. Frank presented the application with the clickable work process models and the start up mechanisms to the legacy systems. He also showed how the WWW could be reached via NOTES. Norne personnel were excited, the formal requirements had been met.

Even though KOT and Norne were in charge of running the development process referred to as "an integrated organization and IT development process", Statoil Data did most of the basic

coding and delivered the necessary Notes release 4 infrastructure. In this project KOT and Statoil Data co-operated successfully, filling complementary roles helping Norne in their preparations for operations. Instead of taking all the attention and credit themselves Norne and KOT were keen on presenting Statoil Data as a key facilitator for this project to come true, and without Statoil Data's help the collaboration between Norne and KOT would most likely have come to an end. The Norne project between KOT and Statoil Data enabled the two former competitors to have regular meetings and align their projects. The major consequence of this new trust was that KOT was given access to new promising technologies and should help Statoil Data in testing and qualifying new IT in Statoil in pilots. Statoil Data should handle the development of products based on the pilot applications and carryon the further proliferation to the rest of the company.

In late spring of 1996 with the introduction of NOTES release 4 Norne had the overall structure of the application, with the main work processes. The numbers of users were gradually increased as Norne recruited new personnel throughout 1996. Changes and evolutionary improvements in the application were handled during KOT's weekly fieldworks in the Norne organization. Larger changes in the functionality were discussed with the process owners in summit meetings. Daily support and small changes were handled informally either via KOT's fieldwork or via the "hot" telephone line directly to Frank, the programmer.

In autumn 1996, Norne gradually took over more and more of the responsibility, both for the development and improvement of the work processes and the maintenance or development of the IT application. A group of super-users in Norne operations were coached to perform simple maintenance and improvements on the application. At the end of December 1996 the research project came to an end and KOT withdrew, enabling Norne to take full responsibility of the further development themselves, together with Statoil Data.

5.3.1. What did the application do?

The IT application that was developed in Norne should provide an infrastructure for the reflection process in planning for operations. It should improve the communication that was going on among process owners and their teams, some geographically co-located, others dispersed at the time in 1996. A basic premise for the project was to be able to help the Norne personnel visualize what a new organization could potentially look like, and help them to develop shared representations of such a new organization. They wanted a Norne "workspace" with an intuitive interface to enable Norne people not only to find the information they needed in their daily work, but also to develop a coherent understanding of what Norne was and its basic work processes. The intention was that the organization should evolve together with the IT application.

The only formal requirements for the information system were, as described earlier: "a clickable frontend that should visualize Norne's work processes and give easy access to key information in operations". Norne used flowcharting to visualize the future practice that had been developed in the multi-skilled groups of the process owners. The first process maps were drawn on paper, but as the charts became increasingly considered "finished" by the Norne personnel, the map was redrawn in LOTUS FREELANCE GRAPHICS (graphical slide presentation tool) and incorporated in a LOTUS NOTES release 4 database. Through the use of hypertext/media and "hot spots" the project made links to information and additional computer systems needed in the work processes (since Norne personnel themselves defined information requirements connected to activities in their development of the process charts).

The point of entry of the application is a graphical presentation of the overall Norne enterprise model (see Figure 5.3), from there you can click further down to the different work processes like maintenance (seen in Figure 5.6). The representation of the maintenance process has a number of "hot spots" with hyperlinks (Figure 5.4). The flowchart itself may not always give enough information regarding the process. You can see what is hidden behind the boxes by clicking further down to a more detailed textual description of the box (a NOTES document like create work order or improvement comment), start up the plant maintenance computer system, access Statoil mandatory procedures that regulate maintenance and read digital copies of operational manuals, access vendor information on WWW, and select checklists of routine operational tasks.

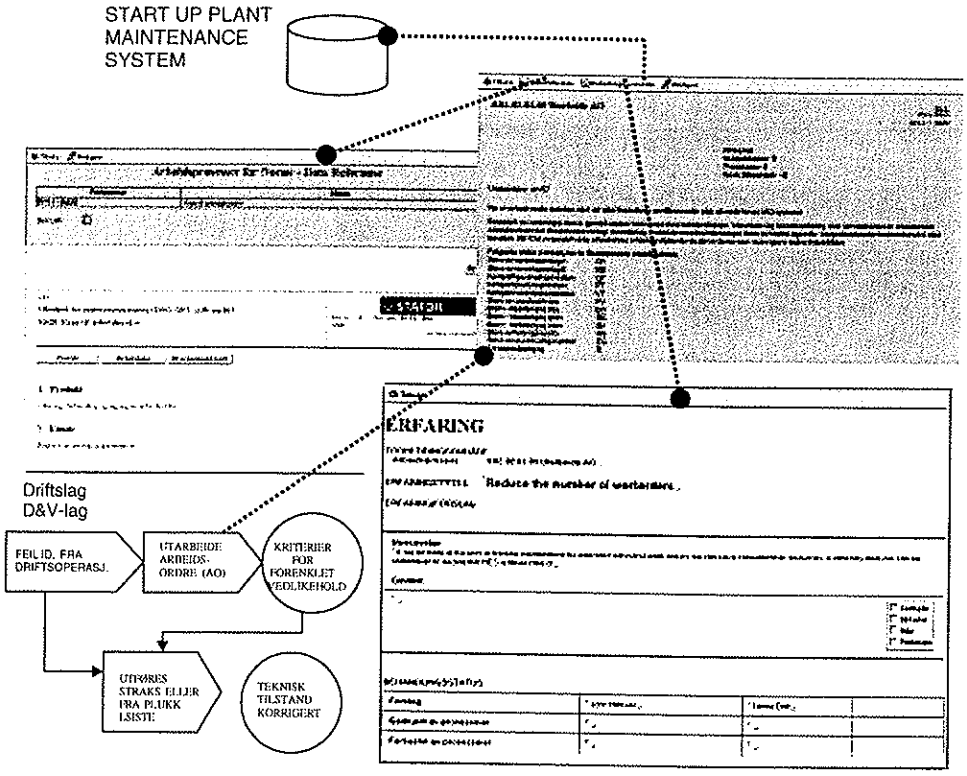

Figure 5.4: Basic functionality of the application, where you navigate in a flowchart environment, open a number of NOTES documents, create improvement proposals/comments and start up a number of other IT systems

From any work process it was possible to create improvement proposals, via a button on each process chart. Anybody in Norne could give comments to any process or sub-process. It became the responsibility of each process owner to enter the improvement proposal module to track proposals regarding his/her process, and on a regular basis discuss these proposals together with the work process teams or other people in the Norne organization that it might be of interest to. The process owner could dismiss the proposal or implement it directly in the application if it was a small change, e.g. change in text. If the proposal was complicated and had consequences for other processes, as the maintenance example I will come back to

shortly, it had to be discussed by management or other process owners before it could be implemented. When the process maps had to be changed, the process owner made the changes in a discussion database view and the programmer entered a new updated bit map into the presentation view.

5.4 Building the Norne maintenance process

In order to describe the maintenance process I start with Business Process Re-engineering (BPR) that helped to shape the production processes in Norne. I then go through the maintenance process in detail, describe the BPR elements of the maintenance process and finally address what BPR rendered invisible and how KOT handled this phenomenon.

5.4.1. Business process re-engineering

I have shown in overall terms how the work processes were set up. Now I can present this work in greater ethnographic detail. I will have to state the basic thinking in Business Process Re-engineering before I go further, and here I go to the business literature.

From the early 1990s and onwards organizations have taken a more system-oriented approach in which they analyse business operations from the group and up, eliminating old processes, controls, reporting relationships, and compensation/reward systems that have more and more assumed to lose their utility. Business Process Re-design (or re-engineering) was one of the most popular management theories in the mid 1990s. It came to be known as the analysis and design of workflows and processes within and between organizations. The idea was to perform critical analysis and radical redesign of existing business processes to achieve breakthrough improvements in performance. It took over after another buzzword, "total quality management" (TQM) that preceded BPR. In Statoil TQM became known under methods of continuous improvement, or quality improvement (named KF) and has been the major ideological basis for improvement of operational practice in the 1990s.

How does BPR define a business process? It is a set of logically related tasks performed to achieve a defined business outcome. A process is a structured, measured set of activities designed to produce a specified output for a particular customer or market. According to Davenport (1993) it implies a strong emphasis on how work is done within an organization. Most BPR methodologies view processes as having two important characteristics: (i) They have customers (internal or external), (ii) They cross organizational boundaries and occur across or between organizational sub-units. One technique for identifying business processes that has been popular in Statoil is the value chain method developed by Michael Porter (1985). In BPR, processes are generally identified in terms of beginning and end points, interfaces, and the organization units involved (particularly the customer unit). High impact processes should have process owners.

Examples of processes include: developing a new petroleum product or ordering goods from an onshore supplier. The use of IT is vital to understand the agenda of BPR. BPR questions the assumptions about how corporations organize and conduct business, ideas that have been institutionalized in organizations for decades. It searches for new business rules that make more sense given current market conditions and the capabilities of IT.

Michael Hammer (1990) considers IT as the key enabler of BPR's "radical" change. IT is believed to inhabit the properties to challenge the assumptions inherent in the work processes that have existed since long before the advent of modern computer and communications

technology. Hammer's (1990) solution is a number of re-engineering principles: (a) organize around outcomes, not tasks; (b) have those who use the output of the process perform the process; (c) subsume information processing work into the real work that produces the information; (d) treat geographically dispersed resources as though they were centralized; (e) link parallel activities instead of integrating their results; (f) put the decision point where the work is performed, and build control into the process; and (g) capture information once and at the source.

IT and BPR are believed to have a recursive relationship (Davenport & Short 1990). This means that IT capabilities should support business processes, and business processes should be in terms of the capabilities IT can provide. IT's promise is to be the most powerful tool for reducing the costs of co-ordination.

5.4.2 Creating the maintenance process

With this perspective in mind, I now move back to Norne and see how Norne addressed these issues. Let us halt and recall what has already been presented. I have already showed how KOT used a BPR inspired way of thinking to define the major value adding processes in Norne in the two introductory workshops. The outcome was that Norne defined a physical process, which they called their value chain. This chain went from the oil reservoir, via shipment to a market.

To work efficiently with this value chain Norne defined sixteen overall work processes decomposed to the necessary granularity (see Figure 5.3). One of these processes was maintenance, and I will now give a more detailed description of how the maintenance process in Norne was brought to life. Each of the sixteen work processes in Norne had a process owner. Tommy was the process owner of "maintenance". He was also responsible for the "operations" work process, which made it easier to integrate these two processes that had to be closely aligned. Tommy was a skilled offshore middle manager with a merchant navy background as electrician and he had worked on various Statoil offshore installations for many years. He had taken part in the Norne project in its important phases to make sure that the needs of operations were taken care of during the concept phase and the engineering of Norne. Tommy had high credibility and trust among the existing Norne personnel.

To start with the work processes Tommy assembled a group of 7-10 people that should have the operations and maintenance processes as their key responsibilities. These people became the team that was given responsibility to describe the maintenance process. The maintenance team consisted of offshore first line and middle managers, process technicians, mechanics and telecom/data technicians. Except for a woman in her mid-twenties they were all males in their 30-40s.

The start-up meeting took place in Norne's meeting room. Stuart was the facilitator from KOT in the start-up sessions because of his thorough understanding of the maintenance process. He had brought with him a large sheet of brown paper and spread it out on the meeting room table. Tommy and some of the team had already conducted interviews with personnel on other Statoil installations to gain input on what Norne's maintenance process should look like, and they had planned to conduct more interviews later. They had also read a number of internal reports on the organization of maintenance in Statoil, the Heidrun installation's "Safe and efficient operations" being the most important. The team had a thorough understanding of the key principles in Norne's operating philosophy document that had to form the basis for the work.

The group started to capture the sub-activities of maintenance and the products or outcomes. BPR-methodology urges that work process descriptions start with the customers, then defines the products, and from the outcomes look at the sub-processes or activities that are needed to meet customer requirements.

Stuart asked: "Who is maintenance's customer?" The Norne group had no problems defining who were their major customers. It is operations, they argued, one process technician said: "Maintenance deliver products to operations so it will be able to operate the vessel under the best possible operating conditions. Stuart continued: "What is maintenance's product?"

(I intrude in the narrative here. There will be a number of products, but BPR methodology urges us to define the key product first). "Is the key product maintenance delivered, or something else?" The products were harder to define, the group had a number of definitions: deliver maintenance, carry out work orders, plan and implement, get spare parts. Stuart asked: "Aren't these things you have described sub- processes and not products? If operations is your key customer what are their claims towards you?"

Tommy was also the process owner of operations and he saw it coming and responded: "Operations are dependent on maintenance in terms of their ability to keep the installation up and running. Maintenance must deliver availability of the technical systems for operational activities to take place. Availability means a proper technical condition of the installation". Stuart nodded and continued: "What do you think this means, is the key product of maintenance the continued efforts to re-establish the technical condition of the installation?" The group nodded and one process technician said: "Doing maintenance is then the process, not the end product, and in addition to this there will also be a number of sub-products of which we have to define further. It was these sub-processes that caught our attention". Stuart wrote, "Technical condition re-established" on a yellow adhesive Post-it sticker and said: "Let us now move to sub-processes of maintenance and define these. Let us do some brainstorming first, all of you should participate. Do you want to start by defining the activities that you know you have to do in Norne that is related to corrective maintenance?"

The group were able to come up with a number of sub-processes: maintenance planning, acquire spare parts and job preparation. In this four-hour session in early April the Norne maintenance team ended up with a large brown sheet of paper that listed the major activities and their interdependencies. They defined a number of interfaces to other processes (operations, health environment and safety, logistics). In a number of follow-up meetings the work activities were articulated in larger details. These meetings were held when the need for consensus on urgent matters came up. If a vital new element in maintenance had been defined, the group discussed it and some of the team members were given the task to write down the details. It took almost a month before the platform maintenance process had got a shape of which the group was satisfied. The flowchart diagram was then digitalized in the NOTES application, and additional changes would be made digitally.

Tommy gave the group responsibility to further develop the sub-processes of maintenance, and had regular meetings with the team. Three process technicians and a first-line manager appointed themselves as super-users. The super-users helped the others that had problems with the functionality of the application.

Most of the sub-processes on platform maintenance had been created in NOTES before 1 June 1996, but the work continued in the summer and autumn of 1996. The last documents were

made as late as July 1997 (see Figure 5.5) The definitions of roles (meaning who should do what activities), descriptions of activities, linking up of information resources (mandatory documents, additional NOTES documents and databases) and possible re-engineering of activities (seen in relation to ordinary practice on maintenance in the rest of Statoil) continued from May to October 1996.

During each group's development of their work processes in round table discussions, the following reflection took place: roles were discussed, it clarified both internal and external demands, and requirements between the groups became clear. KOT described it as a bargaining and mobilization process in the sense that each group and various stakeholders had to argue for their ideas, give and take perspectives depending on the situation and the domain. The IT tool was an infrastructure in which this reflection took place. These reflection or process groups had the delegated (from Norne management) responsibility to articulate the future work practice of the vessel. There were a number of interfaces between the groups and they had to co-ordinate the activities themselves, develop their own self-justice, without appealing to management. In some cases they did not agree, and had to approach management, but it turned out to be a loss of face for the groups involved.

BPR urges organizations to identify processes with no proper customers and products and remove these. These processes will most likely not be value added for the company to continue to pursue. Where there such activities in Norne maintenance that could be categorized accordingly and removed? The two last propositions of BPR are however problematic, and will lead to a number of problems in the categorization of work. BPR's classification focuses on some aspects and renders other things invisible. I will come back to that in later sections in this chapter. Let us now move back to the future platform maintenance that Norne planned to implement and describe it in larger detail.

I spend time on maintenance because it is in-between making and using. Maintenance is a complicated process and I see maintenance as a natural prolongation of using. It can be seen as an adjunct or secondary use or a preparation for future use. A skilful and experienced mechanic in Statoil defined maintenance as follows when I asked him:

> Using machines means not only being able to use them but also to maintain them. The two cannot be separated. I see maintenance as a natural extension of using. It is a secondary activity where I prepare for reuse. When I maintain equipment or parts of technical systems I am not engaged in the machine's technical end-use. However, I see it as a way of extending its making, a way of protecting or retaining the machine.

The reason why Statoil invests money in maintenance is because they want to keep a controllable technical condition on their installations. There are a number of good reasons for this. It will mean safety for personnel, environment and installation. The Norwegian Petroleum Authorities and Statoil have set a number of requirements that must be met. The life cycle costs of the installation will be lower with frequent maintenance.

The operational communities of Statoil divide maintenance into preventive or corrective maintenance. Preventive maintenance is actions made in accordance with a program that will prevent malfunction or any degradation of the installation from developing. Corrective maintenance is undertaken after an incident has led to a breakdown of equipment.

Under these two overall categories there are a number of ways of categorising the sub categories as shown in Figure 5.5. Statoil installations agree to a certain extent on the categorisation, but even within Statoil and not to mention in between the oil companies there

is considerable confusion about the definitions of the sub-categories and how they are related. They still create considerable confusion in the operations engineering community. I do not intend to go into details about the overall classification of maintenance here, instead I intend to move to a more detailed level to show how the categorisation of maintenance work is in fact taking place.

I move to platform maintenance that is considered to be the most important part of the maintenance process in terms of expenditures and high impact. Platform maintenance can be separated from the other kind of corrective maintenance types based on its geographical location. It is performed on board the Norne vessel and the equipment or technology is not sent onshore via supply boat for repair at a workshop, or onshore maintenance can be a sub-process within platform maintenance since equipment can be removed, moved ashore, fixed and then reinstalled onboard the vessel.

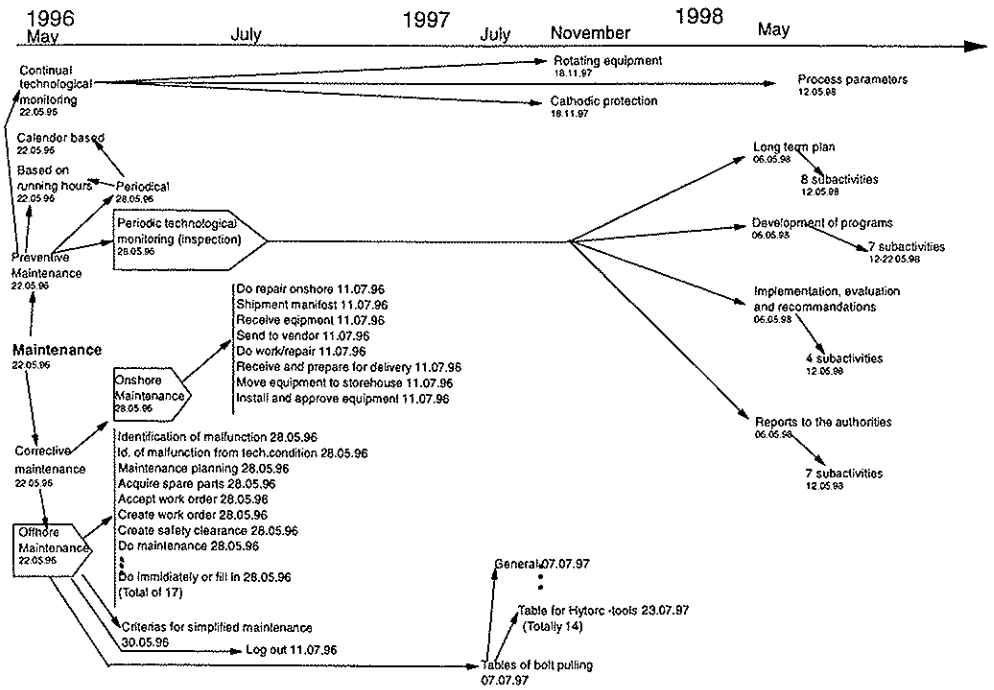

Figure 5.5: The development and categorization of maintenance in Norne from May 1996 to May 1998. Figure shows date of creation of work process, the arrow-box shows if it is a clickable flowchart or not

Maintenance will cover a number of skills and use of various equipment. For some of the equipment, special skills are needed, and specialists must be dedicated. In addition, service vendors do maintenance on specific equipment. Surface maintenance is done in the summer time because of the harsh weather conditions in other seasons. The staffing of maintenance is kept at a minimum and if a backlog accumulates, Norne hires in vendors to do the accumulated jobs. Process technicians, mechanics and automation technicians do maintenance.

A rule of thumb in Statoil support that 60 % of the maintenance should be planned. The rest should be tied up in fixed maintenance tasks and daily-unforeseen incidents. The overall platform maintenance process of Norne is described in the clickable flowchart on Figure 5.6.

The platform maintenance process is believed to start with the identification (Feil ID fra driftsoperasjon) of a malfunction or breakdown. This malfunction can be discovered during operations or it can be seen in the regular inspections of the vessel. The person that discovers the malfunction is responsible either by himself/herself or via the operations and maintenance teams to evaluate the need for a work order. At the same time, a resource and safety evaluation is to be conducted. The idea is that much of the job preparation will be done in an early stage in the process where the involved actors have a clear recollection of the incident. This part of the job preparation will specify the size of the job, what tools are needed, the need for spare parts, scaffolding, safety clearance, shutdown codes and safe job analysis. Equipment in need of maintenance is marked. In cases where work orders are not needed, the involved personnel can repair the malfunction immediately. Work tasks that cannot be done automatically because of lack of time or spare parts will be placed in a "fill in" list in the plant maintenance system and be handled in maintenance planning seen in relation to a number of criteria for simplified maintenance (Kriterier for forenklet gjennomføring).

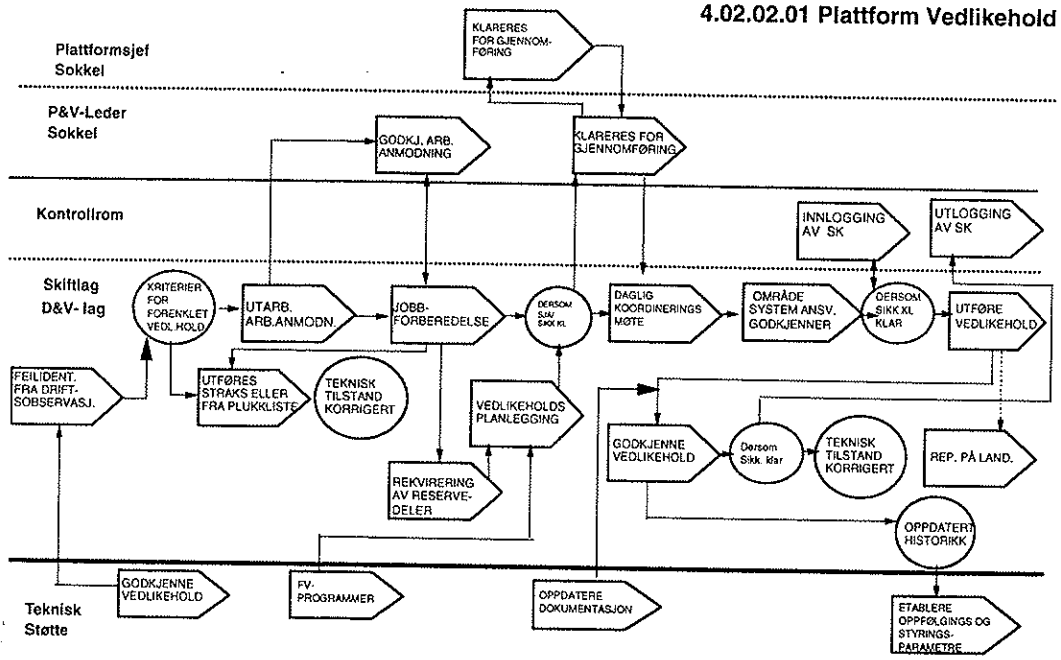

Figure 5.6: Flowchart of the Norne corrective platform maintainance in autumn 1996

A differentiation of maintenance is done by implementing 1-2-3 line maintenance. The complexity of the maintenance work, requirements for safety clearance and safe job analysis will define the actual level of the job. 1, 2 and 3 line maintenance cover all types of maintenance in Figure 5.5: preventive maintenance, corrective, inspections etc. Work-orders are not needed for first line activities. Workorders can also in some cases be left out for second level jobs if the person responsible has the necessary technical skills. The idea behind such a differentiation is that the requirements for documentation, approval and implementation of maintenance are different.

The following definitions exist for 1, 2 and 3 line maintenance. First line maintenance is jobs of low complexity with little need for specific technical skills, as a consequence it can be done by all operations and maintenance personnel on the Norne vessel. No safety requirements exist and in most cases no work orders are required. In most cases it is on non-critical equipment. Second line maintenance is of a more sophisticated character and sets requirements for the specific technical skills for people that should do the job. In most cases work orders are used, in many cases both safety clearance and safe job analysis are needed. Third line maintenance is of such a complexity that specialist skills are needed. In many cases both safety clearance and safe job analysis are compulsory. Work orders are obligatory here.

"Fill-in"(utføres straks eller fra plukkliste) jobs are in most cases 1 and 2 line maintenance and each team on the vessel is responsible for picking these jobs from the list and doing them. Anybody in Norne can create a work order (utarbeid arb.anm), but he or she must check if the same job already exists in the plant maintenance system. Based on the evaluations done on the site (already described in relation to identification of malfunction, safety and resource estimates), the work order is written. Each technical system has tag numbers. In order to locate the site, the lowest level tag number should be written down. In addition the work order contain standard information: a text field and a number of codes in order to categorize the work orders. The code PT is used if the job requires the shutdown of production, VT for shutdown in the water injection system, "fill in" jobs are coded F, jobs that must be planned P, just to mention some of the codes in the plant maintenance system. After the work order is written the person responsible for the system, i.e. a Norne mechanics or a offshore middle manager (production and maintenance manager) approves the work order.

Job preparation (jobbforberedelse) comes next, which can be done both by the shift teams or the operation and maintenance teams. They have to estimate the need for spare parts themselves and procure them if necessary, consider the potential need for safety clearances and safe job analysis. Included in this preparation is also to get hold of the necessary technical documentation (drawings, special instructions) to do the job, estimate the resources needed and make priorities among work orders.

Procurement of spare parts (rekvirering av reserve deler) might be necessary. The teams have to check if these items are not already procured or if such spare parts already exist on the vessel. A material requisition is made and linked to the same work order in the plant maintenance system. The people that create requisitions are normally those in the shift teams or operations and maintenance teams in Norne. There is a budget limit here and middle management must approve procurement above this budget threshold.

Approval of work order (godkj.arb.anmodning) is the next step. In principle everybody in Norne can approve a work order, but the person responsible for the particular technical system in the Norne work teams should principally be the person that approves the work orders on his or her own systems.

Planning of maintenance (vedlikeholdsplanlegging) is the next phase. The planning function is divided according to time range, long-term or short-term planning (one week). The operational engineering people in Harstad do the long term planning onshore. Short term planning is done in a daily planning meeting that starts at 7.00 AM, after the daily co-ordination meeting (see below). Those that take part in this daily planning meeting are the production and maintenance manager, his assistant, and a number of the people from the work

teams based on what tasks are on the agenda. The production and maintenance manager's assistant go through new work orders with given status. These are coded, meaning if they require safety clearance, safe job analysis, and what job packages they could become part of.

The end result is that some work orders are moved to the "fill in" list and others are moved to the week plan (to be executed this week). Work orders are placed on the week plan if they require planning, shutdown of equipment, safety clearance or safe job analysis. Further, if they require the shutdown of cranes, lifts, transport hatches, the helicopter deck, and a number of additional issues we need not look into here. Relevant "fill in" jobs are added to the week plan if possible, depending on the amount of urgent work. The production and maintenance assistant create the updated "fill in"-list. On every Saturday a week plan meeting is held, where the next week plan is discussed. The latter assistant updates and makes corrections, and the week plan is distributed for execution on Sunday. The platform manager, the production and maintenance manager, the production and maintenance assistant and one from each technical discipline participate in this Saturday meeting.

The production and maintenance manager must approve a number of workorders (klarering av gjennomføring PV-leder) if they require specific safety clearances and safe job analysis. Examples are hot work in classified zones, when safety systems have to be shut down, during work with chemicals, radioactive substances and explosives and finally pressure testing of tanks and pipes/tubes. Workorders related to special operations like diving, specially classified hot work and maintenance work over sea have to be approved by the platform manager, the highest ranking manager onboard the vessel.

We have already mentioned the week plan that is discussed and updated in the daily co-ordination meeting (daglig koordineringsmøte). Norne arranges a short co-ordination meeting every morning. The aim of this meeting is to inform key personnel what is happening on board the vessel the next 24 hours. The agenda is a short passage of the week plan and discussions about potential deviations from the same plan, new work tasks, other activities, weather and wind conditions that may influence the execution of maintenance tasks.

Once the plan is finished and the work is ready to be executed, work on the specific system must be approved by the person responsible for the system (område/systemansv. godkjenner). He or she is also responsible for checking out if there are other unwanted activities in the area. Safety clearances must be signed (or logged in) by a technician in the central control room (SKR) before the work can be started (innlogging av SK). SKR is notified and they keep a copy of the clearance. Hot work is marked on the B&G (fire and gas detection) matrix. SKR's function is to have the overall perspective of what is happening on the vessel. They supervise all the technical functions on the vessel, must accordingly know about and co-ordinate ongoing maintenance work and take the necessary precautions.

The maintenance work is now ready to be executed, and is done in accordance with the work order (utføre vedlikeholdet). In Norne everybody is requested to help when needed, independent of technical speciality and title, but the skilled worker in charge of the system has the responsibility and receive help when it is needed.

The approval of the executed maintenance (godkjenne gjennomført vedlikehold) is the next process. After the execution of the maintenance work the person responsible for the technical system must approve the work order, change the status to finished. The area must be cleaned up before the work order can be defined as finished. The logging out of the safety clearance

(utlogging av sikkerhetsklarering) is done by a SKR technician when the work is finished. To document the work the original safety clearance is kept for minimum a month. The hot work mark up on the B&G matrix is removed.

The actual maintenance is now finished, but in order to track maintenance costs and create input data that can be evaluated to improve the operating of the technical systems, a historic record of the incident is updated (oppdatert historikk) in the plant maintenance system by using the code AT. Norne does not keep historic records of all activities just focuses on the most critical systems. The person that did the task should also report in it the historic record. The historic record can be based on the tag number and this makes it possible to do statistical evaluations of maintenance. The work order is ended when the person responsible for the technical system gives it the code AH. The operational engineering group onshore does the actual updating of technical documentation, like updating technical drawings.

Some activities related to maintenance control, management and metrics (etablering og oppfølging av styringsparametre) end the maintenance process. Norne defines specific annual targets for maintenance. These targets are broken down to detail levels from the overall level. The maintenance process is then controlled according to achieved results and indications of non-conformance. Some critical tasks are given priority, planned, implemented and followed up. The operational engineering group onshore follows up these targets. Non-conformance results in corrective action with reported follow-ups. They also analyse the expenditure and results related to targets and try to find causal relations in order to determine corrective actions in future maintenance. Control parameters are included as the basis for this analysis. These evaluations and analyses emphasize if targets have been achieved, if there is a potential non-conformance related to established targets, budgets and programs, and address optimalization and general improvement.

5.4.3 The BPR elements in the maintenance process

The Norne maintenance process may seem bureaucratic and tedious for a person that do not know much about oil production in hazardous and high risk environments. The process institutionalizes a number of features that should reduce the possibility for accidents that end up having disastrous effects on both personnel and environment. Compared to "state of the art" maintenance in Statoil in 1996, Norne re-engineered a number of activities. These ideas had existed in Statoil before Norne. Norne picked up and borrowed a number of practices from other installations. The most prominent example was the Heidrun installation's "Safe and Efficient Operations" that had come up with the ideas and implemented some of the principles already. Let us now look at some of this re-engineering in Norne. I will divide it into three overall areas: the digitalization of documentation, the increase in individual autonomy/responsibility, the removal or re-engineering of important processes or activities.

1. The digitalization of documentation and the transformation from push to pull. I have already shown how all operational documentation offshore used to be paper based and how the industry had traditionally relied upon strict operating procedures in such hazardous environments. The DELPHI application presented in the history of KOT (Chapter 3) was the first application that made it possible for offshore personnel to retrieve mandatory documents on-line in Statoil. Even though the documentation had existed online for a while when Norne started their preparations for operations, no other installation had seen the possibility of linking up NOTES-databases as systematically as Norne did via an enterprise model navigation layer. The operation manuals of starting and shutting down the technical systems were also incorporated into the application, these had always been paper based up to then.

Other procedures related to operations that used to be in different NOTES databases became linked up, which indicated that Norne personnel saved considerable time searching for this information. The idea implemented was to describe the formal process and then link up the information needed to perform the job and let the process owner have the responsibility of updating and improving the links. The enterprise model that Norne developed decreased the amount of paper-based documentation to a minimum, the use of local paper-based guidelines was cut drastically.

The problem with version handling decreased, the latest version was always updated in the database. Missing documentation that used to be a problem in the past could also be found via the model. During government inspections and revisions, installations are asked how they document their work practice. Norne could document their espoused work practice more easily via the application. The biggest change was from push (receiving the information in your mailbox) to pull (via the development of intuitive navigation mechanisms and let the people find the information they need in the daily work themselves).

2. *The increase in individual autonomy and responsibility.* Up to 1996 Statoil-operated offshore organizations had disciplinary responsibilities. This meant that mechanics, telecom/automation, process technicians worked in separate functional silos. Norne was the first offshore organization that tore these disciplinary lines down and organized people in teams. Each team had responsibilities for given areas on the vessel and each individual or several in the team were responsible for the operations and maintenance of that domain. Even though Norne did not call their teams "autonomous", the responsibility and autonomy was much larger than had been the case in the past. The team had their own budgets and considerable influence in their daily tasks, since they were given the tasks both to plan, procure, do the work and evaluate the work afterwards.

Given the expectation that Norne personnel should help when needed indicated that the average Norne employer were multiskilled and had several occupational skills. They had to know more than his or her systems, or area responsibility. Area responsibility is divided among the different personnel according to their technical specialization. Area responsibility is defined as the overall responsibility of a given area on the vessel. The "area responsible" should have an overview of the equipment and the activities that are going on in the area. It is divided according to the decks of the vessel, and is again subdivided in three parts on each deck (aft, middle and ahead). Examples are deck 5 ahead or deck 4 aft. Technical drawings in the Norne enterprise model show the exact location of each area and system. These drawings are marked with colours to show which technical speciality should work on different systems within the area.

To have system responsibility means to have the overall responsibility for a given system. This type of responsibility is divided among the crew in the same way as area responsibility. For instance, the mechanics are responsible for the hydraulic system (system 65), or telecom/data technicians for telecommunications equipment (system 86). A person that is responsible for a given system should have an overview of the equipment that comprises the system and the activities that are going on in the area. When the number of first line, middle managers and managerial levels were reduced the work teams were given more responsibilities. Given the low staffing on board the installation, Norne people had to have a holistic view of Norne's operations and know the most important work processes.

3. The removal or re-engineering of important processes or activities. Fixing the number of employees to around 40 is an example of re-engineering[16]. Much of this was possible because of design decisions taken in the engineering and construction phases, as I have said earlier in the Norne introduction. Increasing use of periodic technical monitoring led to a reduction of work orders both in size and numbers. The team based organization contributed substantially to this re-engineering. Let us move back to the maintenance process for a few examples.

The traditional way of describing maintenance in the oil industry is to write a procedure that regulates activities, and many of these activities must be based on strict procedures because accidents can have disastrous effects on people onboard the installation and on the environment. In the old days a production technician wrote a request for a work order. Before a workorder was written it had to be checked if the malfunction was real. It was then often necessary to find the person who had written the request to describe the malfunction one more time because of a poor description of the problem. This person might had left the installation by then and a new shift had arrived, consequently a new diagnosis had to be undertaken. In other cases several requests were made for the same malfunction, or job preparation had to be done one more time in cases were a safe job analysis had to be conducted. The latter safety clearance could also have been filled out insufficiently so additional rounds had to be conducted.

When a proper workorder was cleared each technical discipline could do their part of the maintenance work when it fitted their time schedules. Critical and safety related workorders would always be prioritized. If the staff could provide the right diagnosis right away and do a larger part of the job preparation when the malfunction was identified this would create a less tedious work process. It would also empower the staff, giving them more responsibility and larger space for taking their own decisions and enhanced control of their working hours. In Figure 5.6 I have described the different roles in the Norne organization that take part in the maintenance process, from the different levels offshore to technical support onshore. The flowcharting method showed that the more the arrows and the sub-processes passed over the lines, the more bureaucratic and co-ordination intensive the process became.

In order to avoid bureaucracy in the maintenance process, Norne decided that the shift teams and operations and maintenance teams should do most of the maintenance, with minimum interference from others. In the maintenance process, to write, wait and approve work orders requires considerable time as I have reported. This has to do with the health hazard, since control of what kinds of work is conducted at different locations on the installation is vital. However, Norne has taken measures to reduce their maintenance work orders by 75 %[17], by differentiating between different kinds of work orders. Much of the maintenance work was rather simple (with no potential hazard) and could be done by the teams without workorders.

To be able to do so they had to design teams based on system responsibilities that could self-organize, instead of having a traditional disciplinary responsibility. Specific technicians are given the responsibility to both operate and maintain their defined technical systems and within that area they have large autonomy. The remaining 25 % of work orders that is hazardous or requires more skilled expertise must follow an approval process and involve the control room on the installation and platform management. The amount of work that had to pass offshore middle managers and the platform manager in the maintenance process decreased substantially. Norne also took steps to cut down on unnecessary administrative work. They cut down the record keeping and analysis on non-critical equipment, believing that it did not pay off.

5.4.4 What do BPR and work process modelling render invisible?

BPR and work process modelling are activities that define categories (as all methods) for constructing a social reality. Let us now take a closer look at what this kind of categorization rendered invisible in Norne. In Norwegian work research, work mapping and representations of work practice have been used in different forms since the late 1960s. With the growth of BPR and enterprise modelling, work mapping became hype again. There are however considerable differences in the way work mapping is conducted. I have to define ideal types to make KOT's position more evident.

Within the paradigm of enterprise modelling in information science (Rumbaugh 1993), the focus on ontology is considerable. An ontology in enterprise modelling tries to define elements of a generic enterprise: reuse of enterprise models, translation of semantics between various lexicons, elimination of redundancies and resolving unnecessary or missing content. (Uschold & Gruninge 1996). They assume general validity and relevance of their concepts, in line with what I described as the construction perspective, or hard systems thinking. The language for developing models is the most important, but the degree of formality and the notations used for modelling are often accessible only to specialists.

The language in the model is not suitable for organizational sensemaking since it is not understandable to none experts and restricts access to the modelling process. In Norne simplified flowcharts were developed to give everybody access to the modelling process, enabling the employees to use their own professional language to a larger degree. In Norne models were not defined with precise and unambiguous definitions. They were seen in relation to sense making, reflection, interpretation and discussion in order to reach a common understanding. Model creation and model interpretation were a matter of involving actors with their local knowledge.

The Norne case used simple models with few elements and few language concepts that were more or less intuitively understood by the actors. KOT believed the simpler the model the less model power[18] and advantages were given to managers, experts and professionals. The assertion of the work in Norne that KOT made was that traditional hard systems enterprise modelling creates model power while their perspective did not. This was a lesson KOT had from their own experimentation with object oriented modelling tools in 1994.

The following notion was prevailing. When the employees themselves create or restructure the workplace, as in Norne, they need a simple method. In the world of engineers and technicians flowcharts are a well-known technique to describe "system" phenomena and dependencies. Over the years this has been a fruitful method to understand the composition and decomposition of technical systems[19]. The flowchart with its weaknesses enables them to talk about organizational problems, roles, responsibilities, apparently irrational phenomena, relations between phenomena, and discuss what measures can be taken to improve the situation. This use of "black boxes" is therefore useful. It is not necessary to know the exact content of a black box to have a pragmatic discussion of relations of "black boxes" at a more aggregated level. Even though people interpret the "black boxes" differently, this is less of a problem when people come from a relatively joint Statoil culture and have been working in the same environment for years. Neither modelling syntax nor semantics were formally defined in large detail. This fact did not have a large effect on the meaning associated with the models, since models were designed for human interpretation.

The flowcharting and the digital enterprise model could only poorly handle issues that anthropologists refer to as cultural issues. How could KOT help Norne develop the necessary qualities that a high-risk organization like Norne needed? The qualities of an organization like Norne are dependent on a number of issues. Much of this could be described in the enterprise model, but to follow up the espoused descriptions was something else.

The goals of the organization were written down and visualized, the qualities of the espoused routines: quality assurance, maintenance, experience transfer and others might be evaluated also. However, the sharing of responsibilities between work teams, the ability to take important decisions under pressure in crisis situations on the installation, the management in daily operations and the development of a safety culture was something that Norne had to take seriously if they were to succeed. The quality of the personnel resources would also be of major importance. If major deficiencies in these factors occurred in a high-risk organization like Norne, a degraded organization might develop, and the risks for major accidents would increase.

KOT saw that understanding the work context became of decisive importance. This understanding dealt with aspects complementary to the BPR perspective. The problem was that since the Norne organization was in the midst of preparations for operations it was very difficult to do a traditional workplace study and study Norne people in their real setting in operations. However, as I already have reported in relation to the history of the group in Chapter three, KOT had conducted several shorter fieldwork studies before on older oil installations, and had a rather clear picture of the "flow of work". The fieldwork that was conducted in the Norne organization one or two days every week from February to December 1996 *could only indicate how Norne functioned in its present preparations for operations.*

The discussion on the future operational organization of Norne was done via work mapping and by using flowchart symbols. It was a poor medium to describe life in its rich detail but it was a simple way of representing organizational issues that the people in the Norne organization both understood and found constructive. In addition, KOT took a number of precautions. Before the project started some overall requirements were made together with Norne management and operators/technicians, see Section 5.2.1. The project agreed to stick to these value-statements and address these issues continually throughout the process if and when they were broken. The aim was to make aggregated descriptions or requirements, and the flowcharts were looked upon as resources for future situated action in operations, a general reference for orientation purposes and self-organization. In order to open the "black boxes", KOT stressed other aspects through their participation as facilitators in the process description workshops, via informal discussions with groups and members during the fieldwork days in the Norne organization.

KOT employed a method they called "coaching" to open the black boxes of the flowcharting method. In Norne this methodology consisted of two situations. Both can be described as a dialogue between a KOT member and a Norne member and evolve around the situation where the user is trained in using the IT application. The first situation tries to develop trust between the two persons (or three if we include the application).

I present who I am and what I am doing in Norne: "I come from Statoil R&D and I am here to help you with developing new use of IT in operations. This means that I am interested in discussing with you how this can be undertaken". The Norne employee presents his or her own background and describes his or her work in operations in Norne: "I come from Statfjord

where I have worked as a process technician for the last six years. In planning for operations my assignment is related to follow up SKR room activities and to get the central control room systems up and running". Based upon this presentation of the person, I ask: "What are the information resources you use in your daily work and what did you miss at your past Statoil installation, I am asking this to have some input to the work process application we are helping you to develop?

This leads to a discussion on these issues. I then go through the functionality of the application, show how to create a NOTES-document, draw flowcharts, and make experience comments. The Norne user is encouraged to try it out and I assist. In between the presentation of the application I also go through the work processes that come along with the use of the application: "When you write an experience comment, the comment will be handled by a given process owner and his group, and you can track the actual status of your comment in this view. You can be anonymous if you want". The first situation ends with a short conversation regarding the applicability of the IT system seen from the Norne employee's point of view. "Is this application useful for you, in what ways, why not, and what can be done to improve it? What work processes must be in place for Norne to take out the effects on new use of IT? From your situation, how can Norne use IT to further improve its operations?"

Situation 2 is taken one or two months later when the person has had some experience with using the application. One objective is now to find out how the Norne user has used the application. This situation also evolves around a conversation: what has been good, what special problems have you experienced in use and what functionality is missing? KOT is given additional comments to improve the functionality of the application but is also given hints on the use of the IT application in the Norne organization. Let me give one example of use of the application experienced during coaching. The application has two views, one by navigation and another by numbers or decomposable document structures (see Figure 5.7).

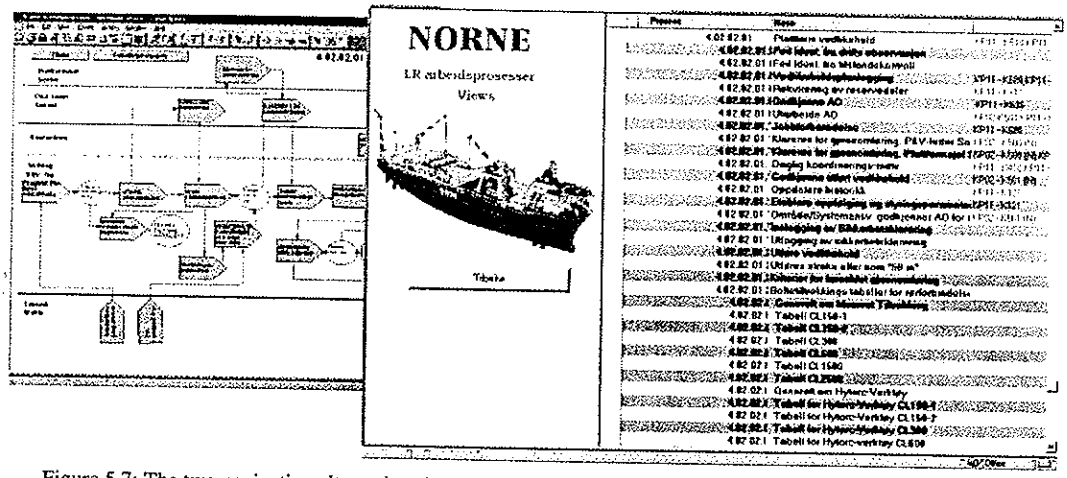

Figure 5.7: The two navigation alternatives in the Norne application: by flowchart or by collapsible hierarchically numbered NOTES documents (1, 1.1, 2, 2.1,2.2, etc)

In general, everybody used the navigation view in the beginning. However, most people found it increasingly boring to use. When they wanted to go to work processes they knew and which they were working with they increasingly used the decomposable (that are both collapsible and expandable) document structure. When a mechanic wants to go into the

operations process and a specific sub-process, like his/her daily maintenance routines, he/she goes directly to the NOTES document without using the clickable work charts.

The users reported traits of a steadily increasing internalization of the model. When users are able to go directly to the sub-processes, they must have acquired some kind of a mental picture of the navigation structure, or Norne's ideal way of operations. However, when he or she needs to know more about the budgeting sub process, they use the navigation structure. The second situation ends as the first, leaving the Norne user with some questions he or she can work with: How can the application be used in operations and not only in planning for operations? What additional functionality do you need?

I attended a number of gatherings when the groups had their status meetings. In this example the maintenance group attended, together with Tommy the process owner, a total of five people. In this situation they had the clickable maintenance process up and running on the PC, and the application transferred via a projector on the wall in the meeting room.

Tommy went through the latest details that some of his team had written into the database yesterday. After a short brainstorming session, he added comments digitally as the different members spoke up. When most of the comments had been taken care of, I spoke up to draw the groups attention: "Go back to the platform maintenance overview chart *(readers can see this as Figure 5.6 or the left picture in Figure 5.7)*. Take a look at the "create work order" sub-process. I know from past fieldwork I have conducted that the "bureaucracy" with work orders take considerable time. You have said that Norne will try to reduce the number of work orders with 75 %, how do you plan to do this when you are in operation, since both you and me know that it is easy to fall back on old practice?"

Tommy the process owner answers: "You have seen our criteria to differentiate between work orders, they are fairly clear". He navigates in the application and clicks on the criteria for simplified maintenance "However, I do agree that we have to do something more than just define these criteria, these things will not happen by themselves". I then ask: "How do you plan to do this?" Tommy answers: "Good question! We have already taken measures to present this way of thinking during our presentation to new recruited Norne people. Another idea is to live by and learn from using these principles during our commissioning phase. I think this is the only way we can make Norne personnel understand what this really is about". Tommy then addressed his four colleagues: "I want you to help me plan how we can take steps to live by these principles before we come into operations".

Let me continue with a passage that shows how tacit knowledge in the maintenance process was handled, something that would never be possible to make explicit in Norne's enterprise model. KOT knew there were a number of examples in Statoil where computer systems had not taken tacit knowledge and the social character of work into consideration. The result was computer systems poorly aligned with work practice. How should such representations be handled in the enterprise model?

I have asked skilled offshore mechanics many times how they diagnose malfunctions or breakdown on their equipment, but am always given a number of answers, often in a narrative form as stories. They all refer to it as a diagnostic manoeuvre, where they do not eliminate one possible malfunction at a time. It is often done together with colleagues and has a hermeneutic character. The mechanics move in repeating cycles from the small pieces of, for instance, some malfunctioning equipment, to larger technical components, technical systems and back again, in a cycle that is repeated. In this hermeneutic circle, the diagnosis is brought

forward and they are able to come up with a likely interpretation of the malfunction (the word hermeneutic is mine of course, and not Norne's). I will return to diagnosis in relation to technology, pragmatism and hermeneutics in Chapter six.

Both Norne management and personnel found it unnecessary to try and capture such processes in the enterprise model, believing that only "self-evident" issues would be covered in such descriptions and not the situated diagnosis in itself. Rather early in the project the participants were talking about the granularity of the work processes. Management and the process owners feared that the processes would become too detailed. The value-statements in Section 5.2.1 became valuable here, because Norne wanted to remove as many of the detailed procedures as possible and instead set requirements to people, to let the personnel do their own thinking (what in work research is called a minimum critical specification). In one meeting we discussed if the maintenance process had the proper granularity in relation to the principles we had agreed upon.

I used the first activity of the maintenance process as an example: 'Identification of a malfunction' and asked: "Do you have the necessary information you need here?" The answer I received from one of the mechanics was evident: "We cannot describe how a person in the team finds a malfunction, it will be very much dependent on the situation and what type of equipment it is. I sense a malfunction, either by sound or intuition but cannot describe the diagnosis that I do. We have discussed checklists, but they didn't make any sense here. Instead we put in the checklists on the job description of each Norne offshore employee into the application". He took over the mouse and clicked down to the operations process, opened the sub-process of operational routines. From there he opened up the operational routines of the mechanics in Norne, and a matrix with three major columns appeared.

The first column showed the activities, or the systems to be taken care of. A second column showed on what days the work should be conducted, and the third column stated with a few lines what should be done. He said rather proud: "Take a look, we have a number of tasks related to first line maintenance, like checking tanks, pumps, and valves. The only thing we need to know regarding tanks is written here (he marks the text with the mouse): check level, draw the nuts and do a visual control. I intruded and asked: "I see you have written 'do visual control', do you have any requirements for that?" He nods and opens up another NOTES document: "These requirements are covered by inspection routines. Inspection is done to monitor the technical condition of the installation, with varying requirements for accuracy and contribution ratio".

When he goes through the content it is evident that he knows it by heart, but he looks at the screen now and then only to make sure he gets it right: " Inspection is divided according to accuracy or inspection type. Inspection type one is a general visual inspection that can find apparent malfunctions, like a mechanical damage, corrosion, leaks, debris and lack of coating (paint). These might be serious malfunctions that may depreciate the integrity of the construction. Type one gives indications for deciding if type two or type three is necessary. Inspection type two is close visual inspection that addresses malfunctions or things found by using type one. It can employ a steel brush, a knife, magnifiers, mirrors or fibroscope. Type three is a non-destructive control type, where different kinds of control equipment are used, i.e. to find weak welded joints and internal corrosion. Type three often demand their own procedures and special competence by the personnel doing the maintenance".

He then went back to the operational routines of mechanics in Norne and the matrix he was presenting when I interrupted him. "We also have to control system 62 (a diesel system) and some other systems. On system 62 we check the storage of diesel every Tuesday, drain water from the tanks every Monday, check the oil level on separators X7100A/B with visual control every day. That is all we need to know, how each mechanics diagnose a malfunction he or she finds we need not describe in detail. It would seem silly and I would never be able to do it either. You have to rely on that we know our jobs".

I reply: "OK, what about own control how do you plan to integrate it in your tasks? You haven't mentioned it at all during sessions I have participated together with you". He answered: "Own control is important, I have caught myself several times not being attentive when doing my work. We have discussed own control in the groups. It has also been up in the introductory training courses that every new Norne personnel have to go through. Own control is, at the end of the day your own responsibility, its about attitudes, if you walk around like a zombie you can get killed out there. However, management also has a responsibility here, can they do something to increase the attention around "own control"?

In similar situations the dialogue that developed by discussing the content of the boxes, enabled Norne personnel like the maintenance team and other to discuss roles and responsibilities. In essence, it helped the groups to reflect upon their culture and what should be Norne's "rules of the game" but not to describe in detail how the work should be done.

The basic problem was as already stated that the *granularity of the method was too poor to describe the rich details of social life, and renders certain aspects invisible.* In order to describe what it renders invisible we first have to look at the weaknesses of BPR. I describe these weaknesses with ethnographic examples from the fieldwork in the Norne organization.

Let me first present what happened when Norne personnel met BPR consultants. Norne was at the time in 1996 perceived by Statoil management to have the best ideas about a future operational practice in Statoil and could act as inspirational input to future operational practice. In the spring of 1996 Statoil was discussing implementing a new company wide administrative IT platform, the German software house SAP that steadily increased their dominance in the oil business was the most likely candidate. A preliminary project for the evaluation of a future administrative platform was set up in the spring of 1996. In this project Norne became the operational pilot for upstream activities in Statoil. The consequence of this was that a number of BPR consultants arranged several meetings with Norne personnel to map the new installation's key operational processes.

The work processes taken from Norne would be extrapolated to cover a future operational practice for Statoil upstream activities, and by aligning the work processes with accounting figures, the preliminary project had the aim to develop some overall financial figures for the costs and consequences of implementing SAP in Statoil. In a meeting in May, the consultants had assembled a number of key Norne work process people (mostly process owners) in a large meeting room in Stavanger.

The consultants' idea was to let Norne define their most important work processes. Further, the consultants wanted Norne to categorize the most important processes according to added value. This was undertaken to develop a better understanding of where the consultants should put their efforts in the mapping of the work processes. High impact processes were important to take first because they would be most vital in the discussion of a potential SAP

implementation. When the meeting started, to define and agree that operations were a key process was not difficult. Neither was it difficult to agree that maintenance was a support process to operations. The discrepancy between the Norne personnel and the consultants started to appear when more problematic value laden and borderline distinctions had to be constructed.

The consultant facilitator had put each process on Post IT stickers after their categorization had been settled. The consultant said: "Can't we put health, environment and safety as a support process to operations?" The Norne process owners looked at each other, and the most critical said: "Have you ever been in the North Sea and seen how an oil installation is operated?" The consultant said "no" to this. The process owner continued: "What do you think happens when health, environment and safety (HES) is in jeopardy in operations? We take strong precautions and if necessary close down the installation. Nothing is more important that HES in Statoil. I am not certain that HES is a value adding process in your scheme, but nothing is more important".

The consultant took the point and went to another work process, one that he perceived as simpler to categorize: "Cookery and accommodation on the vessel must be categorized as a support process, wouldn't it?" Again Norne personnel protested strongly. (I intrude here; there were several reasons for this. Good and nutritious food is important when you work 12 hours shifts often with hard manual labour. On a total institution like an oil installation, life is very much eating and working. Many social institutions evolve around breakfast, lunch, dinner, supper and coffee breaks. To have plenty of good food and to eat meals are important institutions onboard and cannot easily be separated from work situations offshore). One Norne process owner continued in the controversy that developed: "If you cut out the food people cannot work any longer! It might be that you don't see accommodation and cookery as important processes. We are talking about a group of 40 people on board Norne that rely on accommodation and cookery, the nearest restaurant or grocery store is a long helicopter ride away". In the land-based organizations and businesses the consultants had spent their time, this fact was an issue that had never crossed their minds.

What baffled the BPR consultants in this situation was that the Norne process owners knew BPR methodology to such an extent, that they could provide alternative interpretations of the consultants' propositions. They were able to contest the consultants' categorizations of Norne's operational thinking, and not buy whatever the consultants said. The actual model power of the consultants became smaller. In another workshop with the same BPR consultants, a clever process owner asked: "What is the difference between a function and a process?" This question has caused considerable discussion in the BPR community, one answer that the consultants gave was that functions are vertical and processes are horizontal and crosses functions. The Norne process owner then asked: "Is maintenance then a process or a function?" In Norne it could be both things depending on what perspective you took and the consultants could not give a good answer. Another issue was raised concerning the consultants customer-supplier thinking, a comment made by a SKR technician:

"In Norne we have a team based organization, and I have problems defining the customer-supplier relation in the work that we plan to do, we strive towards a close collaborative relationship, customer-supplier thinking draws my attention to contractual relationships".

Let us take a closer look at other potential weaknesses Norne had to handle and where BPR consultants could provide few answers. These were considered problematic to grasp with the

restricted method of flowcharting, mostly because of its basic root metaphor: the machine, and flowcharting's poor ability to handle the social and cultural aspects of work.

I go back to maintenance to give specific examples of what I mean by the safety culture Norne had to develop. To grasp what a safety culture would mean I had to study reports on accidents or "close calls" from both Statoil and other high-risk industries and take this information back to the facilitation within the work process teams. Such past examples related to maintenance were not hard to find, and these reports gave a number of descriptions of what had happened during such situations and possible cultural traits that were in place. Embedded in high-risk industries with an unsafe maintenance culture are traits or actions that goes as follows. The technical systems and components are run over long periods of time with known weaknesses. Further, technical systems and components are run outside or over their specified operational and constructed requirements.

The two latter phenomena are in most cases related to the work practices of the people on board an installation and comprise a shared and collective weakness. This weakness is often related to a choice of values; profit vs. safety, i.e. that production is more important than safety. As a consequence, collective decisions are taken that are in conflict with given safety instructions. These phenomena boil down to the fact that the personnel accept that known weaknesses exists on the installation, and that the proper balance between production, economy and safety has not been properly discussed. An unsafe maintenance culture can also be found in weaknesses in maintenance programs and insufficient maintenance in itself. A situation like this might lead to malfunction in additional components, because they are worn out ahead of their time or that the same components are unavailable when they are needed. Such phenomena can develop because of a lack of understanding of the technical construction and the technical sophistication of the installation.

Let me present an example from KOT's experience transfer days in the early 1990s that I know in detail. This example shows why an understanding of technical complexity is necessary. I do not have similar empirical data from Norne to make these points. In this example I am referring to a case of poor technological design. It shows how problematic maintenance can be and how integrated and complex the technical systems can be. As an example it is *not* representative of Norne's technical systems, but it illustrates what severe limitations a technical system can have on human work. It shows examples of inscriptions and translations that are so inflexible that they cannot be ignored. This gives more ethnographic details on how maintenance is done, or was done in the early 1990s.

The examples I present are from some of Statoil's older installations, and it deals with system 56, the open drain system. System 56 is now modified on older Statoil installations, so the situation that is described here is no longer representative. This system drains the deck on the installation during normal operations and in cases of emergency. Such drain is led to two separate systems; where one system covers explosive areas on the installation (i.e. the drilling area), while the other cover the non-explosive areas of the installation.

The drain from both systems falls naturally to an oil-bearing tank. This tank (identified as 56-TB02) for oil-bearing water is an atmospherical tank with a rectangular shape. It has an overflow vat that separates it in two parts, one part with a drain trap and another part with a pump. These pumps (named 56-PH01A/B) for oil-bearing water are centrifugal pumps and are submerged in the tank. Drain from explosive and non-explosive areas is led into the drain tap to prevent gas penetrating back via the system.

Figure 5.8: Above: setting the open-drain pump in a vertical position. Underneath: transport of the open-drain pump. Photos by KOT

The pumps start and stop depending on the level in the tank. Oil-bearing water is pumped to separator 44-VA01A/B for produced water, or 44-CV03A for ballast water. One alternative is to pump oil-bearing water to an oil mud cell. If the input to the tank is larger than the capacity of the pump, or if the pumps break down, oil-bearing water will be led via an overflow tube to a collecting pipe for seawater return.

These pumps are not critical for operations, because this tank can be bypassed, even though this is not desirable because of contamination of the mud cell. When it comes to safety, the open drain system can represent a potential danger for the spread of hydrocarbons or other inflammable or toxic liquids via the drainage network on the installation. The latter is avoided by frequent use of separate systems for different areas of the installation and extensive use of drain traps. The open drain tank will once in a while contain hydrocarbons or other inflammable or toxic liquids. The tank is regularly flushed with fuel gas that is led to the flare system (and from there burnt in the open air). A potential leak from the open drain system might cause fire or explosions.

Mechanics that maintain the system say that there is a continuing accumulation of matter (like mud, cement, sand and plastic) in the open drain tank, and as a consequence, the pumps in the tank have a very poor regularity. Every time they break down the inflow of the tank must be altered. Water from the non-explosive areas goes directly to the seawater return, and oil-bearing water goes to the mud cell. Apparently this is a good solution, but if we take a long-term perspective this looks different. All sediments that have been accumulated in the open drain tank go through the mud cell. Filters that have been installed on the line become sealed; consequently, the whole line becomes filled with mud. Cleaning and repair is time consuming and costly.

The long-term consequence is also that the mud cell is filled with matter because of the poor regularity of the pumps. To remove mud from the mud cell, two mud pumps are used. According to the mechanics these have never worked satisfactorily. The instrument that shows the level of mud on the mud cell has been inadequate so it is difficult to see the exact level of mud and water. During pump out it is difficult to register any changes in the level of the mud cell. When personnel suspect the mud cell is full they change so they are able to take suction from the mud cell with a loading pump (together with two other crude oil cells to have enough quantity to the loading pump) and pump via the crude oil metering station either to a shuttle tanker or back to an ordinary crude oil storage cell. To use a loading pump to take away the mud is not optimal either, because the suction filter box and the re-circulation valve on the loading pump are blocked by the mud.

If we look at the maintenance of the pumps, they indeed represent some challenges to the safety culture described a few pages earlier. Typical tasks here are related to dismounting, overhauling of the pumps and replacing parts like shafts, bearings and seals. Just to show how this is done I describe a maintenance task related to this tank. In addition, there is also a lot of work that must be done before the actual maintenance can be performed, as I have already described in the previous section related to maintenance planning and execution.

The drain pumps are placed vertically on top of the tank. To start the maintenance job scaffolding must be set up on the same level as the open drain tank. The engine is released from the pump, it is lifted with the help of a tackle that is temporarily attached to a clamp in a rafter and set aside. The pump which is placed in the end of the shaft and riser is around 4.5 metres long and have to be lifted vertically using two tackles (see picture 5.8) These tackles are attached to clamps that are temporally attached to two rafters (at a distance of two metres). When the pump is free of the tank it must be taken with a new tackle and clamp, attached in a similar way, and then be straightened up vertically. Because of cable gates and piping, the pump must be moved towards the end of the open drain tank. This is done by replacing the clamps and tackles a number of times. At the end of the tank the pump is lowered with very little clearance in between new pipes and cable gates down to the deck. From here the pump is moved over to a trolley (Figure 5.8) and taken to a special area on the installation C07 where it is cleaned with chemicals and steam. After the cleaning, it is taken to the mechanical workshop where it is dismounted and malfunctioning parts are replaced. When the work has been done the pump is taken back the same way using the same procedure.

If we look at the situation for the personnel that had to do this kind of work, the access to the pump is problematic. To take the pump out of the tank, they have to work on top of the tank on scaffolds. In order to put the clamps in the rafter, the mechanics have to climb the piping and stretch out, to reach and fasten the clamp in the rafter. To do the work in this phase, three men are needed. During the work with hauling the pump ahead, cable gates have to be used as work platforms. The tools, the clamps and the tackles for taking the pump up/down are not fixed. Access for using the tools is difficult. Clamps and tackles have to be placed in rafters because lifting ears are nonexisting in the area. The tackles are operated under difficult circumstances (see Figures in 5.8).

Access for spare parts is out of the question because a dismounting of the pump at its location is impossible due to lack of space. The tools, three sets of clamps and one tonne tackles must be transported from and to the mechanical workshop and the drain pumps. The weight of all this is around 100 kg. It has to be carried on the mechanics backs, except in good weather when the outside lift can be used for part of the distance. A transport trolley must be picked

up from the cellar deck. The transport of the pump from the top of the drain water tank and down to the deck is done via hauling and with the use of clamps and tackles. The position must be changed a number of times to get pass piping and cable gates. Transport is then continued with a trolley, via reloading in area C07, to C06 where it is cleaned. It is then taken back on the trolley, lifted up with crane to area M21 and down a hatch to the mechanical workshop.

In bad weather the crane cannot be operated, which means that the pump must be dismounted in C06 and carried up in pieces. If we look at the physical work environment of the workers, the lightning is around 60-70 lux, the noise around 83-88 dB. The situation will be very dependent on the weather, and be very windy and cold in the winter. Workers are exposed to filth, oil and different chemicals when cleaning and lifting the pump, i.e. H_2S in the oil-bearing water from the drain tank. They experience strain in muscles and skeleton structure when using tackles and due to lifting and carrying things in the stairs. At some places the stairs are narrow, which makes the strain even harder and creates a potential for injuries. Personal safety is also problematic, there is a permanent scaffolding in the area, but it has open zones where people might fall down. In addition, mechanics have to use piping and cable gates as work places with a considerable risk for falling down. There is no protection against stumbling, which can happen when you carry tackles and clamps over your shoulders and tools in your other hand in stairs and ladders.

This example shows technical conditions of the design of the technical system, can put severe strain on those that do maintenance. Technical conditions and design are not visible in the flowcharts. It did take time to modify the system. On technical drawings and in technical documentation, system 56 seemed fine. If you tracked the plant maintenance system for historic data on system 56, the problem with contamination and the mud in the tank was lost. All the problematic experience of the maintenance personnel was rendered invisible. The text field in the workorders was poorly used by the mechanics for giving feedback. They had problems articulating themselves, new jobs were waiting and their advice was seldom listened to. The embedded categorization of the plant maintenance system had the following consequences: that all man-hours reported in the maintenance of system 56 had been connected to a general category. The mud problem was known among the mechanics but became invisible in the plant maintenance system. Engineers onshore had several attempts to modify the drain tank pump because of highly accumulated maintenance costs on the pump. They had little if no information at all about the totality of the situation.

With this example in mind let us move back to the challenges of Norne in building a safety culture. Another aspect is closely related to a safety culture. It is related to the organization of work, or the methods and routines often hidden behind the espoused planning and organization of organizational tasks, mainly because staff might lack necessary education and skills. In high risk industries like the offshore oil industry accidents often occur when unskilled personnel do things without proper instructions or if the central control room (SKR) is staffed by inexperienced personnel. Examples abound in the past where no safe job analysis has been undertaken or that non-routine work is done without proper procedures or workorders. In many cases vital aspects of the job have not been defined before the job started. Lack of planning and ignoring the necessary preparations often occur before accidents. Missing operational verification or control is also a problem. Valves might be in the wrong position for operations, doors might be open, tested equipment does not work according to specifications and their last check/verification.

The actual work practice of the personnel is very related to a safety culture and the organization of work. Work practice in this case are the methods and routines that people use to do the work and include planning the task, methods to prevent maintenance from occurring, be attentive to details and to use the right documentation and tools. The biggest problem here is often referred to as lack of own control or "egenkontroll" in Norwegian. "Egenkontroll" refers to an internal conversation each person should have when doing maintenance or work in operations. The steps of own control require a person to stop for a while, think through what he or she is about to do and then act.

After action has been carried out reflect on what happened and then communicate and discuss the whole activity together with colleagues. One problem is that potential risks are not discussed before the work is started. An important part of this planning, acting and reflecting should be done by the individual because it is an important source for learning and improvement. Such a conversation should also be taken within a team that does the maintenance in Norne. Stop, think through, act, reflect and communicate is important here.

In the maintenance process of the drain pump there are a number of things that might go wrong if own control is not taken seriously. However, many examples show that people only act. Personnel are mentally absent and are not concentrated when performing tasks. Alarm signals that pop up can be signed out from the log before the incident has been checked. Work can be done without good visual control. Personnel assume things without communicating with others that are involved. They might also use the wrong tools or damage the equipment by using too much rough pressure. Protective equipment like glasses, mouth cover and glows are not used. Work can be done in non-ergonomic ways, because of problematic accessibility or placing of equipment, where system 56 is a key example.

Oral communication influences the result of most activities in high-risk industries where several people are involved. Formal communication is of specific importance in cases where the safety of personnel or installations is concerned. The key example here is that important decisions between the SKR and those that do the job have not been communicated or understood. If we study the historic records of accidents surprisingly many of these indicate that personnel plan problematic maintenance work sufficiently and such work is mostly conducted without injuries or trouble. Many accidents or close accidents occur during everyday routine work. People have their attention elsewhere and suffer from lack of self-control, a lack of co-ordination between body and mind.

Most of these factors deal with attitudes and values that must be kept alive in daily operations. This has not always been evident in the Norwegian oil industry. Bear in mind the words of the skilled foreman in the internal newspaper text in the Chapter three: "people hang their heads off and put on their helmets". It was not only him that argued that the Norwegian offshore industry of the 1970s and early 1980s under the influence of American oil expertise developed hierarchical offshore organizations in the North Sea, where offshore workers should follow orders and not think themselves. Production was more important than safety. When Statoil started their operations in the mid 1980s this was changing, but it took many years for this situation to disappear altogether, with reference to my system 56 example.

Many experienced merchant marine "chiefs", like Hans, started to work in the offshore industry, but their employers urged them to follow strict bureaucratic procedures. The spirit of these days were "forget what you have learnt as a sailor, we work according to more sophisticated principles here". The problem was of course that the baby was thrown out with

the bathing water. Not only had the Norwegian shipping companies lean organizations on their vessels, they also operated and maintained in accordance with less bureaucratic principles. In the 80s much of this merchant marine shipping thinking disappeared from the oil industry, many of the formerly clever engine chiefs showed signs of deskilling. What was lost was this personal or close relation the personnel that work with maintenance traditionally had towards their engines and equipment.

The role model of the "chief" in the merchant navy was a handyman, not only a person that knew the actual functioning of the machines. He was multiskilled and could do a number of tasks related to the operations and maintenance in the engine room. The skilled chief knew every small part of the engine room, and had a holistic perspective of the functioning of the vessel's engines. They (were all men in those days) cared for their engines, cuddled with them and watched after them like their own children. He could wander around and sense the state of the machines, hear sounds that others did not discover and have an intuition that something was wrong. It was a symbiosis of man and machine.

Norne was a ship and Norne management, in the light of NORSOK, managed to introduce new thinking related to how to operate an oil installation. On the British sector there existed examples of production facilities that had an organization more similar to the ones onboard ships. In the rationalization efforts in Statoil of the mid 1990s it was widely discussed within Statoil that something could be learnt from shipping. The Norwegian merchant marine had only a fraction of the manning compared to an oil installation. Moving a ship from A to B was of course something different than oil production but it was perceived that shipping had something to contribute when it came to operational routines and maintenance. Norne recruited people with merchant marine backgrounds from old Statoil installations, believing that they could evoke some of this past expertise and implement group based collaboration that ships have. They also recruited external personnel that had worked in shipping and oil production in the English sector of the North Sea.

5.5 The main concepts of the Collaborative Workspace project in December 1996

The Norne NOTES application developed in the Collaborative Workspace project in 1996 was conceived by Norne as a structural navigation device, a super structure or an information and communication backbone that Norne people could use in their daily work for orienting themselves in relation to a number of another computer systems and NOTES databases. It provided an infrastructure or a workspace for the reflection process in planning for operations. Norne personnel saw the application as a structured way of representing work processes, representations or resources made available that up to now had been hidden in paper based strategies and procedures.

The structural description of a value chain and subsequent work processes were vital to understand what was developed. The fundament in BPR related to added value processes, products and customers was also an important part, even though the word BPR was hardly mentioned in discussions with Norne personnel. All this added up to what Norne called an operative enterprise model: a model of what Norne wanted to accomplish and of how to function when in operations. It contained basic elements and necessary decomposition of activities, roles and specified information requirements to activities. It visualized what a new organization could look like, and helped developing shared representations of such a new organization. This enterprise model was perceived as a navigation layer, or a clickable

navigation interface with access to a number of information resources. It tried to portray the essence of the business. The navigation structure called process maps, flowcharts or clickable graphics represented images that became familiar for Norne personnel and made it possible for them to intuitively navigate in a jungle of information resources.

The process towards Norne will be thoroughly discussed in the next section. All three aspects of the project strategy that KOT had defined in 1995 had worked: closeness to the customer organization in Norne, organization in core teams (Norne, KOT, Statoil Data), and evolutionary prototyping of the application. Compared to the visions of the IT product in the Collaborative Workspace project in the 1995 experience report, the Norne pilot had mainly focused on the work process perspective. KOT had high hopes that work processes would be a key navigation structure in the continuation of the project. The workspace metaphor that was developed in the Norne work was mechanistic, and models of the enterprise were the dominant one of the three original perspectives of the Collaborative Workspace, mainly because this was what Norne requested.

5.5.1 Summing up the work in Norne in 1996: KOT's experience report and Norne-KOT's close out workshop.

There had been regular debriefings and discussions throughout the year, both by KOT members alone, and the same members together with Norne. The major discussion of the work and the lessons of the Collaborative Workspace project for Norne in 1996 were done on two important arenas: the work with the KOT-experience report of 1996 and the closeout experience workshop with Norne in January 1997.

In the work with the experience report KOT created a joint construction of what they had learnt in the Norne project. They backed the evolutionary methodology even stronger than they had in the previous report. The additional back-up support of Statoil Data was considered substantial, without this support the group concluded that the project would have failed:

The controversy in the early phase of the project between KOT and Norne, relating to technological platform was covered in several discussions. Was it proper to focus on the technological platform before the organizational reflection process was up and running? The position of KOT up to then had been to flag the organizational reflection processes first. KOT says in the report:

> We have always chosen to put emphasis on the organizational aspect in our work first. This has been important here as well, but not in itself. Early this Winter the project almost stranded because of a disagreement on the focus of IT tools. The customer insisted on the IT tool while we meant the process was of most importance. Looking back we see that the IT tool with its strong visualization properties have contributed considerably to the end result. Embedded in this are not only negative consequences of what might happen: that the tool dazzles the users. We also see that it would have been impossible to visualize our ideas without the same tool as the catalyst. We have to take visualization more seriously in the future, and the visualization of an operative end product has been an important catalyst and inspiration in the work. On the other hand, the project would never have got this far if it did not challenge current organizational practice in Statoil. The conclusion is that we have to shade our previous comprehension. In some phases we need a strong focus on the IT tools and yet in other phases put stronger efforts on the need for reflection processes in the organization.

Another important issue was described as strong commitment in the Norne organization on all levels. KOT praises the role that Norne management played. They backed the project and followed up the outcome of the project all along the way. Requirements and expectations were discussed early (and all along the project) with the process owners, during status meetings to communicate work tasks and milestones.

A key offshore manager had ongoing personal conversations with the process owners that were lagging behind in the work with the work processes. The key lesson here was, as this manager said himself, he had learnt something new during the work with the enterprise model in Norne. This personal commitment he described as necessary to understand what was going on. Just by delegating the tasks and getting informed during status meetings would never have resulted the same learning experience for that manager. The work of the process owners and a number of super users was also defined as important, to get over a critical mass of users.

But everything were not shiny. KOT discussed to what extent they had oversold Norne and the actual results, since Norne was not in operations. The work had a good steam until September 1996 when the vessel arrived from Singapore, and most personnel became busy working on the ship. KOT saw signs indicating that only operations needed the application, and not the administrative support functions. At the end of 1996 people related to operations were the users, the others had stopped using it. The administrative functions were fewer people and had never really found a need for the application.

The key future problem also related to use was described by KOT as the maintenance problem. The tool had a very tedious way of maintaining the flowcharts. Since Norne wanted a simple way of drawing flowcharts, no apparent software solutions were found, solutions that could be combined with LOTUS NOTES release 4 in mid 1996. Since no proper graphical editor was found good enough each flowchart had to be designed in FREELANCE GRAPHICS, then screen dumped to another drawing tool: PAINTSHOP PRO to become converted to a bit map image. This bit map image was copied to the correct LOTUS NOTES navigator and pasted into the navigator.

All links had to be manually updated on the navigator. Another problem was that document links in LOTUS NOTES disappeared. When a doc link is created in NOTES, an unique identification string is generated that defines the server name, the database to search for, where the document is placed and the correct document within that database. When LOTUS NOTES servers were moved, replaced, renamed or documents were deleted the link "got rotten". It was a considerable job to follow up if the links were up and running. Given the functionality that were chosen, and the trade-offs that were made, no satisfactory mechanisms existed for this in mid 1996, with LOTUS NOTES as the key tool. KOT stressed good IT maintenance routines in Norne as one way of overcoming these problems. They say in their 1996 experience report:

> We see that the application can develop a maintenance problem and become a historical database if not Norne continuously stress the need for improvement processes related to the computer system. The daily improvement work in the organization should be channelled through the application. The division of labour between Norne and Statoil Data will be critical here, but Norne personnel must do most of the work. A system to handle document links that go down must be established.

Another issue was the flowcharting methodology. The discussion on the flowcharting methodology started the year before in the experience report of 1995; see Chapter four. Throughout 1996 KOT discussed the proper balance between flowcharting and other methods. The 1996 experience report states that there are a number of problems associated with this technique:

> ...a number of problems associated with using this machine-like metaphor to understand organizational phenomena. No systematic account could fully capture the richness of mental life, social interaction, and the guiding question was not if we have taken account of all human behaviour, but if we used it in design to augment people's capacity to act.

KOT personnel that had taken part in the work in Norne admitted that the focus had been "structural" and instrumental to a large extent. It was discussed if the new horizontal understanding of business processes that was growing in popularity in Statoil was a move from vertical silos to horizontal tunnels? Both flowcharts and organization charts were structural depictions of organizational phenomena. The process maps deployed in Norne were more suited to describe the value creation in an oil organization rather than an organization chart, but did it develop a more profound understanding of the lives of the people that work in the organization, those that create the added value? Norne personnel described a different model of the physical flow of production than a traditional organization chart could provide, but did they acquire vital knowledge on how the personnel adjust, work against and interpret their work situations?

Both the organizational chart and the flowchart view structures differently, but the organization was still a formal and rational system. If the structural and instrumental perspectives of organizations are allowed to rule, secondary adjustments or the informal organization will be looked upon as irrational or as "left-overs" after a successful reorganization. In BPR's vocabulary it is the criteria for success, or checklists for successful re-engineering.

KOT never described their methodology as BPR. A closer scrutiny of Norne work processes reveals that most of them are functional and not process oriented. They are more aligned with TQM and Statoil continuous improvement (KF) work. KOT argued that they picked out useful BPR elements for a Statoil setting. It was this bricolage or syncretism of perspectives that took up elements from BPR, TQM, cyclic prototyping and anthropology that was the bricolage of the CW project in Norne. Many of KOT's academic contacts regarded such a syncretism as an "epistemological soup of perspectives" that could not possibly be combined. As Ola, the project manager liked to say, a saying he had picked up from a Statoil chief engineer in Stavanger: "We know it works in practice but does it work in theory"?

Based on the work in Norne KOT discussed how such a flowchart methodology might remove work from the social situations it is immersed, the arenas of interaction and the situations where work is done? *Communications of the ACM* had a special issue on the representation of work in 1995. Lucy Suchman's (Suchman 1995) paper in that magazine was read and referred to in the discussions KOT had in their experience report discussions. Suchman's point is that much work seems to be invisible or have a tendency to disappear at a distance. One of these discussions was related to what BPR rendered as wasted work, or work that had nothing to do with value creation.

The key parameter here for added value work processes are activities that the customer is willing to pay for, or active time in production. Some added value activities can be necessary to keep the added value processes going, but the key is to minimize both these and also remove the last category described as "wasted work" in BPR. The wasted work category has nothing to do with value creation. When BPR talks about added value processes they address technological or administrative routines that could have been changed. During one of the discussions I presented a small text passage from Hammer & Champy's *Business Process Re-engineering: A manifesto for business revolutions* (1993). Here they render all other factors than the added value processes as either subordinate to this fact or unimportant. They say (Hammer & Champy 1993:203):

"Teamwork' and 'empowerment' are abstractions and generalities around which it's impossible to get one's arms. They describe characteristics or attitudes that one might want an organization to exhibit, but there is no direct way to achieve them. They are *consequences* of process designs and they can only be achieved in that context. How is one supposed to begin working on empowerment if not through the architecture of the work processes? Innovation" is also the result of well-designed processes, not a thing in itself. The flaw in this company's efforts and in similar attempts elsewhere, is that it failed to take a process perspective on the business. Without that, business improvement efforts amount to rearranging deck chairs on the *Titanic*.

The soft issues of teamwork and empowerment are a remaining factor here. When KOT discussed these issues during the work with their 1996 experience report they were divided. Some argued that you had to start with the added value processes; others claimed that both aspects had to be handled simultaneously. They all agreed that to stress the softer issues like team building and empowerment would not necessary take the focus away from the business processes. Both the work processes and the vital social processes in an organization should go hand in hand, if the softer issues do not operate smoothly, adding value would become increasingly difficult in the long run.

The Norne-KOT closeout workshop in January 1997 had the objective of going through the project and discussing good and weak aspects of the work. What were the lessons learnt? KOT had a thorough discussion on the project in the work with the experience report and had met the day before the close out meeting to sum up the basic lessons. I wrote down the main themes of our discussion and was given the assignment of presenting it the next day. I presented KOT's key lessons first, what having Norne as a pilot had brought of new wisdom into the group. Here the presentation went through much of the same points that I have presented already. My presentation was related to the evolutionary prototyping of a new collaborative application while at the same time building a new organization: little coding/programming was done before the first prototype was up and running, that the computer application was used in real settings at once, integrated organization development and continuous feedback through field work, use of standardized software, gradually enlarging the number of users, focus on good enough solutions, produce towards end targets all the time, spend time with users and stay in their natural habitat and the flexibility of NOTES. Further, I addressed the development of a continuous learning process for Norne.

This meant that the competence level of using IT had improved and personnel had learnt a lot about continuous improvement and problem-solving techniques. Finally, I presented how a dedicated and motivated organization could be mobilized with reference to Norne. I summarized KOT's descriptions of the role of process owners, the supporting role of management and empowerment of employees. On behalf of KOT I finished by asking a number of questions: Where did Norne go now, there were a number of challenges ahead should the work survive in operations? How should the onshore personnel be put back on the track? What could be done with improvement routines to make sure that the application would not become outdated and only have a historic value?

Tommy headed Norne's presentation. As always, Tommy started with the positive. He had run a thorough process with the others to put down Norne's most important experience in a FREELANCE GRAPHICS slide presentation. This presentation had a number of bullet points that he used as the reference point for his talk. The other four Norne personnel that participated were two Norne managers, an operational engineering technician, and a production and maintenance assistant. The other four added important comments as Tommy went through his presentation. He started by saying that it had been a self-developing and learning experience for those that had taken part in the process, and he went on to argue why this was the case. Tommy referred to the activities in preparations for operations and said that

the work process application had let the work be co-ordinated under one umbrella. Governmental and ISO audits had become less problematic, since the application gave Norne operations continuous control of revisions of mandatory documentation. Norne operations could do all the changes themselves and not be dependent on any others. The application had made possible a systematic way to handle parallel activities in preparations for operations and it contained a simple method for continuous improvement. Tommy also said that the application could be used as a front end to a number of other applications, and that it had been easy to use since it was a standard Statoil application (software).

KOT also wanted to spend some time on what had not been so good. Technicians had preferred to use standard flowchart symbols, and some were still a bit confused by the methodology. It had been difficult to create charts in FREELANCE GRAPHICS and export them to NOTES. The most problematic issue was that Norne for a long time had to rely on KOT and Statoil Data to implement changes in the clickable charts, Norne could only write the text documents. When Norne started to create navigators themselves, this became easier. Norne had problems distinguishing between KOT and Statoil Data activities. They were unsatisfied with the poor capacity of the PC's availability of the servers and the computer network, the need to log in and out to get from version 3 to version 4 of NOTES.

A discussion started related to the process itself. Tommy had wanted a more stable group of operational personnel and the others nodded. Too many people were present in periods and left, came back again only for a few days before they started working on the vessel or on other technical systems dispersed in other Norwegian towns. They had tried to implement the best man for the job principle. However, they had seen that several middle managers where not at all able to work as facilitating managers in egalitarian teams. The two managers present commented that non-managerial process owners that took responsibility might turn out to be the future managers of the installation.

Robert asked what would become of the middle managers that were unable to work as process owners, would they function at all in Norne's demanding work environment? The two managers said that that they had decided to give them another chance and work more closely together with them. The managers agreed that these people were a challenge and the same people had problems with buying the work processes and the application. The Norne team attending the meeting stressed that there were a group of people in operations "that had seen the glory" as they said it. They believed in the work in which they had participated. However, there was a group of people that had only been informed, been busy with other operational activities, or were late arrivals in 1996. These people did not have the same ownership and Norne foresaw a tedious process to get them onboard and develop ownership to the work processes.

One of Norne's major points was related to the training of the newly arrived personnel. Tommy said that the process owner's competence in handling IT issues had increased substantially, also their ability to see potential new use of IT. The Norne team were keen on showing KOT how they had used the application in the training of the newly arrived personnel in the autumn of 1996. I asked Tommy how they had done this? He said the following:

"When we were working in preparations for operations in the past we had to read through a number of documents and procedures to understand what the ideal situation should be. I say to personnel when I give a short introduction to the work processes. Go in and see for yourself. The work processes give you an overview of what Norne is supposed to be. You can navigate through maps, read strategies, go down to check lists in

operations. When using the navigators you see how things are put together that would not have been possible with only paper documents in a folder. It is your responsibility to come back to us process owners or use the comment button if you disagree with what's in there".

Tommy also gave me Norne's very neat summary of what the task with the work processes was all about, on one slide: Norne: HOW TO CREATE A WORK PROCESS (see Figure 5.9). This process description was simplified to meet the needs of training new Norne personnel. He said: "This is less complicated than your presentations of work process modelling, but it is basically what we need". The session ended with a symbolic transfer of t-shirts and Norne badges to the people from KOT that had participated. Tommy said: "...only those that have contributed substantially in helping Norne are given such shirts and badges".

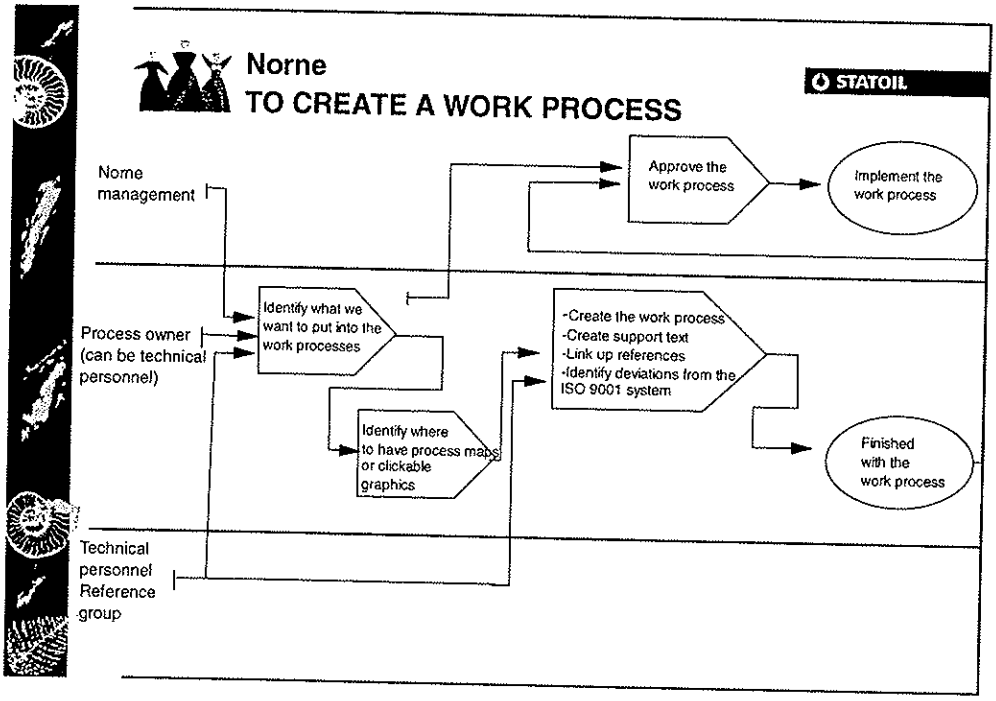

Figure 5.9: Norne's own description of the work processes, translated from a slide presentation in Norwegian

Tommy confessed to me in one of the breaks that he had been sceptical to the work with the work processes in the beginning. In the first meeting he attended in April, where I presented the concept he said to himself: "These are typical academic civil engineering ideas that will never work in practice". He did however decide to give us a chance. I asked him why he gave us the chance. He said there were several reasons, key managers backed the initiative, but it took him just a few days to realize that by using the application he could co-ordinate many of the activities that he was in charge of and had to rely on others to do. It could be a tool for delegating and follow up of activities. The last reason he mentioned was surprising. In spite of his scepticism to civil engineers and "academics", the fact that an anthropologist played an important role in the process made him curious.

5.5.2 What did the CW project pilot in Norne mean for KOT?

Except for the lessons learnt, what did the Norne work mean for KOT? The discussions in KOT described Norne as the perfect pilot. The attention that was already present in the aura around Norne could also shine on KOT and create attention around their work. The Norne pilot that KOT conducted was sold as a success story and it promoted the CW project. It had made KOT a prominent actor in the borderline of IT and organizational development in Statoil. The former controversy with Statoil Data had been brought to an end. KOT were given access to promising new technologies and Statoil Data saw KOT increasingly in a role where KOT could try out new ideas and concepts, ideas and concepts that could be handled over to Statoil Data later for commercialization and subsequent spread to the rest of the organization.

KOT had a strong foothold in Statoil operations. The Norne story or narrative became widely known in Statoil in 1996 and 1997. People came from all over the company to hear about the work. Work process modelling in Statoil increased in popularity in 1996 and 1997 and most business assets in operations had plans for describing or re-engineering their work processes. Subsequently they came to KOT for advice. The Norne story was aligned with the efforts of the two Trondheim university programme professors that held a number of presentations for managers all over Statoil. In the presentation: "The Digital Challenge" a joint one and an half hour talk by one of the professors and Robert the KOT manager, the Norne job was referred to as the Statoil example to bear in mind in the coming use of IT in organizations. Signs indicating the internal prestige of the Norne pilot rose to a peak in October 1996. CEO of Statoil, Harald Norvik spent half a day together with KOT to discuss future use of IT in Statoil. The Norne presentation was a successful narrative here, of a future example in Statoil. Needless to say, KOT knew to tell about this visit.

KOT's scullery, or KOT's office facilities at the Research Centre was the ideal place for such presentation activities to take place. The concept "scullery" was taken from an idea KOT had to develop a communal space where new ideas could be taken in "washed, cleaned and chopped to smaller pieces". The idea was to use this zone to develop new ideas that could be taken further by some of the members for going into detail. Then the group would assemble again for further discussions. A scullery was a multi purpose room with multimedia equipment. It was also meant to be an exhibition of new work practice and information technologies. All KOT cell offices were located around the scullery area. It consisted of a meeting area with comfortable chairs and sofas that could take groups up to twenty people if the furniture were rearranged. The area had a number of white boards, large computer screens, guest PC's and was the location for a number of KOT servers. The scullery was a symbol of KOT. Visitors on tours of the Research Centre were taken to the scullery to see how Statoil developed new architectonic solutions and collaborative forms where IT played an important role.

With the strong advocates in operations nobody at Statoil R&D or the R&D financing structure dared to question KOT's budgets for the year to come. This credibility had also made the reconstruction of KOT's office facilities possible. In 1996 Statoil's new technology strategy was being implemented. I have already mentioned in Chapter three that co-ordination technology and information technology were defined as two important target areas for research. The Norne application became the example of what co-ordination technology could mean in relation to the technology strategy. It showed that standardized IT solutions like LOTUS NOTES could be chosen, some general co-ordination mechanisms had been built in via the enterprise model, and finally how new organizational routines were developed

together with the new use of technology. The combination of developing something useful for Norne, a core symbol of the future in Statoil, that the Norne personnel did most of the work themselves, and the dazzling new functionality of the NOTES -application most likely created the effect. One of the KKG gatekeepers told me later that the Norne application was perceived by the R&D financing structure as a living manifestation of the principles of co-ordination technology as they were embedded in the technology strategy. However, Roberts lobbying in the same financing structure amplified the focus on the Norne application as a living manifestation of co-ordination technology.

In the attention that developed around Norne and KOT a number of new organizational efforts began to pop up. BETA a new knowledge management system in operations in Statoil took the flowcharting navigation principles further, saying that this project used the same methods and that they collaborated with KOT. The CW projects relation to other initiatives will be handled in more detail in Chapter seven. Statoil Research Centre used the methodology from Norne when reorganising their business in 1997. An enterprise model of Statoil was made on the new Intranet, influenced by the same Norne thinking, spreading ideas to the Corporate Information department, from 1997-98. More about this in Section 7.3.2.

5.6 Epilogue

I conducted an evaluation in the spring of 1998 and participated in a reflection meeting with Norne offshore personnel in March 2001 to find what had happened with the Norne work process application. Several important observations could be made. In 1998 the offshore environment still used the application as a part of their continuous improvement process. They had planned to work continuously with improvements, something that was difficult to do due to shift routines and seasonal ups and downs in the production of oil. Improvement work had become much more all-out effort than Norne had hoped, and became coupled with regular revision stops of the installation.

The two work processes, operations and maintenance (with their sub processes) had by far the biggest ongoing activities in the application. The onshore organization that had taken part in the effort had stopped using the application. It was the offshore community that invested effort in the application. They had a number of super-users and enthusiasts that found it inspiring to work with these issues. Through their planning of operations they had developed dependency of the application. Another carrot for keeping work processes updated was the lurking threat of ISO and Norwegian Petroleum Authority revisions that demanded that Norne had good documented routines for all operational work.

This alone was a good reason to keep the work processes alive. Work onshore was administrative and not so strictly regulated, and few interested "doers" that could keep the work alive. Some senior middle managers (including some of those who were not ripe enough to act as process owners) with substantial experience from past installations had problems with letting go of their past power to the multiskilled teams. Even though these forces were kept down in 1996, they came to the surface in operations. BETA the new Intranet application that had much the same functionality was implemented by the other oil installations, and it was difficult for Norne to remain outside this initiative in the long run. Key people in planning for operations that have worked as super users are moving out of Norne to new installations and few new enthusiasts are there to take their place. In 1999 the NOTES application was still in use offshore onboard Norne, but slowly losing its foothold. Researchers from the Norwegian Telecom [20] conducted interviews with people that had not

participated in building the work processes in the autumn of 1999. The electricians, mechanics and process technicians did use the application but not very frequently. The process technicians are still the main users, and describe it as their first source of information, as one process technician said:" I use it at least one time in every shift day. I am looking for requirements. This is our first source. I find a number of links, and it fits our work processes. You know, process technicians also took part in the creation of it".

The people had more or less stopped using paper copies, as several said: "I have the work processes in my head". Some of them made changes in the application themselves or use one or several of the remaining superusers. A revision of Norne documentation in 1997 concluded that Norne had not been specific and detailed enough concerning espoused practice. At this point in time the Norne personnel, and management in particular, did not speak up against this conclusion even though it went against much of the value statements in the development of the work processes: Procedures should be kept at a minimum. After this revision it became increasingly difficult to build robust operations through values, instead procedures and the level of details in the documentation rose.

The Norne work process application was filled with more and more detailed information. Quantities of information it was not supposed to handle, and updating the information become more and more tedious. At the same time, more and more of the old doc links disappeared. In 1999 Norne management decided not to put more efforts in updating the application until the new system for mandatory documentation DOCMAP was up and running. In the spring of 2001 Norne is discussing if they need a way to handle the requirements of DOCMAP. They are discussing if they can develop a new front end or portal that has much of the same functionality as the old Norne work process application. Norne is returning to the problem they had in 1996 when the Norne work process activities started. The only difference is that they are in operations and have a number of existing work practices. The new requirements they have to handle are in a new system, not called DELTA anymore but DOCMAP. How Norne will present and update this information and continue their improvement work remains to be seen.

Chapter 6 The Collaborative Workspace project in Norne, an Analysis

In Chapters four and five I presented empirical narratives from the start of the CW project through its materialization in Norne. In the preceding chapters I also defined a number of concepts that will be employed to analyse the CW project as it unfolded in 1996. I started to describe anthropology of science and technology as a total phenomenon that cannot split human and non-human elements with losing key aspects of the phenomenon. The perspective I took had its roots in symbolic interactionism but I tried to bring together elements from an ecological perspective of the mind, the American school of philosophical pragmatism and actor network theory. I tried to link these elements to the drama perspectives of Victor Turner and Brian Pfaffenberger. In the chapter that follows I interpret the Norne pilot in 1996 as a drama. It enables me to look at the full range of technological activities and organizational activities in Norne, the many discourses of social-technological statements and counter statements. All activities can be seen as a process of communication in which each new act is interpreted in terms of acts already performed, program- anti-program in the language of Bruno Latour and initiation-consummation in the language of John Dewey.

I start this chapter analysing the various forms of embodiment or mediation in relation to technologies based on the Norne pilot. This perspective I define as instrumental realism (6.1). It focuses on each person's individual use of technologies in Norne with an example from maintenance. Such an instrumentalism will focus on what I defined in Chapter two as the *extrinsic* features of technology. Still, this perspective will not help us to understand the intrinsic and unforeseen consequences of this instrumentalism. Through mediation with technologies people dramatize aspects of it in interaction with other people. To understand this process that is far from instrumental and linear I bring in the dynamic notion of a drama. I start with a general analysis employing both Pfaffenberger's phases and concepts, and mix these with the perspective of actor network theory (ANT). This drama consists of actors that form actor networks via inscription and translation efforts. I analyse the development of a new actor network around the work that KOT did in Norne (6.2). Special emphasis is placed on the role of flowcharting as conscription and the Norne enterprise model as a boundary object. Analogies used in the technological drama play an important part and their importance is discussed in Section 6.3. Finally, I argue how the enrolment of concepts and ideas are placed in both reason and nature by the employment of legitimating and justifying narratives (6.4) that in due time enrol and align new forces into the actor network.

6.1. An instrumental realism

In Chapter two I argued that my understanding of technology was strongly influenced by the American school of philosophical pragmatism. In Chapter five much of my empirical presentation evolved around maintenance. Let me now try to exemplify this pragmatic and instrumentalist conception of technology in larger detail with maintenance and inspection as examples. In what follows I will employ the work of Don Ihde (1979, 1990, 1991) to give a short phenomenological introduction to a number of technological relationships that can be observed in the empirical settings of Norne. A phenomenological analysis often describes the notion of a certain correctional scheme between what is experienced (the noema) and a correlation with the mode of experiencing it (noesis). This correlation can be between a human experiencer and that which is experienced. There is interaction between the two. The human can be any range of human experience, i.e. the Norne installation and the world for what possibly can be experienced in this part of the organization or other parts of Statoil.

Human ⇄ world

The arrow is the intentional direction or involvement in any experience. Intentionality is never one way, it also reflects from what is experienced. The latter is important when we want to follow people in action and their reflection on their practice as we do in this thesis. The arrow under is a reflective intentionality or the movement from what is experienced towards the position from which the experience is had. Here I have already presented a number of examples from Statoil that are in the flesh or are non-technological, like informal talks in groups and meetings in KOT. However, most experiences are mediated and include in the correlation some kind of instrument (in the form of some tool or machine). When a Norne technician in Chapter five uses a word processor where do you draw the line to the person that writes? She has a PC with word processing software, uses the spelling and grammar check, can choose a number of fonts and templates, and relies on the printer for a print out of the text. In addition she is dependent on her ability to articulate her ideas when writing. All these factors influence her effort in writing the text, and they are interwoven to such a degree that it will be very difficult to take the factors apart in the effort of producing a text. The relation is as follows:

Human-instrument-world

My maintenance example deals with the visual control of technical equipment and through this I hope to convey some of the tacit aspects of work. Imagine a situation where a mechanic during visual control senses a malfunctioning pump. Recall from Chapter five that inspection is done to monitor the technical condition of the installation, with varying requirements for accuracy. It is divided according to accuracy or inspection type. Inspection type one is a general visual inspection that can find apparent malfunctions, like mechanical damage, corrosion, leaks, debris and lack of coating (paint). These might be serious malfunctions that may depreciate the integrity of the construction. Type one gives indications for deciding if types two or three are necessary. Inspection type two is close visual inspection that addresses malfunctions or things found by using type one. It can employ a steel brush, a knife, magnifiers, mirrors or fibroscope. Type three is a non-destructive control type, where different kinds of control equipment are used, i.e. to find weak welded joints and internal corrosion. Type three often demands its own procedures and special competence by the personnel doing the maintenance.

The Norne mechanic approaches the pump on his round of visual control. He hears a sound and sees that the pump has lost its coating (paint) at a particular place. With his hands he is unable to do much more. He uses his knife as an information-gathering instrument to obtain more information about the pump, and scratch more coating away. Using his knife as a probe he feels the texture and hardness of the pump and discovers a tiny fracture in the metal when moving his knife over the surface of the pump. Therefore, the knife he uses as probe is a means of his experiencing the pump and this instrument amplifies the search. Further, the object of the experience is not the knife or the probe but the pump. However, the knife as probe is the means of the experience of the pump. The way the pump is experienced the mechanic feels the fracture at the end of the knife.

In Don Ihde's vocabulary the knife used as probe and the human form an *instrumental embodiment*. Simultaneous to the discovery of the fracture in the pump, a disappearance of the knife occurs. It withdraws in Martin Heidegger's sense as *"ready to hand"*. Indeed for the knife or probe to function well its disappearance must be heightened to a level where the instrument is semitransparent. Through this withdrawal of the instrument the mechanic can be extended beyond his bodily limits, and the instrument ends up being a part of the mechanic's own extended self-experience, a semi-symbiotic unity. The knife used as probe extends the mechanic's awareness of the world. In the language of Don Ihde (1979,1990,1991) in the use of the instrument there is an *instrumental realism* in which the sense of the pump remains in some respects the same pump whose fracture he could not feel with his bare hands. The knife/probe allows the mechanic to be embodied at a distance, to see through the instrument.

At the same time the extension of the mechanic experience of the pump is never a total phenomenon. Within the experience of the pump itself there is a feeling of contrast (a fringe awareness) between an in-the-flesh experience and the instrumented or mediated experience. At the same time the mechanic could feel the fracture in the pump through the knife/instrument, he also had an impression of the pressure he put on the instrument in using it. The relation discussed has the following properties:

(mechanic-knife/probe) $\longrightarrow$ pump

In the mechanic's relationship with the pump there is also a transformation of the experience with the same pump. When he started his visual control, the mechanic could touch the pump and feel its structure and hardness. He needed the knife as a probe to see that something was problematic. In this sense the instrument that the technician used not only extended his embodiment but it also amplified certain properties of the pump. The knife/probe gave a better feeling of particular aspects of the surface of the pump, a discrimination of micro-features that the mechanic's own finger would not create. However, amplification of some properties of the pump works in tandem with reduction of other aspects of the pump. The mechanic could feel the temperature on the pump and oil being present on its surface, characteristics not visible through the knife/probe. Don Ihde summarizes (1979:21-22):

> I am here making two points: first, the use of the probe transforms direct perceptual experience. This is its non-neutrality. But, second, the transformation itself displays an invariant feature which I shall now call the *amplification-reduction* structure. This structure is constantly two-sided. With every amplification, there is a simultaneous reduction. And within this structure, two effects may be noted: first, the amplification tends to stand out, to be dramatic, while the reduction tends to be overlooked, or may be forgotten, particularly when the technology is truly good, when its transparency is highly enhanced. But the point is that the more enhanced the transparency, the greater the contrast between the drama of the amplification and the recessiveness of the reduction. The second effect is that the transformation also alters what may be called the 'distance' of the phenomenon being experienced. The instrument-mediated entity is one which, in comparison with in the flesh

relations, appears with a different perspective, its micro (or macro) features are emphasized and this is part of the transformation process itself.

The Norne pump is an example of what Ihde calls embodiment relations. It is a relationship *through* a machine. It has two characteristics. First, there is a genuine relationship with the pump (noema) through the knife. Secondly, while it is a genuine way of approaching the pump, it is also a modified a non-neutral way of grasping the object because of the amplification-reduction mechanisms at work. Ihde claims that it is through the transformation that the instrument effects, that features which may be genuinely new emerge. The instrument allows new elements to arise within the horizon of perceptual experience. The Norne mechanic can become aware of the knife if it breaks down or does not fulfil its tasks. In Martin Heidegger's sense it becomes a "thing" or *"present at hand"* thereby losing its transparency.

Don Ihde goes on to say that there is yet another way instruments cease to be semitransparent. Let us say that the mechanic uses a magnifying glass at the pump during his inspection and visual control. The features of the pump are discerned directly and nearly effortlessly through the glass. The visual magnification of specific micro-features is the clue to understand the amplification–reduction[21] that emerges, and the greater the magnification (microscope, electron microscope) the greater the amplification and reduction will become. The microstructure of the fracture comes into view in such a way that much previously invisible or unexpected could be seen. However, what is seen is quite transformed from everyday perception, of a different context and scale[22].

If we do a radiographic scan of the Norne pump using x-rays, it would be possible to increase our understanding of the fracture. The structure of the fracture becomes more visible with radiography. In this example the invisible comes into the visible horizon, it is a feature that develops from a variation of the visual noema. Ihde (1979:34) calls this a *horizontal instrumental variant*, because the x-ray or the end result of the radiography has to be read more like a 'text'. Even though the contours of the pump remains anchored in the mundane and visible, new features of the pump have emerged, using x-rays. The structure of the fracture in the pump is much larger and deeper than we expected. Ihde argues that the hermeneutic quality of this example is even more dramatized and the interpretation of the observer comes more into play. He must be able to read the results from the radiography, and this reading is based on expertise developed in a community of practitioners that knows the use of this instrument.

In the above *horizontal variation,* the thing has a visual analogous resemblance with the thing itself. Let us therefore go a step further and assume that our pump is vibration tested. The result that comes out from this test has no analogous resemblance to the pump. The fracture can be read in the form of a table or represented as sounds or beams on a screen. Our visible result is obtained mainly through the hermeneutic kind of relation with the pump. The representational quality is totally transformed, it bears no resemblance with the former pump, unless for the skilled person doing the inspection and vibration analysis. Ihde (1979:35) calls it a radical transformation of the visible in which recognizable representation disappears, and it is consequently a *vertical instrumental possibility*. He says that the instrument itself is an analytic de-constructor of the phenomenon (by transferring the fracture to signals and vibrations). The vibration analysis is therefore even more "text like" than any of the other examples, since there is no obvious correspondence between the pump and its representation (Ihde 1979:35): " It is rather a 'text' that tells us something about the thing. And what it tells

must now be 'read' by the one who is 'literate' in its language. What is made available is made available through the hermeneutic use of instruments."

Ihde's point is that at the embodiment side of the continuum there is a retained similarity between mundane perception and what is brought into the visual horizon. When the relation to the amplified phenomenon is sufficiently close to the original three-dimensional object/phenomenon he calls the shape of the amplification-reduction mechanism as one of *low contrast.* While on the other side of the continuum, the hermeneutic, there appears a *high contrast* in the amplification -reduction shape. The instrument reduces the visible to what Ihde calls a *mono dimension.* This mono dimension is highly amplified in the instrumental transformation, but it is also what makes it valuable for knowledge gathering, or fit for its designed purpose. However, the reduction is equally dramatic in that the "object" in the traditional sense disappears as recognizibility is concerned. Ihde claims that what remains is the instrumentally delivered "text" which is now read by the Norne employee with special skills. This hermeneutic relationship is an experience *with* a machine (Ihde 1991:75):

"In hermeneutic relations the technology is not so much experienced-through as experienced -with. The perceptual act directed *toward* the technology is a specialized interpretive act. Thus, whether what is being read is a text, a map, an instrument with numbers or a scale, or the dynamically appearing printout of the computer, the "transparance" is not isomorphically perceptual, although it occurs within a perceptual context.

The deliberately designed transformation from mundane perception is the condition of the possibility for the emergence of certain analytic functions through instruments and machines. If we go back to Norne and enter their SKR (central control room), there is little doubt that the embodiment relation is left behind and what replaces it is Ihde's hermeneutic relation. Interpretation comes into focus, and there is a qualitative change in the type of mediational position occupied by the instrument at this stage of the continuum. There is an obviousness and necessity of the instrumentation to be taken thematically as 'other' in the process (Ihde 1979: 32). It achieves a life of its own and is a separate and distinct factor in the investigation.

The primary experimental terminus with the machine is what Ihde calls the hermeneutic relation. It represents a partial opacity between the machine and the world, and the machine is "text like". In the same way as you may read an author, you can only do it indirectly through the 'text' since the machine is only indirectly accessible through the world. It has the following relation:

Technician (control room panel-pump)

It is in this sense the machine becomes 'the other' and retains different possibilities. Anthromorphization becomes possible because of the otherness of the technological object. If we go back to the Norne work process application we see that information technology has a number of features that makes it different from traditional machine technologies. IT can be used to reproduce, extend and improve the process of substituting machines for human agency. Still, it also has embedded additional properties. The first is the interactive and communicative capacities of a computer. It is a "thinking" machine that responds to the users instructions, and it responds with words, sentences and increasingly with speech. Second, the devices within a computer that automate by translating information into action also register data about these automated activities, thus generating new streams of information (Zuboff 1988:9).

A word processor can for instance record data on the level of efficiency of language use and the time used to create the text. The Norne LOTUS NOTES' work process application can create logs and statistics of accesses in the database. The Norne work process application does not only apply programmed instructions but is also capable of converting the current state of equipment, product or process into data. This data can be used for a number of analytical and tracking purposes. I can find out if particular users have visited the work process database last week. Information technology compared to other machine technologies is less mute. It imposes information in the form of programmed instructions, but also produces information. The action of a traditional machine is more invested in its object, which is the product. Shoshana Zuboff argues (1988:9):

> Information technology, on the other hand, introduces an additional dimension of reflexivity: it makes its contribution to the product, but it also reflects back on its activities and on the system of activities to which it is related. Information technology not only produces action, but also produces a voice that symbolically renders events and processes so that they become visible, knowable, and shareable in a new way.

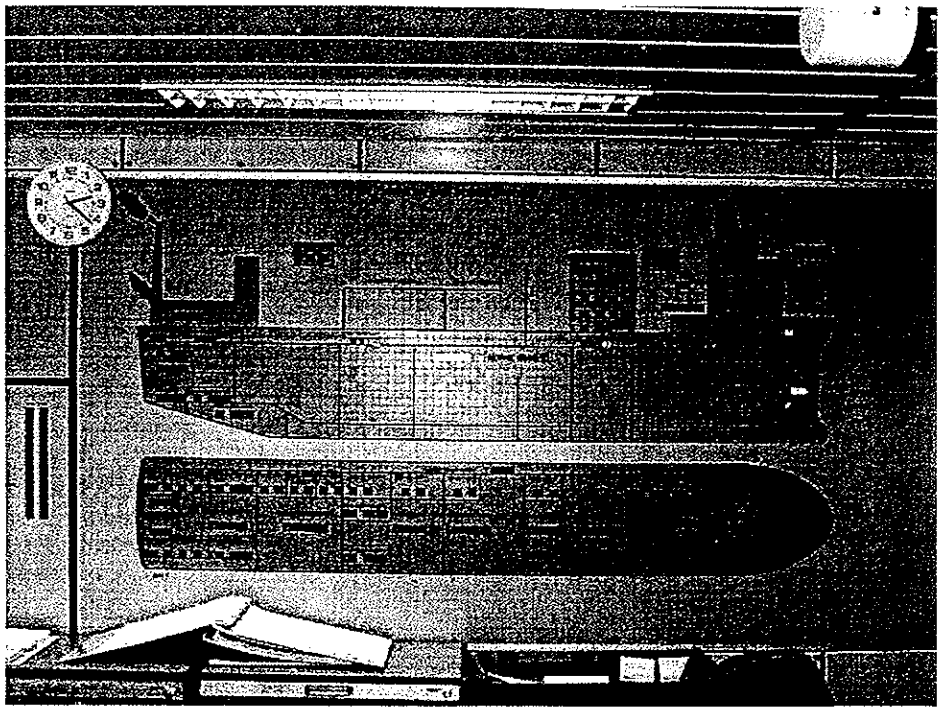

Figure 6.1: Controlroom panel (fire and gas detection matrix) from the SKR (cental conrol room) on board Norne. Photo by Norne

If we go back to our example with the pump we see that the panels of the SKR room (see Figure 6.1.) in Norne displays a faint continuity with the pump as a visual phenomenon. The pump is located in a specific technical system on a panel. The control room technician monitors the technical systems on the ship. He reads all the signs on the boards, panels or computer screens in the SKR. These might indicate that our pump has a malfunction. He might try a switch to see if the visible malfunction on the panel board disappears. If it does, it

is OK, if not he will have to call somebody with area responsibility out in the plant to solve the problem. Here the control room technician is engaged in the experience of a machine.

Through the machine something happens elsewhere, but the technician does not experience the terminus of the intention that traverses the machine. The instrument in this relation is of a hermeneutic character, it must be read and the previous immediacy of the embodied relations are here displaced by the necessity of a hermeneutic process. The whole Norne production ship is too complex for the control room technician to have an embodied relationship to it. He cannot possibly see all the outside equipment and has to read the instrumentation (control panel). He can also scan the P&ID's (drawings that describe the flow of technical processes) to get a more detailed textual interpretation. From these interpretations he or she must try to grasp the essence of the world in the plant. To make this reading of the technology in the plant more efficient, several other reductive mechanisms are in place. The shape of the control panel for improved pattern recognition, the ordering of the switches, lights of particular colour and particular boards and screens to make it more visible and intuitive. See picture from the Norne control room (Figure 6.1.).

Embodiment relations and hermeneutic relations are two types of human-machine communication that stand in contrast (Ihde 1979, 1991 and 1990): through a machine or as focal object of experience. Ihde describes a third human-machine relation where the relation of use is explicit and direct (in an embodied dimension of the person through machine) and being confronted/involved with a machine. He calls this relation *among* machines. His point is that in an increasingly technological society more human-machine relations take on what he calls an atmospheric ubiquitous character of a *machine background.*

In this case there exists momentary relations with machines, in terms of an adjustment or starting its operations. The machines are doing their own work, and the person is only momentarily attendant to them. At the same time she is living in their midst, often not noticing their presence. Everything in the surrounding presence is constant, giving a feeling of being inside a machine. It is a techno sphere in which we do a lot of our living. It is not difficult to imagine the Norne oil production vessel being such a techno sphere. It is a ship anchored to the seabed, a total institution (Goffman 1961) and a technological island only accessible by boat or helicopter. A number of technical systems maintain an environment that is fit for humans to inhabit. No human would be present at this place out in the North Atlantic without these background relations.

Norne personnel → [machine world]

In each of Don Ihde's three technological relations there are amplification and reduction mechanisms that develop inclinations that might be dramatized in social interaction. The materials for dramatic elements that lie in the amplification and reduction mechanisms are substantial. Don Ihde (1979:57-58) argues how these dramatic features are central to understand computers and information technology:

> This general observation concerning amplification and reduction and a shape of selectivity applies to computer technology as well. First, note a very broad selectivity concerning computers: out of the entire possible range of human experience, the development of computers *selects* a certain range. Furthermore, this selection, in part deliberate on the part of the designers, but also in part appropriate to the artifact itself, provides the basis for much farther reaching *inclination* for the possibilities of human social and existential experience...My only point

is a simple one, computer technology in its capacities is both selective out of the range of analogues of human experience possibilities, and is amplificatory and reductive within that selection."

In Chapter five I showed how the work process application or enterprise model in Norne visualized and amplified the formal espoused BPR business processes. If we look at what are the more specific amplification-reduction mechanisms that come from interactions with computers in the Norne project and in exploration (in later chapters) it was mostly experience with machines (computers), and the focus in preparations for operations was in most cases different from the embodiment of experience the Norne personnel had in their past jobs. Fieldwork indicated examples of Ihde's *through* and *among* relations with computers also but I will not touch upon that here. The work I present include mostly the hermeneutic relation, where in the flesh work experiences were translated to flowcharts and Web pages and texts during writing and reading.

In later sections of this chapter I describe how KOT and Norne personnel saw the enterprise model as a methodology, or a language that enabled them to use reflection objects. Here they are in line with Don Ihde that is of the opinion that modern machinery like computers are more and more tending away from extending our body towards extending our language. Thus the computer orders a dimension of possible experience and it selects out of a certain part of language. From the lively free speech it selects and amplifies calculational, deductive, and functional experiences (Ihde 1979:59):

Not only is this 'language' a selection of possible language possibilities, but it has a characteristic shape which is its *inclination* and which provides the condition of the possibility for further structuring experience. The organization of computer 'language' is that which enhances the collection of data, factual information of any kind; it also enhances the breakdown of that *data*, factual information into *bits* or atomistic items, organized according to a system of *categories;* and in this organization there is an unfolding of what I shall call linear 'logics'.

In Chapter five I presented how the enterprise model created to a large extent what Ihde calls a "mono dimension" and was a de-constructor of a phenomenon, it amplified some elements that could be used for further reflection and learning. Still, it became a useful tool in preparations for operations in Norne. In Don Ihde's phenomenology of instrumentation, and also in the Norne narrative, the instrument/machine (enterprise model) displayed itself as simultaneously the condition of the possibility of certain types of knowledge and yet as a non neutral transformation of what was known. But for *every revealing transformation there is a simultaneous concealing transformation of the world, which is given through a technological mediation.* Technologies transform experience, however subtly, and that is one root of their *non-neutrality* (Ihde 1979:49): "In use the instrument has the 'phenomenological' capacity to bring into presence that which was previously undetected and even invisible, but precisely in this *difference* it also transforms the way in which the phenomenon may appear."

The more a high contrast amplification dominates the easily recognition of the mundane world recedes and the analytic capacity of the computer begins to become increasingly apparent (modelling language, taxonomies, lexicons, generic computable business processes). The instrumental realism I have presented in this section has focused on what I defined as the *extrinsic* features of technology. Still, this perspective will not help us to understand the intrinsic and unforeseen consequences of this instrumentalism. Through mediation with technologies people dramatize aspects of it in interaction with other people. There was a possibility that Norne might believe that the tool, that in the beginning dazzled the users, could become the solution to all problems.

I tried to show in Chapter five how KOT was aware of the weaknesses of the flowcharts or the NOTES application and took steps to handle what became invisible as a consequence of the flowcharting methodology and the Norne NOTES application. For the remaining sections of this chapter I will focus on the intrinsic consequences of the organization and technology development in Norne.

6.2 Developing the Norne CW pilot into an aligned actor network

At the turn of 1995, KOT had ideas about a new concept that they called the "Collaborative Workspace". It consisted of a number of concepts, where the idea of the "integrated organization and IT development" and the enterprise model was the most prominent. How should KOT go ahead? They had formal backing in the technology strategy of Statoil. It stated that co-ordination technology was to be a target area in the coming years. A defined target area would however not given the necessary funding and support in the years to follow. It could give KOT some basic funding but they had to go into the Statoil organization both to find customers that needed their concept and could act as advocates for the successful development and implementation of the CW project. The methanol plant where KOT had worked in 1995 was not willing to play such a role because they would be busy starting up the plant in 1996.

For KOT to gain support for their ideas they had to do two things at once. To enrol some part of the Statoil organization so that this organization or group would take part in the development of "integrated organization and IT development". Second, to control the behaviour of the enrolled. In Pfaffenberger's terminology a process of technological regularization had to be initiated. Bruno Latour (Latour 1987: 108-121) describes five alternative strategies for translation of interests KOT could use. First, enrol your interests into others interest: "I want what you want". Second, to make others follow you: "I want it, why won't you"? Third, to make a short detour and try to convince others that their interests will be taken care of if they follow. Fourth, reshuffle interests and goals. Finally, become indispensable. Each of these strategies aim at convincing others in Statoil that they must follow the claims put forward by claim makers like KOT.

The experience summary report of 1995 described in Chapter four gave a number of hints on how this endeavour could be started (flowcharting, regular participation in the customer organization and cyclic prototyping of new tools were strategies envisioned) in order to make the enrolled assembly's actions predictable. As Bruno Latour (Latour 1987:108) asserts, others than the scientists themselves are needed to transform a claim into a matter of fact, or in this case a successful technological dramatization of the new KOT concept. The best way to do this is to find people who believe in the concepts, caters for these peoples explicit interests and offer new interpretations of these interests to the latter people.

A technological realization of the KOT concept could not only rely on a deployment of materials and techniques. It was also a construction of alliances, new principles for social interaction and had to provide powerful new vehicles for culturally provided legitimating and justifying narratives. In what follows I describe how cascades of increasing inscriptions created the new work process applications in Norne. Norne popped up as a potential partner, partly because people in KOT knew key Norne managers, and partly also because Norne was a positive key symbol of the new Statoil organization.

Norne was in 1996 a summarizing symbol in Sherry Ortner's (Ortner 1973) sense. The new business asset combined several ideas into one symbol: lean and efficient organization, new vendor relations and new production technology to name a few, and Norne stood for all these ideas simultaneously and acted as a catalyst to impact the respondents. Norne also proclaimed its focus on using IT in new ways in Statoil, and they had definite management targets going in this direction. In this sense an alignment of interests between Norne and KOT was possible:" we want what you want".

The first meetings with Norne created an initial alignment around a navigation layer on top of existing IT systems. This navigation layer was also aligned with KOT's targets in the CW project. Once this initial alignment had been established, KOT and Norne had to develop a kind of working order in the new design constituency. Actors working together in the Norne case came from different communities of practice and a new working order did not develop by itself. This process consisted of both communication as well as creating new intermediaries and boundary objects. New artefacts and methods will signify different things in different worlds, or communities of practice (the KOT researchers, Norne operations and Statoil Data). Still, the actors had to reconcile these meanings if they were to collaborate, and it required substantial work from all participants.

Each group translated, debated and simplified elements of this fragile order in order to work together. Concepts like "integrated organization and IT development", "work processes" and "enterprise models" had different meaning in the multiple social worlds we have described in the Norne narrative. Imagine the different lifeworld of KOT and those of Norne maintenance personnel, if we go back to the examples from maintenance in Chapter five. All actors did something to the concepts. They did not only transmit them but added their own elements, modified the arguments, strengthened them, and used them in new contexts. It was infrastructural work (Bowker 1994) adjusting and transforming bits of information.

In addition to translations, this new working order in the Norne pilot was achieved via methods standardization, and through the un-deliberate development of boundary objects. Work process flowcharting was supposed to be the key tool for helping Norne in developing their work processes. KOT facilitation and participation in the Norne organization, and a simple NOTES release 3 discussion database was developed to use in this process. They were key intermediaries that passed between the actors in the new working order and defined the relationship between Norne and KOT. A number of workshops and weekly facilitation by KOT should also help improve this working order and support KOT's programs of action. In early March 1996 this working order crashed, the alignment had been too weak. The crashed working order was the consequence of a counter argument or an anti-program in the terminology I described in Chapter two.

In Pfaffenberger's language it was a technological adjustment from Norne just as much as a technological reconstitution. Norne's aggressive e-mail to KOT in early March 1996 might be interpreted as an act of *counter signification* (Pfaffenberger 1992), an attempt to develop a more favourable framework of meaning: a framework that decomposed and re-historized the meanings embodied in the artefacts of which KOT and Norne were working. Norne had ideas about WWW based counter artefacts. KOT was more interested in organizational issues and Norne stressed a proper technical solution.

Enrolling BPR inspired work methodologies, facilitation and participation in Norne, release 3 of NOTES and making a new Norne home page on the WWW were not enough to make

KOT's program work. Norne demanded new Web-like information technologies and threatened to bring the project to an end. In fact, the idea of a WWW based counter artefact was spun around the legitimating and justifying narratives of the WWW and it was a substituted meta-language that undermined the authority of KOT's artefacts and methodology. It established Norne as the superior authority. External vendors to Norne and collaboration in the oil industry had placed focus on the Internet. The folklorization of the WWW in the media created the impression that the Internet was the future, the road that also Norne had to take and the sooner the better.

The counter statement of Norne can be interpreted as an act of anti-signification, or the active use of signs to create technological alternatives, to oppose KOT's attempt of technological regularization. KOT knew that there were few WWW based end user applications in 1996. This meant that too much would have to be coded in HTML and built from scratch. KOT meant that this would cause too much focus on technology, less cyclic prototyping and consequently a poorer organization development process. Their compromise, after going through the pros and cons, was NOTES.

Let us pause here for a while and go back to Pfaffenberger's technological adjustment. One of these adjustment strategies he calls *counter appropriation*. Access to a technological artefact can be problematic. Pfaffenberger (1992: 302) asks how should those deemed unsuited to possess a given artefact prove worthy to appropriate the artefact? *Counter appropriation* is an adjustment strategy pursued by those deemed unworthy to posses or operate the technological artefact. KOT's access to LOTUS NOTES r 4 can be interpreted in this light. Statoil Data was unwilling to let KOT try out the new version of NOTES. KOT's strategy is then to reinterpret the discourse with Statoil Data[23] so that their access to the technology is morally legitimated. Pfaffenberger also describes how this process might include attempts to acquire and operate the technological artefact.

To gain access to NOTES release 4 KOT had to go via Statoil Data that was the obligatory passage point for NOTES in Statoil. Statoil Data controlled the development of the new IT infrastructure. The action of KOT in this phase of the project must be seen as a reintegration effort, in the light of Pfaffenberger's phases, since it was a response made by the agents of regularization to new and problematic ideas about counter artefacts made by Norne. KOT had to mobilize the support of and enrol Statoil Data more seriously into the project to be able to go further. The KOT-managers lobbying among Statoil divisional managers enabled Norne to become an operational pilot for new work practices with IT in Statoil operations. Statoil Data then joined the process after the NOTES release 4 decision in April. Norne, KOT and Statoil Data became aligned around the application of NOTES release 4. It was difficult for Norne to have an integrated WWW-based application, and by following KOT and Statoil Data, Norne would reach a more favourable situation faster. KOT and Statoil Data offered to guide them through this short cut, and it worked because Latour's three conditions for this type of translation were fulfilled. The main road was for practical purposes cut off, a WWW based application would be expensive and require too much time to develop. The new detour was clearly marked, via the implementation of NOTES r 4 and the detour was short: NOTES r 4 could be implemented right away.

Going back to our discussions of affordance and intrinsic and extrinsic meaning; there was a perceived property of the artefact LOTUS NOTES release 4, since people had used NOTES before, but it had a number of new features that could develop new interpretative flexibility (WWW access and clickable navigators) and perceptions of the artefact. Consequently, there

had to be a design discourse between KOT-Norne-Statoil Data that regulated or narrowed the outcome of this interpretative flexibility to meet the programmatic goals of the project. A number of subsequent inscriptions were necessary to create a potent application that made it visually evident what KOT meant in their discussions with Norne personnel. A number of small translations had to be made in order to knit the new working order together.

In Norne a new situation (or working order) developed where KOT, Statoil Data and Norne personnel shared a common program, with sub programs that fitted each of the others agendas. Internet technologies (the counter artefacts) were relocated to technical documentation only and out of the main discussion, and a NOTES "Web look a like application" was chosen. After the release of INTERNOTES in Statoil (the NOTES gateway to the Internet), all of Norne's claims or counter statements had been fulfilled. INTERNOTES was enrolled into the project. This made an alignment of programs possible between the three. Their goals could be lined up, and the working order was upheld because each of the groups had satisfactory work to do in each world.

The coincident boundaries, around a loosely structured boundary object, the enterprise model of Norne made this order possible and provided an anchoring point between KOT, Statoil Data and Norne. The enterprise model of Norne meant different things for the different groups. For KOT it was a symbol of the CW project, something that could be promoted in the larger Statoil organization and give them feedback on their work methods and prototyping development. KOT helped to develop new work routines in Norne, employed a work methodology, and developed a systematic way of handling translations and inscriptions via the evolutionary prototyping cycles in the work with the application. In the flowcharting work those that participated translated their interests: going from brown paper sketches, via FREELANCE GRAPHICS presentations, to bit-maps in a NOTES release 4 database, electronic updating and improvement of work processes and finally implementation in the organization and following up by management and process owners.

In the light of ANT, the CW project, the drama related to the development of Norne work processes and the NOTES application in 1996 is the development of a heterogeneous actor network, with both humans and non-humans. It is a drama with many trials of strength (Latour 1987:200) that reveals which link is solid or weak. In 1996, a number of inscriptions were already in place on the vessel due to its engineering and construction phases: no oil drilling but underwater well systems, reduced complexity of operating the ship, automation requirements, variant restrictions on equipment and standardisation on type of equipment just to mention some. The example I showed from the open-drain system (system 56) was an example of what inflexible inscriptions in technical systems can have of consequences. If inscriptions create inflexibility as in this example, the development of a decent safety culture can become problematic. Finally, merchant marine organizational routines had been enrolled to improve operations.

KOT, the process owners from Norne and the participants from Statoil Data that took part in the project were heterogeneous researchers and engineers. They involved not only inanimate material, like the NOTES application. They built on these materials, went through people, texts, divisional management and government bodies like the Norwegian Petroleum Directorate. Each of these components or materials had their characteristics but they had to be moulded to the former groups design if the actor network as a whole should work. The non-humans (like the NOTES-application) had to fit into a number of other information systems (the installed base), work procedures and routines already in place.

The development of the Norne application urged a continuous effort to maintain the network's alignment, and this included attempts to align new elements and new organizational actors in the network along the way. In Norne this was aligning and enrolling mandatory documents (and thereby simplifying revisions and government inspections), operation manuals, and incorporating as much as possible of the work that was going on in preparations for operations. When inscriptions of these routines were made via hypertext document-links to mandatory documents, and the improvement button on each work process was created the work gained momentum. It was also a consequence of the amplifications that the new NOTES application made possible, like clickable graphical charts and instant access to a number of NOTES databases and the World Wide Web.

KOT assumed a movement from push to pull interfaces in the application that was made for Norne. KOT assumed that Norne users would not be able to use a heavy graphical editor, and FREELANCE GRAPHICS was chosen as the drawing tool since it was the Statoil standard. This solution seemed to be a reasonable one given the situation that existed at the time. However, functionality that made it easy to enrol Norne employees in making their own flowcharts, made the application difficult to maintain later, since the process maps were not dynamic and easily changed. That NOTES was chosen as the basis for the enterprise model was also based on an assumption that Norne could have their needs covered by NOTES. An INTERNET based application might have done more or less the same things, but the alignment of interests between KOT, Statoil Data and Norne created a go for NOTES.

LOTUS NOTES was a powerful tool for inscriptions, since it was already in use and additional inscriptions could be placed on the top of existing solutions: NOTES mail, mandatory documents database, calendar scheduler and others. To succeed, KOT had to gradually enlist participants from a range of locations, reinterpret their concerns to fit their programmatic CW project goals. They had to translate the concerns of other groups into those of KOT. Then, KOT could establish themselves as gatekeepers, or obligatory passage points for integrated organization and IT development in Statoil. As the drama unfolds in 1996, KOT became an obligatory passage point after the Norne work when a number of internal projects consulted KOT before starting the process of describing their work processes.

I argued in Chapter two that the strength of an inscription is related to the irreversibility of an actor network. In most cases it is difficult to know if the inscriptions work and the pragmatic test of practice and use is the only verification. Let me describe this with an example from Norne's point of view or program. Norne personnel tried to develop a new organization by charting a number of new work routines, via a number of translation efforts. In order to inscribe these new routines Norne planning for operations used a number of inscriptions. They developed a text-based operational philosophy document. This was not enough in order to inscribe a new practice. They translated their interests through an operative digital enterprise model. These translations increased their thrust because of training and a number of dedicated process owners. In addition, Norne management took responsibility to follow up the work.

When the inscriptions brought forward by the operational philosophy were not strong enough, a number of additional inscriptions were added on top of the original inscription. The narrative I have described from Norne shows how a number of work routines in planning for operations were translated into different materials. Such materials were of different types. The enterprise model was in a digital form and the operational philosophy on paper. Process

owners were of flesh and blood. Translations were materialized in both humans and non-humans. They ranged from work routines, artefacts, legal documents (project contracts), existing norms and habits, written manuals like mandatory documents or operational philosophy, methodologies (BPR and flowcharting) and a number of organizational arrangements. All these components were linked together into a socio-technical network around Norne. When these translations were added and imposed on top of existing translations they accumulated strength.

Instead of presenting a phenomenon as social or technical, ANT urged us to ask: has a non-human replaced a human, or has a human replaced a non-human? In the Norne narrative there are many such examples. For Norne the application was a practical tool for handling and inscribing routines that had to be co-ordinated in planning for operations. Many of these activities had to be co-ordinated by a project manager. It found a solution to the problem of version handling of mandatory documents, effective and standardized communication between process owners and their team members that could be geographically separated at the time. The Norne management needed a structured way to handle planning for operations. A traditional approach of control would not work given the challenging objectives of Norne. Operators and technicians wanted autonomy and quality of working life in their daily situations and saw the opportunity to achieve this by developing new work processes via the flowcharting effort. Finally, it handled government inspections and revisions in a simple manner.

For Statoil Data, it symbolized the robustness of NOTES, but it was also a symbol that showed their ability to turn around when the organization needed them to do so. It was also an arena for receiving feedback on the new version of LOTUS NOTES that would be implemented company wide in December 1996. Since the application was run in a closed environment the chance of things getting out of control were small.

An alignment of interests in Norne also supported the agenda of the different organizational actors. All the defined organizational actors targets could be achieved with this alignment. KOT tried to inscribe a scenario for "integrated organization and IT development" in Statoil through the Collaborative Workspace project. To succeed in their mobilization KOT needed material for their translations (BPR, business relevant cases, prototypes and pilots). All these ideas and concepts were translated and inscribed into the enterprise model. Improvement comment functionality, management support, process owners like Tommy, super users and KOT facilitation and coaching helped KOT increase the thrust of the initial inscriptions. The simplest way to keep a set of allies in line, or as a whole act as one is to tie the assembled forces to one another, to build a machine, or the digital enterprise model in Norne. As Latour agues (1987:129): "A machine, as its name implies, is first of all, a machination, a stratagem, a kind of cunning, where borrowed forces keep one another in check so that none can fly apart from the group". The enterprise model was an infrastructure that facilitated a number of translations.

Let us take a closer look at some of the properties of the Norne enterprise model. In what follows I argue that the Norne digital enterprise model was a multiple boundary object. It was not designed to be a boundary object but evolved into such an object as a consequence of the technological drama. The character of the "Norne digital enterprise model" made it possible to maximize the autonomy and communication between different worlds within Norne like onshore- offshore, and in relation to Statoil Data and KOT. It enabled the different social worlds that participated in the project to maintain a large portion of autonomy in the daily

work. Only given parts of the work in Norne (or those of importance to maintain coherent information in case of the enterprise model) were pooled in the intersection of information, the rest could be left alone.

In Norne boundary objects were produced when researchers, Norne personnel and Statoil Data collaborated to translate representations of a future organizational practice in Norne. If we look at the character of the flowcharts presented in Chapter five they are both concrete and abstract, specific and general as well as customized and conventionalized, finally internally heterogeneous, as Star and Griesemer (1989) say.

Star and Griesemer define four types of boundary objects (1989:410-411). The first are repositories, which are ordered piles of objects indexed in a standardized fashion like what we find in libraries and museums. The enterprise model of Norne had a repository structure. The technical systems were defined by systems and tag numbers and the maintenance work offshore (1-3 line maintenance, inspection type) were divided according to this structure. The defined work processes in the enterprise model of Norne like the decomposed maintenance process (Figure 5.5) also had a repository character. Such a repository had the advantage of modularity, and people from different communities of practice could borrow from the pile of objects. As the ethnographic examples I have presented from Norne in Chapter five indicate, several technicians used the enterprise model as a pile of references when they were asked to tell how they handled numerous issues in operations. Norne management was explicit about the idea that the enterprise model was meant to be a repository where the Norwegian Petroleum Directorate should find Norne's operational practice. ISO 9001 reviews were to be handled the same way.

The second boundary object is the ideal type. Examples are objects as diagrams and atlas, or in Norne the clickable process map for navigational purposes. Star and Griesemer tell us about the character of such a description (Star & Griesemer 1989:410):

> ...description which in fact does not accurately describe the details of anyone locality or thing. It is abstracted from all domains, and may be fairly vague. However, it is adaptable to a local site precizely because it is fairly vague; it serves as a means of communicating and cooperating symbolically- a 'good enough' road map for all parties.

Norne flowcharts were of this type and also maps of area responsibility of Norne personnel on the vessel. Both were in the enterprise model.

The third kind of objects are the coincident boundaries, or common objects that have the same boundaries but different internal contexts. These arise in the presence of different means of aggregating data and when work is distributed over a large geographical area. The result is that work in different sites and with different perspectives can be conducted autonomously while co-operating parties share a common reference. Norne and KOT used the same flowchart map. Norne personnel translated it to visualize their future practice. KOT used it to present work process modelling and their methodology for a broader audience and future customers. Therefore, it had a more generic use in KOT's application of it. In this example it was a manifestation of what co-ordination technology was. Both Norne and KOT took resources from the same symbolic fountain, the enterprise model.

The last object type is standardized forms that are boundary objects devised as methods of common communication across dispersed work groups. The work methodology influenced by

BPR was central here; improvement comment forms and work process templates for work process modelling are additional examples.

The Norne enterprise model was a multiple boundary object. It had elements from all the various sub-objects of which Star and Griesemer refer. This gave the enterprise model its evocative and strong mobilizing character.

A visual culture can link explicit material culture to a particular way of seeing the world. Sketches like the ones developed during Norne's flowcharting sessions facilitated both individual thinking and interactive communication by getting ideas across. Sketches drew Norne personnel together and formed a social glue. The flowcharting methodology was a group thinking tool that facilitated distributed cognition and served both as an individualistic thinking tool and as an interactive communication tool.

Sketches more in general can work as indexicals, meaning that they might stand for or point to more complex repositories of tacit knowledge. Consequently, they can facilitate a frame in which individuals or groups can index different information and knowledge from the same representation (Henderson 1999:81). Visual practices were important in the problem-solving activities I have described in Norne. In Norne the visual flowcharts had a meta-indexical quality that provided the holding ground and negotiation space for both explicit and implicit knowledge. In spite of their mechanical analogy, or mono dimension in Don Ihde's language, flowcharts had a flexibility that facilitated multiple readings.

Kathryn Henderson describes features of such meta-indexicals (1999:199). They transform ways of knowing into visual forms, index and re-frame tacit knowledge of people interacting, make tacit knowledge readable for others, represent knowledge flexible in a more un-coded format, extend a given lexicon to maintain consistency of meaning and represent different ways of knowing using many different systems of representations at once (verbal and numerous visual modes) (Henderson 1999:200):

> It is because of their meta-indexical qualities that drawings and prototypes can so easily function both as boundary objects that are capable of being read on different levels by different groups involved with the design and its final product as well as conscription devices that are so central to the design process that they must be used by anyone who communicates about the process.

Henderson uses the term *conscription device* (1999:53), to accentuate how engineering drawings operate as network organising devices and how their creation includes power issues. I discuss the use of flowcharts instead of engineering drawings but argue that they share similar properties. She argues that conscription devices are a subgroup of inscription devices. They enlist group participation and are receptacles of knowledge created and adjusted through group interaction with a common goal. Henderson shows how actors must engage one another through visual representation of the conscription device to participate at all in such a design process.

In Norne this is comparable to the early flowcharting sessions, of for instance maintenance in Chapter five, where the overall properties (activities, products, roles and flow) of the work processes were charted. A conscription device focuses on process and a boundary object describes a product (the Norne enterprise model as an IT application). Henderson's point is that engineer's sketches function as boundary devices and conscription devices. During the Norne work process design participants found it difficult to communicate about the new organization without the maps. In Chapter five I have described how these maps were drawn

into the discussion when a situation began to collapse and that the conscriptive quality of these representations were so strong[24] that the people found it difficult to communicate the new organization without them. The development of a new organization was to a large extent captured in a progression or cascade of visually oriented conscription devices. These conscription devices enlisted those taking part in the Norne work process development; hence it was a particular form of inscription.

The Norne pilot needed the help of non-humans to go through with the technological drama. The alignment of the actor network also needed a number of human spokespersons or voices. These organizational actors had different interests, but the programs were aligned at a higher level. Stability in the actor network was, as a consequence of all this, a sufficient degree of alignment of interests among organizational actors in 1996. All these actors were keen on translating their interests on a local level. The management was keen on inscribing routines for revisions into the application. Workers translated their autonomy and work routines in the flowcharts and the clickable interfaces, translating their interests in role descriptions and checklists. The whole prototyping process can be seen as a number of translations or inscriptions. Electronic operation manuals solved the problem of not having updated manuals. Clickable navigation charts and document links made it easier to find information in the many thousand NOTES databases of Statoil. All these translations, some technical (push buttons, improvement comment view, clickable navigation flowcharts) and non-technical (the flowcharting methodology, routines of process owners and others) were the combination of translations that gave the stability of the Norne actor network.

If you want to translate disparate worlds into aligned entities, you must develop, teach and enforce a clear set of methods to discipline the information obtained by the other participants. You need a sufficiently precise set of standardized methods for labelling and understanding things in a new organization. These methods have to be both simple and stringent as KOT's flowcharting methodology was. As Star and Griesemer (1989) point out: methods standardization is different from standardizing theory. The former makes information compatible and allows a long reach across divergent worlds. It became a common ground, a useful lingua franca, for both technicians and researchers. Technicians in Norne did not need to learn the theories of BPR to be able to contribute in the work process activities. Such higher order questions could be addressed by KOT in their experience transfer summary, without influencing the process in Norne. All Norne needed was simple questions like: "how do we do it, why do we do it? " As Tommy's process map indicated in Chapter five, Norne could make their own versions of the methodology. KOT's methodology was so little stringent that using it in preparations for operations in Norne meant that the basic Norne activities (that is, work that had to be done) in planning for operations were virtually untouched. As Star and Griesemer argue, methods control will never be enough to ensure co-operation across divergent social groups.

For KOT these additional devices, that we have already described, were not engineered in the same way. They emerged as a consequence of the drama, of conscription devices, the various meetings, workshops, flowcharting sessions and cyclic prototyping. I will later in my analysis use string figures and a "game of cats cradle" to describe the ingenious interaction pattern, the development of a dramatic pattern that only KOT could partly control. Metaphorically speaking, KOT and Statoil Data provided the material for the strings and some of the rules of the game, but less of the patterns and variations that became translated as the strings passed along in the drama.

How stable, or irreversible is the network now, or in the terminology of Bryan Pfaffenberger, has it reached a phase of de-signification, an objective reality? In the operations and maintenance environment it had the potential of becoming a social fact in 1996, but we see the working day it will have to go because of a number of forces that the actor network must align continuously. KOT tried to develop good maintenance routines on the application by a number of translations to control the weaknesses of the application. "Rotten" document links and maintenance routines were to be resolved by taking the system of process owners and super users into operations. By inscribing materials for a system of continuous improvement around the application KOT hoped to gain a sufficient degree of irreversibility.

Pragmatic trials of strength have shown that this only partly worked. KOT left the scene and Norne operations was dependent on their own efforts to keep the work alive. Some senior middle managers (including some of those who were not ripe enough to act as process owners) with substantial experience from past installations had problems with letting go of their past power to the multiskilled teams. Even though these forces were kept down in 1996, they came to the surface in operations in 1997. DOCMAP the new Intranet application that has similar functionality is used by the other oil installations and is becoming the obligatory passage point. It will be difficult for Norne to keep their own "proprietarian" application as I told in the epilogue of the last chapter. To get the Norne work process NOTES application up and running again with the proper information resources that Norne needs in their present operational activities will require too much effort.

Key persons in planning for operations that worked as super users have moved out of Norne to new installations and few new enthusiasts are there to take their place. A number of offshore users report that they need not use the enterprise model any longer since most of the work process maps and their content is internalized. Since the work process application is no longer updated, it is a question of time before it dies altogether. A substantial number of visitors in the enterprise model today are not Norne personnel at all, but people that collaborate with Norne and need to know more about the Norne's espoused operational practice. For the same reason a number of database visitors from other offshore installations and onshore units still use the Norne enterprise model as a repository to gain input to new organizational models and practice in their own improvement projects.

6.3 Grasping the nature of classification and sense making

If we go back to the discussion on analogue and digital concepts that I touched upon related to systems design in Chapter four, the work in Norne had to follow repeated movements from analogue to digital concepts as the work with the Norne application progressed. The tacit knowledge of the people that participated in the flowcharting groups had an analogue character. To become externalized it had to be broken into a more digital form, the flowcharts are more digital representations, but they rely on some analogue features. When the information of people in Norne were put into the enterprise model it gained qualities of a modular system. In the Norne CW pilot, as everywhere, digital distinctions are the precondition for generating categories and moving from analogue to digital processes is what naturally follows inscriptions and translations. Classical categories must be defined in relation to clear boundaries. Remember the insight of Mary Douglas (1986) that to recognize a class of things is to polarize and to exclude. It will involve drawing boundaries, which is a very different activity from grading. As a consequence, the move from recognizing degrees of difference to creating a similarity class is a big jump.

In my presentation of Mary Douglas (1986:59) in Chapter three I used her argumentation that sameness is not a quality that can be recognized in things themselves; it is conferred upon elements within a coherent scheme. In ANT's terms it is the institutions or their human and non-human delegates that via inscriptions and translations do this job. Finally, the idea of a quality of similarity keeps resurfacing because sets of similar things are so well established and aligned within a particular culture that their sameness has the authority of self-evidence, often as a consequence of past translations. This activity of creating sameness necessarily involves drawing boundaries.

It is the daily social interaction (or in ANT terms actors translations and inscriptions) that forms the basis for the construction of the world into classes. Survival is dependent upon sufficient emotional energy to carry this elementary enterprise of classifications through all the hard labour necessary to create a workable world. Social interaction gives the element missing in the natural history account of the beginning of classification. The analogies chosen are therefore a fundamental starting point to understand the subsequent inscriptions and translations. Metaphors used in the Norne pilot made it possible to develop a new kind of experience through making influences from the metaphor to other actions as a method for sense making.

The IT prototype called the Norne enterprise model created a mechanism to show the maximum level of information through the least amount of energy. Metaphors and analogies provided an important mechanism to develop a network of concepts that could be used to create knowledge about the future operation of the Norne vessel by using today's knowledge. The association of meaning through analogies (like the move from machine inspired flowcharting to future operational practice) are led by rational thinking. The flowcharting analogy let the functional operation of new concepts or systems become explored through reference to things already understood. If we look at the reflection process and the new concepts related to new collaborative IT that developed during fieldwork days, workshops, the regular project meetings, KOT experience report and the Norne-KOT close out seminar they all have an abductive character.

In Chapter four I described abduction as an unconscious process, a lateral extension of a reasoning process that centres on the use of metaphors and analogies to find a new pattern and try to transfer this pattern into new operational practice. Reflection in action was a way to stimulate this unconscious production. Abduction played a role of explorer of viable paths to further inquiry in the development of new concepts in the CW project and in preparations for operations in Norne. In abduction, as in preparations for operations, the goal is to explore the data, find out a pattern, and suggest a plausible hypothesis for future operation of Norne. Only operations in Norne could find the empirical verifications, provide the pragmatic test of the new concepts and ideas.

Once metaphors or analogies have become externalized, there must be some mechanisms that will enable them to stay in use or to become institutionalized. Ritual and myth, the latter in the meaning of legitimating and justifying narratives helped in this institutionalization. Pfaffenberger (1992) gives the term myth a key meaning in this theory of technological dramas, and myth is also an important part in Victor Turner's (1974, 1982) social dramas. Myth has become colloquial in the organization literature (Karlsen 1990, Allaire & Firstotu 1984, Bowker 1994). It is however a sophisticated question if myth in the traditional anthropological sense can be used to describe these organizational phenomena. To avoid this

discussion I substitute myth with legitimating and justifying narratives that cover only parts of the traditional myth concept in anthropology.

6.4 Legitimating and justifying narratives in the institutionalization of new ideas and concepts

In 1995-1996 a situation of uncertainty existed in the organizational context of KOT. The funding for the experience transfer project was depleting fast and they had to develop a new project that could secure the financial situation of the future. Mary Douglas (1986) argued, as quoted earlier, that institutions like KOT have to legitimate their existence and justify their projects in reason and nature. Myth and ritual were according to Bryan Pfaffenberger (1992) a prerequisite for the spreading of new ideas and concepts related to collaborative technologies. A similar case is reported by Geoffrey Bowker (Bowker 1994) in his description of the history of Schlumberger and the company's development of a scientific rationale for well-logging.

Even though I am sceptical to Pfaffenberger's use of myths, a symbolic discourse is necessary to create the interpretations of the new social practices and artefacts and develop a working order among persons and groups. Pfaffenberger uses the term myth to denote the written and oral narratives that work in tandem with the development of new technologies, and he argues that myths are not necessary confined within traditional societies. Still, in what follows I will, as argued above, use the term legitimating and justifying narrative, since a number of narratives both served the function of legitimating and justifying the work and concepts of KOT. In KOT's local interpretations these narratives were referred to as "selling in new ways of thinking and using IT in Statoil", "making people in Statoil reflect on new ways of collaborating" and "taking synergy's out of new work processes and IT". We can go back to the research reports in 1995 and 1996 to find input to these legitimating and justifying narratives.

In Chapter five a number of examples are described related to the future use of IT in organizations: ORG + IT = SYNERGY...that application of future IT will make it possible to reduce the multitude of barriers that present work processes and IT solutions have...future information technology will provide space for ways to visualize structures and connections that up to now has not been apparent or possible to create. It can lead to added value for Statoil.

KOT had their reasons for addressing the positive aspects of IT since Statoil management as late as 1995-96 was not convinced that investments in IT paid off. It can be seen as counter narrative to that of IT as an expense. The attitude towards IT in Statoil until the mid 1990s was that of IT as an expense and not as an enabler. The theories of BPR that KOT picked up and adapted in their flowcharting methodology helped prepare the ground for this thinking on IT. The ideas of radical new organizations enabled by IT, horizontal value creating processes and the belief in the death of the pyramidal hierarchy were all part of these legitimating and justifying narratives. The KOT managers lobbying for new use of IT, the Norne pilot, and the two university programme professor's many presentations held for Statoil managers helped increase the strength of the narratives. The folklorization of the Internet in the media, a "myth" making process of dimensions in itself was used actively to develop more legitimation and justification for the KOT ideas. Norne also relied upon legitimating and justifying narratives that asserted: "Norne would not succeed in operating the ship with so few people

without extensive use of IT... Norne will have to use Internet technology to operate such a new organization... Production ships can be operated at lower investment and production costs". The legitimating and justifying narratives here were dramatized or co-produced between KOT and Norne, each group borrowing elements from the other.

One element of the technology advocated in KOT's legitimating and justifying narratives must be discussed: its link to the nature of high technology. To link the narratives to new information technology and new production technology like the Norne ship creates a particular credibility. Examples in anthropology abound where symbolic tools bestow power and status. Such tools can have status as special objects, not necessary because of their functional properties but because such objects draw their power from special sources and places within the social fabric of the community (hierarchy, myth, lineage and history).

High technologies assume, a dichotomy relation or a binary opposition (Douglas 1967), a classification mechanism arguing that some technologies are "high" while others are "low" or average, consequently with a lower status. Kathryn Henderson (1999:198) shows how high technology confer status on the corporate possessors and producers not because the new high technology may get the job done more efficiently but because it signifies power and prestige more efficiently within the pertinent social networks of importance. She describes how the status of a new technology is of a temporary status, meaning that it is crucial to be one of the first to employ its capabilities (Henderson 1999: 189-190):

> ...new technologies become known beyond their original context but are of limited availability because of high cost or intentionally limited access. During this period they develop a heightened aura.... Initially, the making of copies adds to the notoriety of the original new technology, while the time lag involved in dissemination also enhances the aura. The aura then gradually begins to fade as the new technology is demystified through dissemination of the copies. Further widespread dissemination eventually kills the aura as workers work out, around, and through its bugs or inadequacies and incorporate the new technology into daily work patterns where it becomes mundane. Hence, a high technology is elite today and obsolete tomorrow, rapidly losing its status to a newer or higher technology.

The new version of NOTES, had navigator features that dazzled the Norne users, but the aura of NOTES release 4 faded away gradually. The glamour of the aura was initially of such a nature that it overshadowed the ponderous task of handling the problems in the workings of the new technology itself or making it fit with existing practice. The involvement process, the flowcharting sessions and daily use gradually demystified the application. By the time Norne had developed large use of the application in late 1996, the product was no longer the latest but merely a part of Norne's daily routines. KOT could build on this Norne application in their further work but had to go one step ahead to let the aura of new high technologies develop new legitimating and justifying narratives. In Chapter seven I describe how KOT used the new LOTUS DOMINO technology that was assumed to be the next natural step to take with regard to high technology in Statoil.

Actor network theory has been criticized by the anthropology of science and technology (AST) (Martin 1998, Forsythe 1994, Hess 1992, Hess 1997). ANT according to Emily Martin (1998) sees science from physics to sociology using the same features to produce its effects. These features are: clarity of signs, simplicity of explanation, visibility of inscriptions, continuity and linearity of links in its networks. Mietinen (1999) has also criticized ANT to be Machivellian and one dimensional, interested in power alone.

To defend ANT here, you can interpret ANT this way, although ANT will be uninterested in such a critique. ANT does not try to portray the detailed inner thoughts and agendas of

people. It follows people in action and observes what they do. As Michel Callon (1999: 181-182) argues there is no model of (human) actor in ANT nor any basic list of competence that have to be set at the beginning because the human, the self and the social actor of traditional social theory is not on its agenda. Instead of constantly predicting how an actor should behave, and which association are allowed a priori, ANT makes no assumption at all, and in order to remain uncommitted needs to set its instrument by insisting on infinite pliability and absolute freedom. Michel Callon says that ANT is based on no stable theory of the actor but assumes radical indeterminacy of the actor, whether it is size, psychological make up and motivations behind its action.

What does this mean for an anthropological interpretation of ANT? Is KOT power seeking, profit maximizing, aggressive individuals moving around in the Statoil organization, as one possible interpretation of their actions might be? I will say no to this question. KOT works and lives in an internal market, in an attention economy. It is continuously seeking for a niche to survive in a technological environment that at numerous points in time have showed that they want the group removed. Their visible actions must be understood as a means for survival. Without telling too much about what happened later in the CW project, KOT became dissolved in the end.

It might be that we have to make some complimentary additions to this picture of KOT, without our use of ANT falling to pieces. One aspect deals with the process of enrolment: Did KOT have the amount of power to influence and create social facts as Latour assumes? No, the enrolment process or the drama was more dialogical, going both ways. KOT participated in the Statoil organization, got their feedback from fieldwork and cyclic prototyping. This process cannot only be understood as strategic, but is also a process of co-learning where all participating parties learned from each other.

The working order was negotiated; KOT was never in full control of it. In cases like these the KOT researchers and the others must be seen as co-participants in the processes by which intermediaries and boundary objects, do or do not become part of the lives of people within a given working order. The overall requirements or the value standard that KOT and Norne agreed to follow, described in Section 5.2.1, must be seen as an input to the translation and inscription process that followed: quality of working life, do not describe details, supervision is not an issue. It was not the work of KOT only. Of the three original concepts of the Collaborative Workspace, work processes or the enterprise model was the only perspective that was handled in detail, mostly because it was what Norne requested.

Is there another metaphor that can capture the spirit of the social and technological drama in Norne? Emily Martin (1998) is seeking to understand processes by which things, people, concepts and events become invested with meaning and she introduces a metaphor that consists almost only of process, Donna Haraways (1994, 69-70) use of string figures in the game of cats cradle[25]. String figures can be passed back and forth on the hands of several players, who will add new moves in the building of complex patterns. This game invites a collective work in which one person is not able to make all the patterns alone. It is possible to repeat interesting patterns, and figuring out what happened to result in intriguing patterns is an embodied analytical skill.

If the Norne case is a game or drama of cats cradle it would most likely in the light of Donna Haraway and Emily Martin be a serious game about complex collaborative practices for making and passing on culturally interesting patterns. Martin (1998:37) asks what kind of

game are string figures? It has some rules, but they are few and flexible. Any number of people can play, for any length of time. The string can be made from any material. Old figures can be repeated or new ones invented. It can be played competitively (who will mess up first) or co-operatively (how long can we keep the figures moving). It can be played in any location, by anyone invited to join. This loose, casual drama with so few rules or scripts can be a model for the Collaborative Workspace project. String figures improvizational and embodied character makes it compatible with the drama metaphor.

As noted earlier KOT was good at managing legitimating and justifying narratives. They picked up formal ideas, structures and concepts that were well aligned with formal structures in nature and reason (management and business goals, integrated organization and IT development, BPR, the Internet, enterprise modelling, the technology strategy and Norne the core symbol to mention a few). More general management and organization development narratives influenced KOT's narratives. Consider the BPR theories described in Chapter five and of which KOT adjusted. Huczynski (1996) has defined some major traits of such a performance or genre[26]. It is placed in the present situation and address what is perceived to be the present problems of doing businesses. The ideas must be spread to a potential audience. Such ideas or theories suggest changes that addresses individual managers needs. Those that herald the new ideas must be able to portray the essential ingredients in a way that users find relevant, and the performance itself must be filled with engagement.

As I argued in Chapter three, institutions like KOT have to find legitimation in both reason and nature, and legitimating-justifying narratives are important in this process. However, to say that KOT only used the narratives to enhance their own ideas and concepts is too simple. In the workshops, flowcharting sessions and meetings with process owners and management such narratives served the function to "think out of the box" in relation to present operational practice. Such narratives could work as metaphors, enabling the Norne personnel to reflect upon their present thinking and action and what steps had to be taken to walk in the direction of the "perceived" future.

It is too easy to say that these concepts were cynically used by KOT, that they were "buzzwords" or lacked meaning, because they signified something new. The name or concepts of the CW project in Norne served the function of being chosen standards that people could gather around in their communication with each other. What for the deconstructivist seems to be an epistemological soup or stew, was sense making for handling IS/IT -issues for those taking part in the project.

Consequently, the CW concepts that materialized into the Norne work process application had an important function even though there was a large amount of ambiguity and multivocality related to the concepts meaning. Finally, even though the name or concepts portrayed something, that might be difficult to understand, they created attention around the project. Barbara Czarniawska (Czarniawska & Sevòn 1996:25) is touching an important aspect of this when she shows the link between fashion related to management concepts and institutional change:

> Fashion is the fringe, the margin, the challenge to the institutionalized order of things, but its durability in time and mobility in space, indeed, its use of technologies which are required for that scope, depends on its firm institutionalization in the contemporary western world. Similarly, much as fashion seems to sabotage and threaten established institutions, it is also an institutional playfield: new practices can be tried out and disposed of - or institutionalized, thus revitalizing the existing institutional order.

Metaphors like "enterprise model" and "integrated organization and IT development" were potent and could provoke strong feelings and meanings. In the magnetic field around a buzzword like BPR, other elements of language, specialized terms, phrases and general terms were developed. However, they influenced the world of KOT and those that participated, or were bystanders. Some of their attitudes were changed but what was most important was that it created a level of agreement that made a discourse possible. There were many good reasons to believe that IT did have synergistic effects in the Statoil organization, that it would be cheaper to operate Norne than the previous installations.

The main point is that these legitimating and justifying narratives, in most cases, lacked empirical validations. Consequently, they presented a possible pattern, only future action or trails of strength, Norne in operations, could test the patterns workability. Legitimating and justifying narratives of the sort KOT and Norne developed together had strong elements of truth, but they did not tell the whole truth. However, when these narratives were employed in the vicinity of KOT's actions in the organization they increased the support of KOT and their ideas, and in the subsequent spreading of the CW project.

Legitimating and justifying narratives consequently had both legitimating and action extending functions for KOT. At the same time as KOT put forward their equation "ORG+IT=SYNERGY" and reported their stories of successful use of IT from inside Statoil and outside, an explanation of the legitimating and justifying narratives got placed outside doubt and argumentation. At the same time that KOT described elements of everyday situations they created a bridge to the unknown since the justifying and legitimating narrative depicted the future trails that everybody had to go.

KOT's production of legitimating and justifying narratives can also be seen as an adaptive mechanism used in order to maintain a logical framework to reality with its meanings related to action, to understand their own situation within Statoil. Without this logical framework it would be difficult for KOT members to take decisions under uncertainty or act with information scarcity. The narratives provided answers to basic organizational dilemmas, like how to use IT strategically, or how to use new IT in everyday situations to create added value, questions that KOT struggled with themselves. KOT believed in the legitimating and justifying narratives and it influenced both KOT's thinking and action. We shall see in Chapter seven that newly employed KOT personnel in the VISOK project in 1997-98 did not buy or lost confidence in the narratives of the original KOT-group.

Why did KOT have to maintain a logical framework? One aspect of this deals with the sense making of KOT, as already mentioned, to find the world understandable. For this they need consistent categories to pursue logical thinking as researchers. Another aspect deals with the same legitimation and justification processes that we have described above, but which are related to deeper modernistic beliefs. Or beliefs that are "nature and reason"-like in Mary Douglas vocabulary. These narratives are related to core beliefs about organizations: that an organization is a rational and logical system that processes information, takes decisions and solves problems, and that the solution is to develop ways of effectively handling information and decisions in a turbulent environment.

As Pfeffer (1982:9) and others have stated (Czarniawka & Sevón 1996), organizations are not necessary operated according to internal/ external input-output mechanisms. Rationality, goals, and preferences often develop from action more than being influenced by the latter. Compared to the classic assumptions, that mission, planning, and management comes before

organizational action, it might just as well be the other way around. In the vicinity of this modernistic thinking a number of legitimating and justifying narratives exist: complex tasks requires planning, future decisions demands that the consequence of alternatives are evaluated. More information leads to improved decisions, professional managers take better decisions and can lead any business (the last traditionally referred to in Statoil as a major management thesis).

If we go back to the discussion of the construction paradigm in systems development described in Chapter four these modernistic beliefs about organizations share the same properties. Characterizing a process as rational means at least two things. First, that the process has identifiable and agreed upon goals and a number of prescriptions to reach those goals. Good IT systems development processes should consequently produce systems that improve organizational effectiveness and task performance, and at the same time be systems that are accepted and used appropriately. An information requirements analysis that was a part of the flowcharting method and general, BPR methodologies are examples of methods used in Norne that fit in this context. Here, objectives, value chain and operation strategy are defined first, then existing jobs are specified, and improvement planned (flowcharting). Finally, new information needs was determined and incorporated in the Norne enterprise model. From such a perspective of rationality systems design elements are instrumental to the achievement of organizational goals. As rituals these same elements fulfil different although equally important functions. Robey and Marcus (1984:12) argue:

> Rituals in systems development function to maintain the appearance of rationality in systems development and in organizational decision making. Regardless of whether it actually produces rational outcomes or not, systems development must *symbolize* rationality and *signify* that the actions taken are not arbitrary, but rather acceptable within the organizations ideology. As such, rituals help provide meaning to the actions taken within an organization.

Robey and Markus argue that when rituals provide meaning to the actions taken within an organization and perform this function systems design uphold the "myth" that organizations are rational entities serving social interests by pursuing their own goals. This is of course not all false, but the distinction between "myth", narrative and knowledge as justified true belief is transparent. Since a lore of rationality surrounds Statoil decision making, like decision making in all organizations, it is understandable that organization and IT development processes like that of KOT also must be regarded as rational to gain legitimation and justification.

The rituals help to ensure this perception (Robey and Marcus 1984). KOTs focus on evolutionary methodology, was of a different rationality than Statoil Datas MIDAS (Statoil Datas software engineering methodology), but it was still rational, and KOT was just as keen on presenting themselves as professional and rational as Statoil Data. They argued strongly in their meetings with Statoil Data and in their experience transfer report for an evolutionary and cyclic methodology. In their 1995-1996 research report the irrational aspects of their experience is de-emphasized or removed to meet the demands of the modernist organizational narrative genre of Statoil. In an organization like Statoil that is committed to intelligent choice and actions, those that want to look effective will have to demonstrate their effectiveness and rationality. Robey and Marcus (1984: 12) argue:

> Clearly, this need for rationality extends into the systems development process. The rituals of systems development perpetuate the prevailing ideology of rationality and provide an acceptable cover for inexpressible political motives in the dealings between users and designers. Overt conflict and manipulation are thereby

controlled, lending stability and order to systems development. In effect, the rituals of systems development enable participants to act in their self interests without discrediting the organization's rational ideology.

In this light there are certain elements that are believed to enhance Statoil's effectiveness. Statoil still believes in the construction approach, when political issues do come up to the surface they are not always reflected upon but defined as misunderstandings, arising from unclear objectives. These legitimating and justifying narratives never pick up sequences from the intervention paradigm of Bo Dahlbom and Lars Mathiassen that we presented in Chapter four.

Organization and IT development is an organizational game with conflicting goals, contradictions and paradoxes comparable to a court of law. Such a perspective will never make any claim that actors work towards the integration of their difference with other groups. It is possible to say that one works according to company interest in the perspective of that particular life world, and these targets will be vague enough to make multiple interpretations possible. In many instances contradictions are related to project uncertainty, vague targets, artefacts that had to be developed on the way, different interests, scarce resources and multiple perspectives among participating groups. Change, flux and contradictions is the normal and less the exception. I will take up this glove again later when I describe elements of a "due process" in Chapter nine.

I started this chapter with an instrumental realism and tried to link it to the work that KOT was doing in Norne in order to describe the pragmatic nature of technological relationships in Norne. I then went through the development and spreading of new ideas, concepts and visions of new IT in KOT's Collaborative Workspace project towards Norne in 1996. With Bryan Pffaffenberger's technological drama as the back curtain, I analysed the work in Norne as a development of an aligned heterogeneous actor network with both humans and non-humans. I used a number of ANT-concepts in this analysis to describe the development of the actor network around the new Norne installation: translation, inscription, conscription, and boundary objects.

There is a strong Durkheimian legacy here, the focus is on social facts of different kinds: the construction of technological solutions, black boxes, beliefs and new categories. However, it is the questions posed by Durkheim more than his answers. The point of entry is that the social order cannot be taken for granted. It must be established and be continuously reformulated to remain a working order. To establish this working order groups use different forms of material or immaterial symbols that we have called boundary objects and conscription devices. The working order becomes coherent by means of boundary objects and conscription devices, since they are concepts and objects that inhabit several intersecting social worlds and satisfy the construction of meaning in all of them. Finally, I showed how a symbolic discourse between Statoil Data, KOT and Norne was needed to create the outcome: interpretations of new social practices and artefacts. The use of legitimating and justifying narratives was important in the subsequent development and spreading of the CW project in Norne and in the rest of Statoil. Let us now follow KOT' s action further and see what happened with the ideas and concepts of new collaborative information technologies when KOT's CW project moves from operations to exploration in 1997 and 1998.

Chapter 7 The Collaborative Workspace project in Exploration (VISOK 1996-1999), the further career of the concept

7.1 Introduction: Exploration and improvement work

In the mid 1990s a number of change efforts were undertaken in Statoil. Up to now we have dealt with Statoil operations. This chapter describes what happened when the CW project tried to mobilize efforts for the new concept in exploration and development of new oil and gas resources on the Norwegian Continental Shelf (NCS). Here the main objective is to develop commercial solutions for future oil and gas fields. Users are small distributed project teams that are responsible for developing a particularly promising part of the Norwegian Continental Shelf where Statoil has business interests or licences. Projects are multidisciplinary with geologists, geophysicists, reservoir engineers, interpreters, financial and risk specialists and engineers with an understanding of possible technical development solutions. Teams (and often even the members in the same team) are situated in different parts of Norway. Exploration and development projects are complex knowledge construction processes, since the financial uncertainties and risks associated with finding oil and gas are large. In this domain most of the work deals with the processing of information that ranges from geological seismic data, financial data based on possible field solutions and risk assessments.

In what follows I present the context in greater details. I start by describing Statoil's exploration challenge in the mid 1990s and give a short introduction to the exploration activities (7.1), or *the early phase* as it is often called. After this introduction I describe the start up of the VISOK project and the further alignment between KOT, Statoil Data and EDN (7.2). I then go through the overall project development and implementation of VISOK in 1997-98, touch upon VISOK's functionality briefly, the development of a niche of VISOK in the new landscape of a Statoil Intranet and finally how key Intranet actors agreed upon some basic sense making principles or a working order in relation to further Intranet development (7.3). The main content of the chapter is a number of polyphonic narratives (7.4), where I have surrendered ethnographic authority to let the VISOK participants themselves describe what happened. Four narratives are chosen because they bring a direct connection to the concepts of the collaborative workspace project described in Chapter four.

7.1.1. A short introduction and a presentation of activities in the early phase

BRU TF (or early phase) was an improvement project initiated by the organization responsible for early phase oil and gas business development (EDN) in 1995. The target of the project was to improve Statoil's ability to move new oil and gas projects to a decision on further commercialization, and consequently an improvement of the business development processes. The early phase (TF) is, simplified, all business development activities related to exploration activities in open areas (government territory with no concessions), collaboration internally and together with partner licences leading to a decision that will eventually start the process of making a plan for the development and operations of a new installation. (PUD), see Figure 7.1.

The situation in 1995-96 was as follows: Statoil had problems finding new prospects for future development, e.g. fields that could be built with net profit. To keep up the present production rate Statoil had to improve its prospect acreage. New projects were not only fewer but also of a different character (smaller and more complex reservoirs). Statoil was becoming more a partner in licences operated by other oil companies. New development concepts saw the light, a change from giant concrete installations to floating installations, production ships (like Norne) and more simple underwater solutions. However, newly discovered resources were not large enough compared to the present production rates. Statoil's oil reserves were mainly a consequence of improved oil recovery on oil installations in operation (being able to extract more oil resources from the reservoir because of new technology and techniques). The target rate was 500 000 barrels per day in 2010, but the estimated figures in 1996 were 200 000 barrels. Exploration had to be put high on the strategic management agenda in Statoil for the years to come.

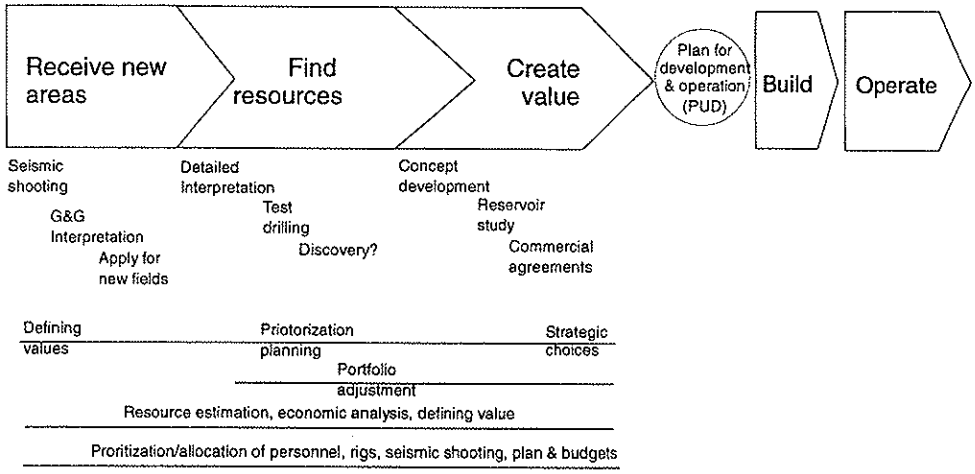

Figure: 7.1: The work activities of the early-phase

The activities in the early phase consist of mainly three overall activities: receive new areas, find resources and create value. I will briefly present these three activities. Exploration work are complex activities and I only present an overview here. These three activities lead to a plan for further development and operation (PUD) that is handled over to the Norwegian Petroleum Authorities and Parliament for decision. The processes leading to a PUD might seem sequential but most of these activities go in parallel. After a formal approval of the

PUD, the licence facilities are constructed. In the Norne narrative we followed the last part of this particular phase, preparations for operations. After the construction the installation is put in operation. It will be operated for a number of years until the reservoir is depleted and the owners of the licence clean up the remains of the offshore activities. Let me now take you back to the overall activities in exploration and the early phase.

Receive new areas consists of two major activities: 1. In the processing of open areas a mapping of potential new resources in open areas in the Norwegian Continental Shelf (areas not released in concession rounds by the Norwegian State) is done continuously by the Statoil organization.. This mapping is based on new seismic shooting surveys or existing data (previously analysed data). A map of prospects and risked resources for a number of areas are set up. In these prospects a preliminary evaluation of reservoir characteristics, a technological and economic evaluation (prospect evaluation) is undertaken. This leads to a map of prospects with net present value and consequently a ranking of both geographical area and prospects. 2. Apply for new licences. The Norwegian government releases a new part of the continental shelf and divides it into licence blocks. Oil companies apply for new concessions and licence blocks. Before the release of new licence blocks Statoil organizes a new round project that is supposed to find which of the new licences Statoil should apply for. From the open area processing activities comes a number of prospects that are evaluated in geological and geophysical analysis. The prospects are undergoing a reservoir evaluation that ends up with given prospects and risked resources (a risked estimation of volume of the hydrocarbons in the actual reservoir). The risked resources are taken further to a technical field evaluation where potential development concepts are evaluated (ship, condeep, pipeline, underwater systems). Based on the reservoir evaluation and the field evaluation a financial evaluation is conducted. This forms the basis for a net present value estimation of the prospect. Net present value estimates form the basis for which blocks or licences Statoil chooses to apply for in the contact with the Norwegian State during concession rounds. Statoil applies for a number of licences. Some are given to Statoil while others are awarded to other oil companies.

These processes lead to the next phase. **Find resources** covers work on Statoil licences before the discovery of new petroleum resources. After Statoil has been awarded a licence, a licence agreement is set up between the licence partners and the Norwegian State. Work obligations or activities are set up for each licence. To make this even more complicated Statoil can apply for new licences in between the concession rounds. The "find resources" phase has three (or four) parallel ongoing activities. An important work of the work is done by EDN namely the licence administrative work that leads to project plans and budgets.

The geological interpretation and reservoir simulation are done by EDN, LTEK and PETEK. This work leads to database prospects with maps of risked resources and production profiles of the new reservoirs. The last parallel activity is field development, which is an economic calculation that leads to net present values for each prospect. These three parallel activities are put together in order to evaluate where test drilling is to be conducted. From here there are three directions. The drilling can be postponed. Statoil must then go back to the licence committee and argue why they have not followed the obligations in the work programme. If the results of the three parallel activities are not satisfactory the licence can be given back to the authorities or sold to the other partners. The last option is the most positive option. If there is a "go" or "yes" due to positive results of the three parallel activities, an exploration well must be prepared and executed. The drilling environment in LTEK does this.

All test drilling on the continental shelf must be co-ordinated since drilling vessels are scarce. Statoil must prioritize wells that most likely lead to the most added value, in relation to the exploration market and their access to rigs. Drilling will give additional information in terms of well data that can be analysed further in a new round of the prior three parallel processes above. If there is a proper discovery, as a consequence of the test well, to the next stage ***create value*** starts. If the well is dry, the reservoir must be evaluated via the parallel processes one more time.

The last phase is ***create value***, which deals with work in licences after a discovery. The three parallel processes above are once again executed, but the properties of the new licence are increasingly put into more concrete terms. The licence administrative activities develop a project implementation plan. The earth science activities continue on well and reservoir evaluation and end up in a geological model of risked resources and a specific production profile. Field development activities define a field solution for the installation with a net present value, meaning: "find the most profitable way of bringing the hydrocarbons from the reservoir to the market".

It consists of three major phases: screening, feasability study and concept phase. In the screening phase a number of different solutions are compared. In the feasibility study a harsh evaluation of the costs of various solutions is undertaken and in the concept phase the costs of the chosen solution is evaluated. A decision on the internal commercialisation of the licence is taken, based upon the input of the above three processes. If the net present value is high the project can make a PUD. Decisions are not problematic if the net present value is too low. This means that the licence can be handled back to the authorities again or sold to competitors. The problem is the many "may be's" that are the most common situations in the course of exploration projects at this point in time. Here the uncertainties related to further development are so large that it is difficult to take the right decision.

Three types of action can be taken to improve this situation of uncertainty. First, you wait, go back and go through your evaluations one more time. Second, you gather more existing data and do the three parallel activities one more time. Third, you drill an out step well to apprehend more data on the properties of the reservoir. This will give you more earth data and decreased uncertainty. Finally, the licence has the acceptable net present value and can be taken to a PUD decision. If not, additional loops and evaluations are needed. A simplified version of these activities is described in Figure 7.1.

Throughout the three main activities: receive new areas, find resources and create value, there is a division of labour between EDN, LTEK, PETEK and B&B. Most administrative and financial work is done by EDN. They set up a project team to work with the licences/prospects through projects and develop project execution plans. They evaluate the new prospects, initiate licence agreements and keep all contact with the authorities like (delivering licences back to the authorities) on issues related to new licences. LTEK does all the collection of seismic data. They develop exploration strategy programs, initiate test drilling and create field evaluation reports. B&B and PETEK develop the actual drilling programmes. TEK UBT maps and evaluates technological or economic development solutions.

7.2 EDN and KOT are aligning their efforts

In June 1996 the CEO of EDN and an important EDN gatekeeper visited KOT. As a consequence of the role that KOT had played in the BRU TF project, the two visitors came searching for advice on how to organize their improvement efforts in the aftermath of the project. The conclusions from the BRU early phase work indicated that communication and information were critical factors that had to be addressed in the future: The common understanding of overall business targets in the EDN organization had to improve. Communication between different occupations and positions (geologists, geophysicists, concept developers) was poor. Improved use and sharing of information among the same groups was identified to have vital importance. There was a lack of information available from past exploration projects, indicating that much business development work was done several times. Finally, the ability to identify and co-ordinate dependencies among regions, groups and persons working in the early phase had to improve.

In this meeting with EDN stakeholders KOT had involved one of the university professors to present the prospects on the future use of information technology. The Norne enterprise model in LOTUS NOTES was used as an example of how some of EDN's challenges could be met. In the discussion that followed Robert stressed the following:

"An enterprise model like the one we have shown you from Norne makes it possible to retrieve necessary and updated information in an intuitive and efficient manner seen from multiple contexts in the organization. It will support the processing of and construction of knowledge by letting teams collaborate/communicate through the model. The enterprise model will enable more focus on knowledge creation and decision processes than is the situation today. At the moment we spend too much valuable time searching for and processing information. Imagine if more of this time could be used for knowledge creation activities?"

The EDN CEO presented a vision of what he called "the virtual North Sea". In this virtual world Statoil had good aggregated predictions from seismic data, easy accessible and quality assured (QA) databases, multimedia interpretation techniques, new pressure and migration models and broad use of animation techniques within geology. "The Virtual North Sea" was to be developed in tandem with more efficient project work, integrated "dream" teams, stronger prioritization of projects, regional projects (moving from smaller to larger areas), better exploration plays to decrease the time to drilling, and decrease the uncertainty in exploration projects. The development of skills was important: Should they hire the best 10 North Sea geologists? How should technical skills among groups like geologists become more oriented towards business development? The conclusion of the meeting was that KOT should plan a preliminary project and invite EDN stakeholders to a meeting in Trondheim in October 1996. If the stakeholders found the initiative promising, a larger project between EDN and KOT could be set up in 1997.

The road ahead was still uncertain. Peter who had the continuity and most "hands on experience" in the EDN organization went to MIT for a one year study leave just after the meeting, and the rest of the KOT personnel had little knowledge about EDN's work processes. However, KOT started to build a mock-up based on LOTUS NOTES release 4. A replica of the Norne database was modified for this purpose, see Figure 7.2. Before the meeting the content was discussed with important EDN stakeholders, but it was still a general mock-up. KOT was very much aware that they had only to a small extent been able to catch important business development activities for future IT support. Ten EDN stakeholders participated in the October 1996 meeting. They were all managers. Most of them had backgrounds in the earth sciences and it was a mix of staff and line managers. However, the staff managers dominated in numbers.

Robert started with his version of the university professors animated MICROSOFT POWERPOINT slide presentation. In his talk: "Perspectives of the future", addressed the challenges of the new economy, of the Internet and of what it might mean for EDN. His talk culminated in the presentation of the demo VISOK, named "Enterprise Description Norwegian Continental Shelf". The first VISOK demo in LOTUS NOTES had what KOT called six perspectives on EDN's business (see Figure 7.2). It was the *external perspective* that gave access to external information on the WWW. The idea was that this perspective should visualize important external social and political aspects related to the enterprise model. Relevant information sources within themes like business area, market, government and environmental issues should be linked up as resources.

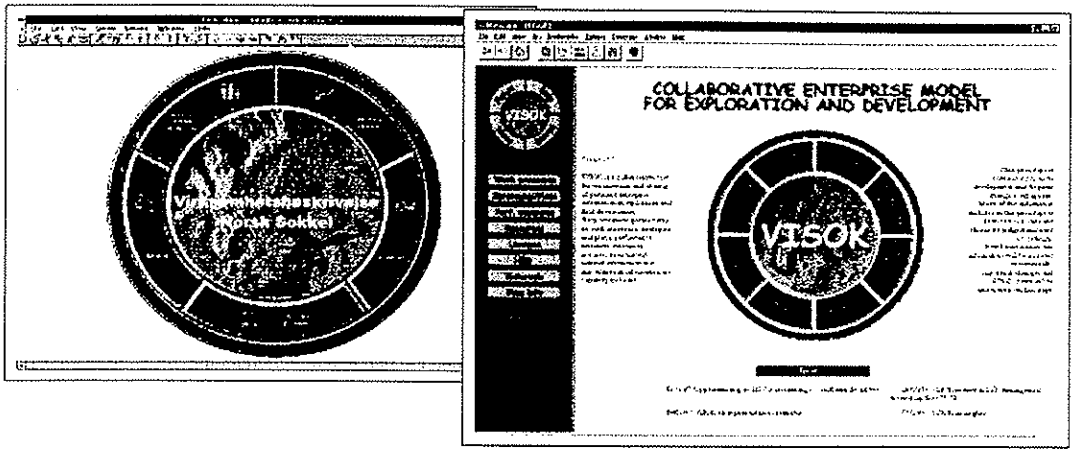

Figure 7.2: VISOK "Enterprise description Norwegian Continental Shelf". Left, version from autumn 1996 in LOTUS NOTES r4. Right VISOK 1.0 from February 1998

The *business/strategic perspective* should give an overview and access to important strategies through clickable navigation maps. The third, *resources in the ground* presented a map of the Norwegian Continental Shelf with areas/licences that could be activated in order to retrieve and share geological data. The fourth was the *organizational perspective.* It tried to visualize relations and dependencies among actors in different units/projects in the early phase. In the *work process perspective* some designated work processes were depicted on flowcharts indicating roles and responsibilities of the organization as in the Norne application. Finally, the *communication perspective* intended to facilitate an environment for desktop conferencing systems that should enable informal communication across geographical borders.

When being presented with the mock-up, the stakeholders added several fruitful comments but none that created additional perspectives to the VISOK model. The comments were rather general and new information resources could be placed in the existing categories that KOT had already checked out in the EDN organization. Much of the discussion focused around what existing information could be linked up; strategies, external Web resources divided into sub categories and how this information would be easier to retrieve, categorized and used in EDN's decision processes.

Why were the comments so general? Most EDN stakeholders had problems understanding what VISOK was about and this can partly explain why KOT was given little feedback on the perspectives of the mock-up. Their idea or conception about the Internet was that it had little to do with their business processes, even though they began to see potentials. The concept of an Intranet was still unknown to them. They saw a new computer system, even though KOT tried to stress that VISOK would become a tool to be used in their future improvement efforts. This integrated organization and IT development KOT promoted was unfamiliar. They struggled with everyday problems in legacy systems and LOTUS NOTES. Few of them had used Web browsers.

KOT knew this but wanted to present the mock-up as an appetizer, presenting it as something that could be developed further in the five-year research programme KOT had hoped to achieve based on the current focus on exploration in the strategic agenda. In the discussion that followed, the key point was to make VISOK a part of future improvement efforts, a continuation of BRU TF. VISOK should not be looked upon as a new change process, but an effort in conformance with BRU TF project targets. VISOK had to be owned by key stakeholders. Management was defined as important here. There was a need to find good pilot environments in EDN and interested participants were considered as important to be able to develop more concrete application of VISOK ideas in the organization. An information campaign in the EDN organization should be initiated. A group of KOT and EDN people should set up a further plan for the development of VISOK.

As a consequence of the October meeting KOT had passed the first threshold in the EDN organization. The VISOK application at that time was not perceived as useful at all. It was too general since no particular user group had been addressed. However, through the work in BRU TF where KOT personnel had worked, combined with the success in Norne, EDN had hopes that KOT could provide substantial help in EDN's improvement efforts in exploration. As stated in Chapter five, KOT had the necessary funding from the KKG financing structure. Because of the perceived success in Norne nobody challenged KOT's budget claims for 1997. This meant that EDN could get much of the support from KOT with only a fraction of the total project costs. For EDN this was an opportunity they could hardly refuse: "we want what you want."

EDN's business plan stressed co-ordination technology as a target area and VISOK was firmly placed in EDN's strategies and plans concerning development and use of future IT. In December 1996 EDN management approved the targets, activities and products for VISOK. The work should have a five-year horizon and had two main agendas: First, *to develop operative solutions for the early phase.* This meant building models of the early phase that enabled improvement of work processes and or easy access to information used in the same work processes. The research should support ongoing improvement efforts in EDN and be implemented in such a way that results became developed continuously. At the same time, a more long-term improvement effort should be developed. Second, the project should be a *testing ground for more company-wide applications of IT and new collaborative practice.* Pilot applications in EDN should be implemented in the larger Statoil organization. In the discussions between KOT and EDN in the autumn of 1996, typical administrative processes were discussed. These were chosen mainly because the VISOK team had best access to the administrative staff of EDN and less the line organization.

The official start of the VISOK project in the EDN organization was January 1997. The project should report quarterly to the EDN management meeting. KOT had plans for coaching

key stakeholders continuously when new functionality in VISOK was being developed. They developed a survey of ongoing improvement projects that were relevant for the early phase, to avoid double work and in order to take advantage of ongoing projects.

KOT was organized in four overlapping teams. In the periphery was the academic team that consisted of Peter, the latter, being at MIT at the time and myself. This team should follow up the academic activities and contacts of the group. All the others were part of minimum two teams. One lab team should secure consistency in the solutions that was developed and it was the home base also for the fieldwork team that fronted the EDN organization more directly. A fieldwork team provide the "hands on experience" from the EDN organization both related to work practice should and information requirements for the targeted work processes.

There were three field teams that had been awarded responsibility for their VISOK project deliverables in the EDN organization. In addition, there was a strategy team that consisted of Robert the department head, Ola the project manager and Christian, in chief of technological development of VISOK. At this point in time the KOT staff that had their background in operation and maintenance, continued to pursue projects in operations and KOT was divided in two units that had no day-to-day collaboration. Those remaining in KOT were assembled around the belief that work in exploration and early phase was more important than operations if Statoil should succeed in the future. What they left behind was a group of senior researchers with high credibility in Statoil operations. KOT had to recruit new people in the VISOK project to fill the vacancies of the senior personnel.

7.2.1 Aligning the further support of Statoil Data

KOT and Statoil Data had developed a good working relationship in the Norne pilot. When the VISOK project was initiated, additional collaboration was necessary for a number of reasons. KOT wanted to make sure that the solutions they developed fitted the present and future IT infrastructure of Statoil. VISOK's complexity led KOT on a trail on which they had never been before compared to their previous LOTUS NOTES databases. To meet these challenging objectives KOT had to work with interfaces to old legacy systems, dig into the deepest details of NOTES/DOMINO and use the newest data pumps and middleware. If VISOK was to become a company success KOT had to have dedicated maintenance personnel in Statoil Data that could handle the daily operation of the application, like help-desks and system maintenance.

KOT did not have the necessary coding personnel and expertise to embark on a full-scale development of VISOK. To have Statoil Data integrated in the project from the start would decrease the obstacles of creating production systems earlier out of the prototyping efforts. On the job collaboration was being perceived by both KOT and Statoil Data as the best way to secure experience transfer and sustain an ongoing relationship. As a consequence of a number of discussions, Statoil Data let programmers work as an integrated part of the VISOK development team. Regular meetings between the KOT strategy team and key Statoil Data gatekeepers were held, and a more formal division of labour was defined. In essence, KOT was given more competence and skills to do more structured systems development when necessary (from prototyping to production systems). Consequently, more input on the organization of the future IT and user support of VISOK.

In the life cycle of a new concept like VISOK, KOT's main arena would be the *testing of new technologies and applications*. KOT and Statoil Data should work together in integrated teams during pilot work in the Statoil organization. KOT's main expertise was in organization

development and new collaborative practices and KOT held courses for Statoil Data personnel in the year that followed. Statoil Data's major asset was their technical skills and their control of the IT infrastructure. Consequently, both groups filled complementary roles. While KOT would be in the lead in this first phase, Statoil Data would manage the two next phases: product development and company wide distribution. The results from the collaboration with KOT would be taken towards further product development if it had potential value for the rest of Statoil. Statoil Data would then create a more standardized product that would be fit for a larger part of the Statoil organization. A subsequent spread of components, like the map navigator (see Section 7.4.1) and licence perspective (see Section 7.4.3.) were expected to arise from VISOK as the project ran its course.

7.3 The overall development and implementation of VISOK in 1997 and 1998

The spring of 1997 was used to develop relations to personnel in the EDN organization and to acquire a more context specific understanding of EDNs business. In the first part of 1997 the team focused on making a first version of the principles and mechanisms that should give access to licence and resource information from legacy systems. This work with the licence platform was a prerequisite for everything else that had to be in place. The concept of a licence platform (Section 7.4.3) was to become the mechanism that should support the retrieval of information from core EDN databases. In most cases it was the same source of data used in different work activities and the processing of information was done for different purposes. Later that year these mechanisms should become the licence perspective in VISOK.

A first prototype of VISOK was presented in the EDN management meeting in May 1997. The licence perspective was fronted and created so much attention that other activities were downgraded in the meeting. There was a need to present licence information from the LISA database through a proper interface (see Section 7.4.3). To be able to do this was considered critical in order to succeed with the other perspectives, to develop a killer application. It was therefore decided to put efforts here, at the sacrifice of other perspectives. The decision to take a close look at map functionality in VISOK, and conduct a requirement's analysis on the needs of map sketches in EDN was also taken in this meeting, see more in Section 7.4.1.

At this point the decision to move from NOTES to a Web interface had been taken. From the management meeting in May 1997 to the next one in September 1997 new functionality was added to the prototype. Statoil Data hoped that VISOK would pick LOTUS DOMINO and offered a test environment free of charge. VISOK was nominated as number four in the prestigious competition "The golden @" of 1997 in the class of Norwegian Intranet applications. At the same time KOT was active in gaining insight into what needs and requirements EDN stakeholders had concerning VISOK, or even more important: why did they have these requirements? Of particular importance here was the work on the need for digital map sketches, and what needs have users of map sketches?

The map perspective became a new perspective in the September 1997 meeting. A coaching round was conducted before the September meeting. This workshop in September provided additional prioritization of functionality in VISOK. The agenda of this meeting had the form of a two-day workshop that had a thorough run through of the VISOK prototype so far. Sets of tasks were discussed in groups. Two VISOK project members assisted each group. One member functioned as coach and the other observed the use of VISOK. Quality of maps in VISOK was considered as important. Morten and several other VISOK members claim that

VISOK changed its course in this meeting. Until this September meeting VISOK had been an improvement project with a fair amount of research. From now on it took increasingly the shape of a systems development project. Some of these signs had been apparent for some time. Morten argues that already from April 1997 VISOK consisted of two processes that influenced the development of the VISOK-prototype:

First, what everybody saw at any given time and what could be discussed; page design, front page, perspectives and links more in general. Second, what had to be in place of structures and architecture in order for the content and functionality to support work processes in the early phase in real terms and create a match between work processes and systems.

A prioritization of activities and revision of the original ambitions on some of the VISOK deliverables were the consequence of the new release that was to be implemented in the first week in January 1998. The system VISOK was in focus. The budget situation of 1998 was bright and KOT got the KKG funding they requested. A larger proportion of the budget would come from EDN in 1998.

The year of 1997 was also a phase of development of new skills, recruitment and socialization of new staff. New personnel were recruited both internally and externally. The veterans had to formulate the working principles: prototyping, ethnography, integrated organization and IT development. All this had to be adjusted to a number of new people and work skills had to be transferred. KOT had always been communication intensive, but projects had never had a complexity of VISOK's size, and the number of participants: both new members and the relation and collaboration with Statoil Data had to be handled.

The communication between those working with different deliverables in VISOK were not good. Two camps grew, that of organization and IT. These two camps put different meanings into phrases and concepts, and the project lacked a common methodological basis. There was as a consequence of this a great need for reflection. Another dividing line grew up between those working with different VISOK perspectives: licence, map, work processes and others.

KOT's challenge in VISOK in 1997 was described as follows. To oversell solutions can often be considered a problem in the relation between KOT and the customer. However, to have access to the customer KOT had to exemplify what added value the customer can get from their activities. Ola the project manager said the following in a late autumn project meeting in 1997: "If the added value is too small the customer will not let us in. Consequently, it is easy to oversell products. When the complexity of the deliverables appears we might be far into the development process".

There were several such examples in 1997 but I mention one here. VISOK's first production version was postponed one month, from January to February 1998. The over-sale of the first version of VISOK created a heavy workload at the end of 1997. Overselling pushed some VISOK project participants to their outmost limits, in spite of the EDN IS/IT manager's request to lower the ambitions in the first version and meet the target date instead. There were high demands both for robustness and stability of VISOK, mixed with the need to implement as much functionality as possible. All this led VISOK into a production phase in November 97 throughout January 1998 where the project worked with the first production version of VISOK (version 1.0). A production version here meant a version of VISOK that was thoroughly tested and run on a production server (with a minimum of stability and working hours and which had a help desk). In this demanding process reflection and research issues were skipped.

KOT struggled to get EDN's attention. KOT had to take responsibility for much of the improvement work. EDN filled more and more an advisery role commenting on KOT's proposals. EDN was a busy organization of professionals and had problems allocating time for a development process like the VISOK project suggested. KOT was not able to communicate the essence of their work practices and they were increasingly looked upon as heralders of negative descriptions of EDN situations.

At the same time, the role of integrated organization and IT development in the EDN organization was signalled by creating a permanent position in EDN management for an IT and improvement manager. This manager reported directly to the CEO of EDN. Peter was awarded this job when he came back from his studies at MIT in spring 1997. He both filled the job as a demanding customer and a speaker of the VISOK team in EDN management, since he was updated in what went on in both arenas.

Managers in EDN and staff were the first defined stakeholders. In an important meeting in September 1997, KOT researchers argued that VISOK was seen as a management information system and not intended for ordinary organizational use in the EDN organization. This meeting decided that VISOK should offer information to all members of the EDN organization and the collaborators. The relationship to the operative regions of EDN had to become more sophisticated. In spite of this VISOK continued to contain information that was most valuable for management and administration and less valuable for other groups in the EDN organization, as I will come back to. The inscriptions of the VISOK application were that of a management information system.

The past KOT successes had always relied on an organizational pilot of some sort. Until autumn 1997, VISOK had no particular pilot. The team had contacts in the EDN base and management organization in Stavanger, but the main users were in the three regions of EDN: north, west and south. Harstad (or EDN N) was picked out to be the pilot that would enable VISOK to develop more concrete business applications. Harstad was far up north and consequently far away from Stavanger. To go up there by plane would take half a working day. The use of information technology for collaboration between Stavanger and Harstad was therefore believed to have a large potential. The Harstad office was picked out as the pilot by EDN management in the September 1997 VISOK-EDN management meeting. This work is handled in greater details in Section 7.4.4.

In their discussion and reflection process at the end of 1997 KOT defined the following action points for 1998. It was based on feedback from the EDN organization but also from their own reflection on their actions in 1997. 1997 had been a year with much technological development. Much of which was necessary to achieve a reasonable technological level of VISOK. The work in developing a "killer" application would have to continue, especially the work with the map navigator and the licence perspective. An authentication system with differentiated access rights was also necessary because of the sensitive data that could be retrieved by the VISOK middleware. However, the VISOK team agreed that the organizational aspects had to take a lead in the year that lay ahead.

First, there had to be a stronger emphasis on the updating and maintenance of source data in EDN's company databases to let the information presented in VISOK become more reliable. The quality of source data had to be included in the agenda in the EDN organization in the

year ahead and dedicated people in the EDN or support organizations (LTEK/PETEK) had to be involved in this process.

Second, the EDN organization had to develop new ways of working together in order to improve their business development processes. Two promising new ways of collaboration were being discussed in the EDN organization. The first, peer assist, was a particular form of collaboration where area geologists and geophysicists in one part of EDN worked together with colleagues from another region or project to attune specific assessments, for instance related to project decisions. The other, peer review is to let peer groups have systematic reviews of other groups' decisions to secure the quality of their work and assessments.

Third, an increase of the target group of VISOK in order to incorporate earth science personnel was heralded. The map navigator was promising here. A pilot in Harstad was already established. The problem with the increase in the target group was that user requirements would become too diverse to create a VISOK application that would be consistent. The challenge after the implementation of VISOK 1.0 in 1998 was to increase the enterprise description to include earth science personnel. These groups had very different requirements and needs. Earth science personnel did not have much interest in VISOK as it was at the present time of version 1.0 because of its administrative focus. What aspects should EDN prioritize; was the focus on management and administrative support compatible with the support the earth scientist personnel requested?

Fourth, a stronger focus on coaching and fieldwork was vital to increase participants understanding of work practice. The VISOK team had to challenge EDN's work practices, via participation in peer review-assist sessions. All this meant a stronger participation in the EDN organization.

Fifth, VISOK had to develop a stronger commitment in the EDN management group. Monthly customer meetings were set up. KOT had plans for collecting good examples of the perceived added value and usefulness of VISOK for EDN personnel.

Finally, the VISOK team addressed their own internal processes in the group and how these could become improved. At the end of 1997, VISOK was in a production mode. Much of the spontaneity and brainstorming sessions and collaboration that had characterized the group one year earlier had disappeared. The group had grown considerably in 1997 and the veterans of KOT had not been good enough to convey the traditional way of running projects. There was also an increasing need for professionalism in relation to project management. Ola the project manager became increasingly occupied with administrative issues. Christian was assigned the role as production co-ordinator to ensure the many threads of VISOK could be pulled together. The morning coffee, colloquiums and project workspaces in the scullery area outside KOT's offices should improve these efforts. In addition to project meetings, debriefings should become institutionalized. This meant that every new week of coaching and fieldwork should be planned to become more focused, and address urgent issues in the project at that point in time. When coming back, the overall impressions or "narratives from the field" should be discussed, not only among those that participated, but also together with the systems developers, to improve the design of VISOK.

On the official release of VISOK version 1.0 (Figure 7.2) on 2 and 3 of February 1998 the project had stands in both Stavanger and Harstad. The VISOK team had invited all EDN personnel to stop by and look at VISOK. The VISOK project participants described the

feedback as disappointing. Some visitors claimed that there were too many information systems already, others smiled and said that they had too little time for a presentation. Earth scientists perceived VISOK to be of little value in their work. A number of coaching sessions were held both in Stavanger and Harstad after the release. The project had two full-time coaches. There were department presentations, and there were internal groups in EDN that had their own presentations. In spring 1998, VISOK was still unstable, LOTUS DOMINO, middleware and the map navigator did not work satisfactorily and patching tied up considerable resources. When the 1.2 version was released in June 1998 there were no campaigns. People in the project team reported that most users hardly noticed any difference.

The summer of 1998 marked a reorientation of the project. Further development of the remaining perspectives in VISOK were downgraded. Instead two new work processes were defined by EDN: the process of developing core area strategies, and the everyday routines of the geologists. This initiative coincided with the EDN's IS/IT improvement managers' demand to the VISOK team to improve their understanding of the users and their context. The aim of this work was to address the users' needs for information in both work processes and adjust VISOK's ability to cover user needs. At the same time it was necessary to develop a close relationship to chosen problem owners. This change also coincided with the reorganization of KOT itself, a revision of work practices, activity level and roles in the team. Harald was appointed the new project manager of VISOK.

Future VISOK activities were presented in the EDN management meeting on 29 September 1998 but not taken further. It came as a consequence of the dramatic low price of crude oil (USD 9) and several dry exploration wells where Statoil had hoped to find hydrocarbons. Exploration budgets were cut and the general activity level in the early phase shrank in the autumn of 1998 and 1999. As a consequence of the situation, the September VISOK-EDN management meeting spent considerable time discussing the status of the VISOK project so far. In the light of the difficult economic situation in Statoil no new IT activities were to be started in VISOK. EDN had hopes for a large discovery this autumn in a newly licenced area. The dry well gave a major set back and consequently led to a reduction of the activity level in EDN.

This set back also hit the VISOK project via EDN. From now on the focus should be on what had already been developed, and VISOK should be completed in its present shape. The research input and consequently the role of KOT became considerably reduced. Still, the EDN management meeting demanded a small number of additional deliverables from the VISOK team. The first deliverables were connected to new practice around licence administrative data (LISA) and resource data (PROSA). Second, an evaluation of the work forms in peer assist and Exploration forum. These two will be presented shortly. Version 1.0 and 1.2 of VISOK were prototypes and it was decided to develop a new version from the scratch in order to secure a maintainable and production safe system. This version of VISOK was called VISOK NG (next generation). After the 29 September 1998 the focus of VISOK was mainly to develop new a final version of VISOK and make it ready for transfer to EDN and Statoil Data (see Figure 7.3). EDN took over the user responsibility of the application and Statoil Data took the system responsibility. The project ended with training the two groups in using and maintaining VISOK NG.

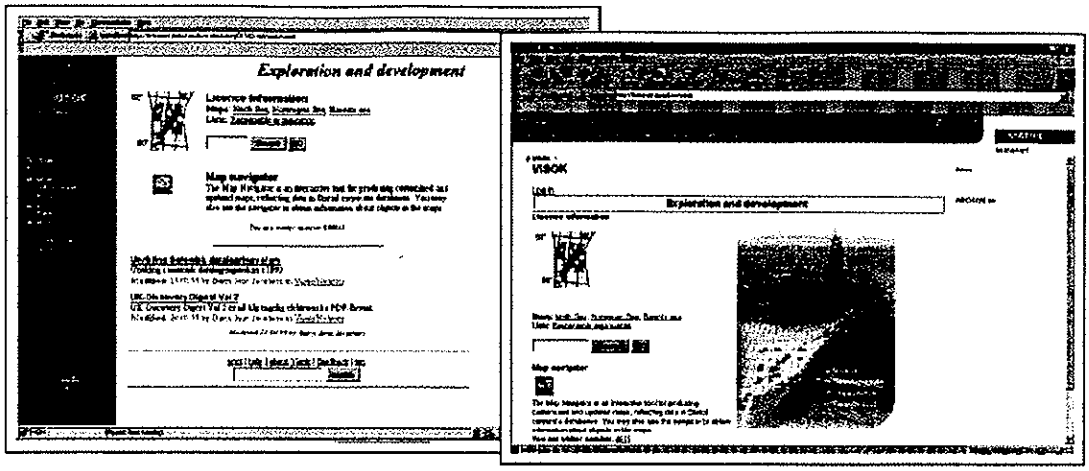

Figure 7.3: Left VISOK NG January 1999. Right VISOK in spring 2000 with the official Intranet template

Peer Assist (PA) was a form of collaboration in exploration that originally British Petroleum had success with employing in the QA of work with prospects. In Statoil several important gatekeepers in the exploration environment of Statoil wanted to develop similar practice in Statoil. The earth science community in Statoil saw a need to develop a consistent picture of the Norwegian continental shelf. This picture should be consistent across regions focusing on resources, potential, develop a common methodology, criteria for resources, evaluations and risking in order to make prospects in different regions more comparable and usable in further strategy work.

The idea behind the use of peer assist in Statoil was to use skills in nearby regions of EDN (geologist and geophysicist advisers in other EDN regions) to assist in concluding discussions related to exploration work in licences and EDN regions North, South and West. The idea was to compare prospects in different parts of the Norwegian continental shelf. Results would be compared to prioritize drilling, seismic shooting and use of resources more in general.

A senior LTEK manager argued: "Nobody in Statoil thinks horizontally, PA is positive because we get experience transfer and information sharing across the regions". In an evaluation report earth science advisers argue that PA have given better opportunities to handle the wholeness of the resource basis, portfolio and exploration plays in core areas, better communication and information sharing between the advisers in the regions, consequently better relations between the regions.

PA should be a group process that would provide assistance and trigger the reflection and learning in exploration projects. Personal dialogue and discussion should be more important than using sophisticated IT risking tools in the discussions. Peer support should be used in projects to lift their status and quality. Peer assist was organized as a team of one geologist and one geophysicist (G&G) advisers from each EDN region, an adviser from LTEK plus additional people depending on the needs of that particular licence being assisted. EDN management gave a few requirements on what PA should be: create a consistent picture of the shelf, develop a common methodology, criteria for resource evaluations and make risk assessment comparable across regions, secure efficient experience transfer between the

regions and bring the regions more together. As one G&G adviser said regarding a common exploration strategy that covered all EDN regions:

"How are the volumes evaluated across the regions: across the regions or seen together? It shouldn't matter if it's east or south. Statoil is operating according to geographical/ organizational borders and not geological borders as it should be doing."

A peer assist session takes 1-2 days. The material to be evaluated should be sent out in advance. Discussions before the meeting is a combination with use of telephone, ESOP and e-mail so that the participants can prepare themselves. In the PA meeting the peers go through the prospect's assumptions, its risk analysis and evaluations. Peer assist activities should ideally use a common risk scheme, prioritize or rank potential plays and use defaults for the three regions. PA advisers should use 10 % of their job for PA, included is also to secure ownership and experience transfer across regions. Peer assist is meant to be a voluntary arrangement for EDN project teams.

However, EDN management wanted a more stringent process that was named peer review that could involve more continuous questions, taking decisions within the frame of a mandate. This formalized process should handle the development of a consistent perspective of the Norwegian continental shelf (hypothetical and speculative prospects). Second, all prospects to be drilled should have a peer review round before drilling prospects. To do the same peer process after drilling was also a part of this ambition. The ambition was also to develop a common exploration strategy that covered all EDN regions. The six PAs and EDN regional managers should meet in the Exploration forum (EF) four times every year, together with the adviser in prospect evaluation from LTEK and others depending on the agenda.

The Exploration forum should be a professional arena for making priorities and holistic thinking across the three EDN regions. It had a professional advisery role to EDN management, and should help EDN management to take decisions based on solid professional work. The Exploration forum (EF) should use the results from the PA work. One of the persons that took the initiative behind PA in Statoil argues:" Exploration forum is meant to be an important part of PA, an active tool to summarize what is revealed through peer assist." The main task of EF was to use PA work as the basis for the choices of exploration strategies and prioritize across regions, exploration play, resources, prioritized of core areas and portfolio adjustment.

The VISOK team participated in evaluating peer assist for four months, from October 1998 to January 1999. Marit and Emily followed four rounds of peer assist reviews of prospects, and developed a number of improvements to the peer assist process together with the PA-advisers (use of debriefings, use of ESOP). They ended up selling or promoting more efficient use of ESOP instead of VISOK. One of the major lessons in the aftermath of VISOK was that there was more to extract from the use of existing information technology rather than to develop new, like VISOK. Marit and Emily were used as discussion partners on the way and were assistants during the processes arranged by the PAs.

In KOT's own discussions at the turn of 1998 they saw that they finally had the core to EDN's work processes and challenges. Unfortunately, it was too late. EDN management had stopped the VISOK research project because of Statoil's financial situation and cut in exploration budgets. All that was left was to implement the VISOK Web site. Harald summarized the change of focus from technological to organizational issues that occurred in the last phase of the project:

If we look at the concrete choice of values, it is interesting to see that typical organizational tasks like evaluation of peer assist or Exploration forum and change of practice related to updating of licence administrative data and resource data and the use of existing information systems were issues that were demanded when the scope of the VISOK project was reduced considerably in the spring of 1998. Tasks that were related to the further development of technology were stopped. The VISOK project ended up focusing on what in the first place was wanted, that of human work practice and use of technology. The technological focus vanished. Still, it is frustrating that it took such a long time to reach that focus.

After the handling over of VISOK NG to EDN, almost a year went because VISOK had to be adjusted to the new corporate templates of the official Statoil Intranet. This killed the remaining interest of the application once and for all. VISOK still exists as an Intranet site for sharing news, administrative and licence information in EDN (see Figure 7.3) but the ambition to use VISOK in combination with organization development has since long been abandoned.

Ola the former project manager is of the opinion that the project got its particular course because of the external conditions under which the project operated. These conditions were difficult to change if KOT wanted to run a project of this size and level of ambition. He also mentions how the lack of competence and skills stopped the project. When the project started it consisted of the core of KOT and a good mix of senior and junior personnel both in organization and IT skills. In the start up new IT people were recruited because of the need to develop a prototype.

In summer 1997 this changed, the number of senior members were reduced and many new persons arrived. At worst, during peaks of the project there was a ratio of 10 juniors compared to 3 seniors. After the reorganization of Statoil R&D in 1998, even more senior personnel disappeared. Robert, the department head left Statoil, with him his network and abilities to lobby for VISOK among gatekeepers and senior managers. Christian in charge of the technical development of VISOK left some months afterwards. Ola the project manager received a chief scientist position after the large reorganization of Statoil R&D in the winter and spring of 1998. Harald, the new project manager was skilful but inexperienced and needed time to organize internal KOT activities in addition to VISOK deliverables.

In 1999 KOT concluded in their research report after a review of the pragmatic test of their work in 1997 and 1998[27], that a lack of understanding of business processes and basic work processes killed VISOK and the CW project. First, because VISOK participants lacked an understanding of EDN work processes, they were not able to decide if a task was small or large. The size of the task could not be anticipated by speaking with the users only and the VISOK project did not have enough insight to predict if the demand presented was real and if the solution that was developed was helpful.

Second, the work of other project participants became invisible. The organization development camp did not see the complexity in the task of the IT camp (i.e. making graphics in VISOK navigators) and vice versa (the need for or how to conduct coaching). Third, some EDN stakeholders participated as claim makers on behalf of others. They should not use the functionality themselves, but the results, meaning that other people should enter the information they needed. Several of the perspectives in VISOK were designed as a consequence of wishes and input from other people than those that were to use it in their daily work. One consequence was that several of the perspectives were not used at all. Those that gave input to the perspectives did not need it, and those that intentionally should use the perspective did not find it sufficiently useful.

7.3.1 VISOK's functionality and the move from NOTES to DOMINO

KOT had developed good working relations with Statoil Data through the Norne case. The start of the VISOK project was initiated via experience transfer meetings between Statoil Data and KOT that discussed more technical issues related to LOTUS NOTES release 4. As I have presented elsewhere, the struggle between NOTES and WWW technology among IT professionals was rather vivid in Statoil in 1996 and 1997 (Monteiro & Hepsø 2000). It was not at all certain if LOTUS were able to handle the new challenges of the WWW. The pressure was building up for non-NOTES collaborative systems, growing in intensity with the folkorization of the Internet in the media. When the first prototypes of VISOK saw its light in August-September 1996, LOTUS had a beta version of a gateway solution, called DOMINO that enabled easier Internet access. Statoil Data was saved by the bell, since LOTUS DOMINO let Statoil take advantage of its installed base and LOTUS NOTES system development skills.

The first prototypes of VISOK were developed in LOTUS NOTES R4 in order to take out effect of the skills that had been invested in the Norne work. However, the actual decision to transfer VISOK to DOMINO was taken in early spring 1997. As I will come back to later, much of the actual needs of the users were still connected with more efficient use of NOTES, something that KOT ignored for a long time. It was seen as evident in the VISOK team that LOTUS would make their first DOMINO versions compatible with previous versions of NOTES. This solution also made the use of middleware easier, that is, to extract information from Statoil legacy systems and present it in a form that the stakeholders requested.

VISOK was an IT application where the complexity does not need to be described in detail. In this presentation I can only present those parts of VISOK that are most relevant for the further discussion of the narrative.

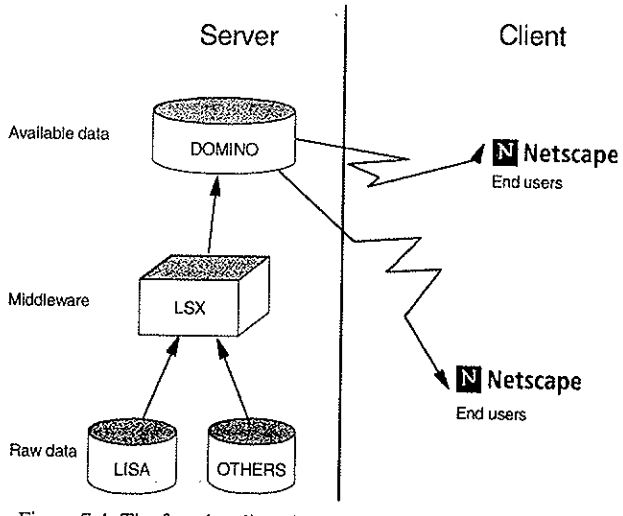

Figure 7.4: The functionality of LOTUS DOMINO and middleware

VISOK put together standard components and converted raw data from old legacy systems via middleware to the end users in the EDN organization. The key component was LSX, the middleware component between raw data in the legacy systems and DOMINO (see Figure 7.4). This particular component made it possible to extract a particular data set from the legacy system.

Various kinds of data could be extracted and configured to stakeholders' requirements. Information from lower data levels to a more integrated data set that gave what to be believed was "a bird's eye" perspective could be configured. LISA is an example I will come back to in detail in Section 7.4.3. It is the key EDN database for licence information, a relational database (ORACLE), run on an NT server (the Statoil standard in 1997-1998). Any kind of relational database could be used but the maintenance of the data

had to be done in the legacy system. It is a one-way relation and not a transaction relationship. Data could not be maintained from the Web browser, which was the major argument for continuing with using NOTES.

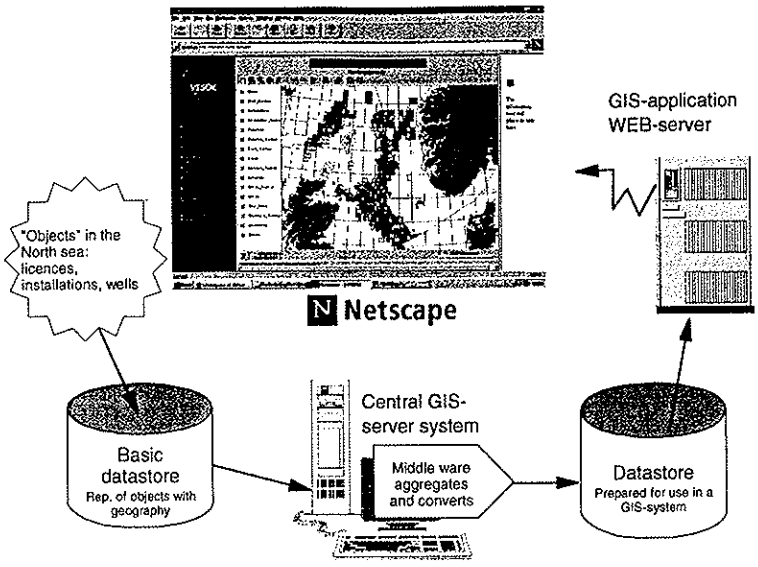

Figure 7.4. The functionality of the map interface of VISOK

The map navigator, another key functionality of VISOK, was not based on DOMINO, but other standard components made by ESRI, a large geographical information system (GIS) development software company (see Figure 7.4). They had a chain of components that ranged from raw data to enduser maps in Web browsers. Raw data are extracted from LISA, PROSA or other legacy systems. These databases are the foundation for the data shown in the map navigator. VISOK consisted of a combination of an assembly of foundational/ basic data from these sources.

The central GIS server system is the middleware of the map system. ARC/INFO is a component used to produce foundational data for the GIS application, that is, a number of chosen data from raw databases underneath. Functions within ARC/INFO make it possible to extract and build a given data set in advance. The GIS application was ESRI's ARCView 3.0 that retrieved data as cover files (or data prepared for use in a GIS system). ARCVIEW collaborated with an Intranet map server to present maps on a Web browser. The Web server was an Internet Information server by MICROSOFT, chosen because it was more compatible with the rest of the components or the whole chain of components from ESRI.

7.3.2 The development of a working order between VISOK and other Intranet initiatives: BETA and OMEGA

The concepts of the CW project planted a number of seeds in the Statoil organization. Similar ideas also seemed ripe at the time. BETA was a Statoil Intranet project that had a number of similarities with VISOK and was initiated and implemented in the same period, from the autumn of 1996 to the beginning of 1999. In what follows I give an overview of how the two projects interacted with much the same background of people through a struggle for niches in the Statoil organization towards a reconciliation of the two projects into a working order.

In the early phase of the Collaborative Workspace project KOT had substantial interaction with a Trondheim university professor when discussing the use of collaborative and visualization technologies. He took part in the development of the early concepts of the workspace. In the vicinity of KOT, sitting in their area at the research centre sat a number of people that caught up new ideas. One of these, Nigel, considered by KOT and himself, as a

"hangaround" in the milieu was central in the development of the BETA project from the autumn of 1996. In the years from 1993 to 1995 KOT had worked closely with the DRTEK-STI unit in Stavanger in the development of the DELPHI application, that implemented on-line distribution of mandatory documentation in Statoil, see more in Chapter three.

One of the project leaders of the STI unit had spent several months in the United States in the summer of 1996 and had seen the growing focus on WWW and learning, through visits both at IRL (Institute Research on Learning) and XEROX. He came back with a number of new ideas on how to improve the learning abilities of the Statoil organization. He considered himself to be an intrapreneur (an entrepreneur working on the inside of large organizations) and saw the ability to improve the scope of DRTEK STI's products in the Statoil organization, through the use of emerging technologies.

When he came back from the States to make these ideas more manifest he stumbled across the work that KOT was doing in Norne. Navigation in flowcharts to access mandatory documents that STI were responsible to have up and running, soon became an important aspect of his own initiative. In the launching of the BETA project, the Norne work was used as an example of a computer-based training system that could be further developed to cover vital parts of the Statoil organization. In the early phase of the BETA project, KOT personnel had a number of presentations during discussions concerning the BETA concept. These presentations covered flowcharting methodologies and team development among BETA project participants.

In the beginning of 1997 the STI project manager wanted to buy resources from KOT to go through with his plans. He needed personnel that could run the involvement process towards the multifarious operational environments in the Statoil organization. KOT turned down the request for resources, since they were booked up in the VISOK project and could not man a project of this size. Instead, the only personnel resource that came from the environment around KOT was Nigel.

The Norne work was perceived as a success and BETA took pride in saying that they relied on resources from KOT and run the process of involvement according to KOT principles. In the start up of the project BETA was presented as a natural continuation of the Norne work, but an initiative that would cover more of the Statoil organization. BETA had a natural niche since KOT argued that they should put future resources in exploration and not in operations.

The BETA and VISOK projects shared a number of properties. Both initiatives came from people that knew each other, had collaborated in the past and consequently had common perspectives on a number of issues. Much of the basis for both concepts could be found in the original concepts of the Collaborative Workspace project that at least two of the BETA concept makers knew in detail.

There were a number of examples here, one dealt with shared metaphors. The knowledge room of BETA resembled that of the KOT's Collaborative Workspace. The knowledge navigator, originally a room with walls, roof and floor resembled the room depicted in the first sketch of KOT's Collaborative Workspace, see Figure 4.1. The clickable work processes, the value chain and access to mandatory documents were exactly like KOT's concepts and had the Norne NOTES application as the basis. BETA also claimed to be using the same flowcharting methodologies as KOT, and it had the same feedback mechanisms/improvement comment functions as the Norne application. Both VISOK and BETA were pioneer Intranet projects in Statoil. The projects had started up using LOTUS NOTES as the development

platform. In 1997 they both chose LOTUS DOMINO as the development solution and used much of the same technology to implement their products.

Much of the concept development of BETA and rapid prototyping took place in the vicinity of KOT's scullery in the autumn-winter of 1996-97 and KOT members could follow rather close what happened. BETA promised to run the same involvement processes (as KOT had done towards Norne) towards several operational units. KOT considered this to be impossible since there were too many organizational units in Statoil: How could BETA involve the larger operational organization with less manpower than KOT? KOT felt that the BETA project was dishonest, but they also felt threatened by the aggressive marketing of BETA in Statoil's operational environments.

STI sold BETA as a continuation of what had been started in Norne and argued that they took KOT's concepts and methodologies further. Concepts of experience transfer developed by KOT three years before had certainly been spread in a joint KOT and STI process. In the process I described in Chapter three KOT had come up with the main concept and it was natural that STI wanted to continue this collaboration via BETA. Now KOT feared that BETA would eventually hit KOT back, and create doubt concerning integrated organization and IT development projects, if BETA were not able to deliver its products. Robert argued in the winter of 1997: "BETA is mostly an IT project and they do not take the reflection and organizational issues serious enough".

A troublesome relationship developed between Robert and the BETA project manager. The climax between BETA and VISOK hit a peak in a meeting in Stavanger in August 1997. STI had summoned their offshore supporters from the new Åsgard installation and drilling, two major customers of BETA. KOT found no understanding for their argumentation in that meeting and started to realize that BETA had to follow its own course. A few other things were bundled around the same time. BETA had gained a certain momentum and internal prestige. The project was not dependent upon using Norne and KOT as advocates anymore.

As a consequence, KOT was not being associated with BETA to the same extent as in the beginning of the project. There had been an increasing development of a division of labour between VISOK and BETA, where each project had its niche in the Statoil organization. BETA was for operations and VISOK for exploration. BETA focused on work process flowcharts, computer-based learning, mandatory documents and technical information. VISOK became increasingly less concerned with flowchart modelling and focused more in the direction of a management information system presenting pertinent business information. A working order was established where the two projects could live their separate lives.

The VISOK-BETA working order was more problematic for the rest of the Statoil organization. Since VISOK and BETA were among the first attempts to develop business applications on the Statoil Intranet, an increasing number of new Intranet users did not understand why the two initiatives were not aligned. Statoil employees saw that it employed the same application, namely NETSCAPE as a browser. As one human resource professional asks in a mail to VISOK project participants:

> We have developed a concept of teamwork that we want to put on the Intranet, should we use BETA or VISOK, and how do you recommend that we implement the concept on the Intranet? Shouldn't projects that use NETSCAPE be aligned since it is about using the same system?

This quotation describes the state of confusion that existed in the early days of Intranet development in Statoil: a large uncertainty regarding what this new media could do, and that the applications that were built, both VISOK and BETA had a too general audience. Both Statoil operations and Statoil exploration needs were too specific to be handled in general Web applications of this type. The human resource professional worked in a staff function and neither exploration (VISOK) nor operations (BETA) fitted his concept that touched issues on a general company level.

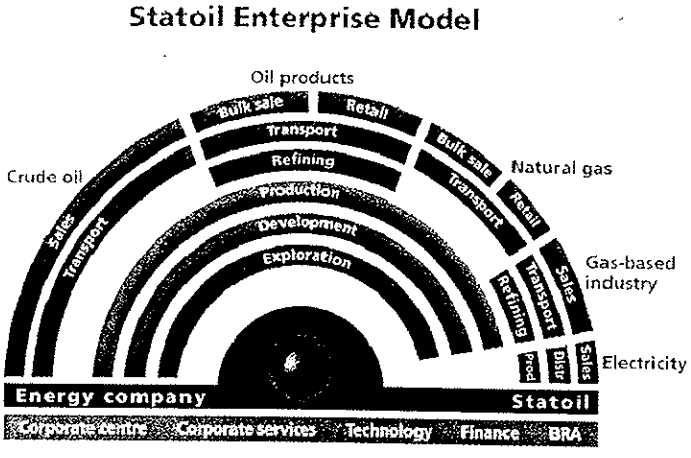

Figure 7.6: The enterprise model of Statoil on OMEGA, the official Statoil Intranet 1998

This tendency of fragmentation of the Intranet was addressed when the company started a general Intranet project (OMEGA) to deal with issues related to information sharing on the Intranet. This project called "information sharing in Statoil" set up a number of guidelines to handle this development already in 1997. Robert became the project manager for this comp-anywide initiative, and the project sug-gested a general enterprise model of Statoil as one of the solutions for navigating in information. However, it was first in January 1998 after Robert had left the scene, that the project started the development of a company-wide or overall structure (information architecture) and technical solutions for information sharing on a Statoil Intranet. In a report dated December 1997, the information-sharing project argued:

New IT makes it possible to send enormous amounts of information within such a large company as Statoil. Intelligent and conscious use of this technology will give Statoil increased competitive advantages. Missing conscientization will result in non-productive information overload. If Statoil is not able to create a reasonable structure for how to spread and share information and take steps to use this structure correctly the result will be that we are flooded with information that is difficult to find one's way into.

The mandate given by management was to carry out a number of actions that would secure that the handling of information in Statoil created added value. Further, to establish solutions that opened up for an efficient and simple sharing of electronic information within the company. This meant that information should be easy to find. It should be correct and updated and be understandable for the receiver. Information that did not meet these quality requirements would be excluded from such an arena. The OMEGA project created a front page for the Statoil Intranet; news, help functions, a free text search engine, search engine for categorized searches and an overall enterprise model (see Figure 7.6) that linked up a number of organization specific Intranet sites.

VISOK project participants were regularly met with questions concerning VISOK and BETA: how the projects were aligned and the nature of their integration. In their 1997 research report KOT describes the relation between VISOK and BETA in the following manner:

A question that keeps returning by people outside VISOK is how VISOK relates to the BETA project. Many have difficulties in distinguishing what VISOK and BETA can offer. To give a short summary; VISOK focuses on the exploration phase while BETA focuses on the operational phase. Both base their concepts on Intranet technology, but the development philosophies are different...BETA uses the space metaphor where VISOK uses the wheel metaphor. The perspectives to the information that are offered also different, even though both focus on work processes. The collaboration with BETA is poorly developed and little resources have been provided to align the projects. The main reason behind this is that the two projects focus on different phases, but it is also due to a disagreement in the way integrated organization and IT development is to be conducted in the organization. There should be room for certain collaboration between the projects, at least on the underlying technology, if not in content since the customers differ.

Harald sums up the relationship between BETA and VISOK:

"VISOK had problems describing themselves as something else than BETA. We were very keen on the differences ourselves, as the way we involved users, and the fact that VISOK was for the early phase and BETA for operations. The users of VISOK had problems seeing the difference between the two projects and wondered why there was no collaboration and overlap".

BETA continued to exist and developed a larger user community in Statoil than VISOK. BETA still has a considerable amount of users in operations. However, the further development of BETA was stopped in the summer of 1999 based on the argumentation that it would be too expensive to continue the development. When VISOK NG was handled over to EDN in the end of 1998, the OMEGA initiative had gained control of the Intranet. This control was founded in their mandate and OMEGA functioned as an obligatory passage point.

Since VISOK had started earlier it had been developed on a VISOK specific template type. The information-sharing project (OMEGA) had developed a company template that was a prerequisite if the sites should became a part of the Intranet. Since this company-wide template came rather late in the design process of VISOK, it was not implemented in VISOK NG. This gave the final nail in the coffin of VISOK. As one of the VISOK project participants commented:

"It is a bit odd that what put the last nail in the coffin of VISOK was a project that KOT had supported strongly, that Robert had initiated, where some of our people participated in their activities. We were never able to see that these small differences in templates should postpone the final deployment of the VISOK Web site almost a year."

Again, this was what happened. Almost a year went before VISOK was adjusted to the new corporate Intranet template and implemented on the official Intranet. Most people had by then forgotten VISOK. The most popular feature of VISOK was the retrieval of LISA data. When it was decided that LISA would be replaced by another system, the last argument for continuing with VISOK had depleted.

7.3.3 Creating a new working order: enterprises, components and databases

In 1997 and the beginning of 1998 the old working order related to IT systems in Statoil was changing. The growth of the Internet had led to the introduction of DOMINO and a growing Intranet with a number of projects like BETA and VISOK. Forty Intranet initiatives existed in the winter of 1998. SAP was implemented company-wide and the SCORE-project had started in the earth science environments. In a meeting in KOT's scullery in March 1998, a new working order was discussed and formalized. Those that met were those that saw the need to

develop a more consistent understanding of the new situation. It was the VISOK project, key stakeholders and gatekeepers in Statoil Data, one of the IT concept makers of BETA and the manager of Statoil's data warehousing initiative. Let us take a closer look at what happened in this meeting.

Initiatives like Norne work processes, VISOK, BETA, information sharing/OMEGA and data warehousing were linked to building superstructures (displayed as front ends in NOTES or through a Web browser) on top of existing databases irrespective of type and create gateways for presenting data of different kinds. At this point in time, March 1998, there existed considerable confusion related to how the development of such superstructures should be handled. BETA and VISOK was just one example here. One of the Statoil Data gatekeepers gave the following description of the situation:

"We need some standardized technical solutions and have some key strategic opinions on how information should be arranged and made available for different parts of the company. We need a library or a repertoire of tools and be able to pick components... It will be increasingly important not to make standardized products that everybody should use, but make components that are tailored on the top, exploiting the same database information in the bottom. Specialized systems ranging from legacy databases to NOTES applications have traditionally owned their own interface and are made to match a predefined purpose. They are not able to handle a situation where new needs are developing all the time. The concept of a computer system is losing its meaning since the interface does not need to own the component and database level".

The gatekeeper addressed the need for a library of components that could be used to tailor according to specific customer needs: to tailor on the top interface and keep a more strict structure of components and databases underneath:

"One size fits all thinking like we have done with ESOP will become more problematic for Statoil Data in the future. The use of explicit digital enterprise models in Norne, VISOK and BETA as a graphical interface on the top as a navigation structure indicate at least that the traditional IT -system concept is about to fall to pieces".

Another Statoil Data executive adviser draws a picture of three levels. On the top he draws something that he calls the enterprise level. This level consists of the many superstructure projects seen through BETA, VISOK, OMEGA and others. Underneath is the component level and at the bottom, the database level, see Figure 7.7 of a copy of this model. He argues:

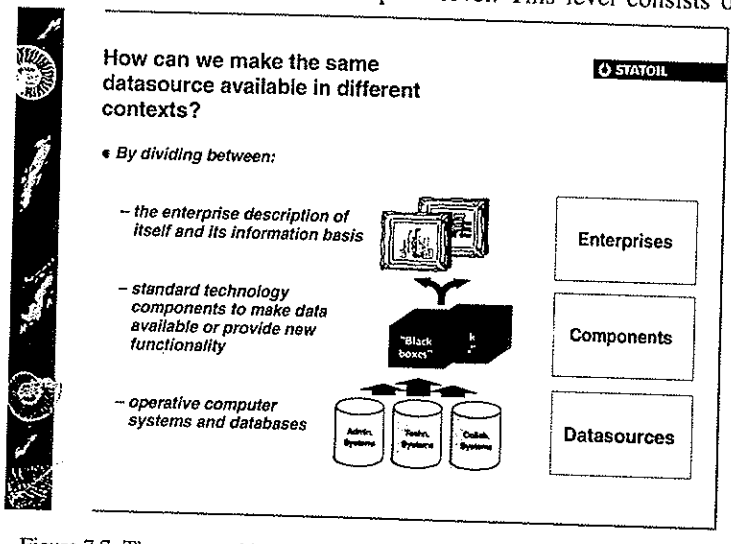

Figure 7.7: The new working order between enterprises, components and data-sources

"It is about discussing perspectives through which you want to see your business. Here we have to deliver interfaces that match our business customers needs in the future. Still, we do need some flexibility. We are able to control the component level and the structures of the databases in the bottom. We

have to have good source quality of the data and good stringent components on the mid level. The components we can reuse and sell to different parts of Statoil and combine like LEGO bricks. This is also aligned with warehousing. On the top there will be an enterprise model, here we are increasingly talking more and more about methods for helping the organization to describe its work processes and organize its information resources instead of systems development".

Christian argues that this is how KOT has presented VISOK for a long time. The other participants are adding valuable comments to this description and other KOT participants address the need to focus more on the work processes and less on the information architecture in itself. Ola responds:

"We have to think organizational application and work practice first, information sharing is a part of that. Then you can think about information architecture/information logistics. Technology is only in the bottom. What is missing in the model is the actual work. You have to look at both the organization development aspects and IT-issues. It is then you are able to take out the effects".

The participants did not share the same definitions of "enterprises". For some of the Statoil Data participants it was the graphical user interface (GUI). For KOT it was also a GUI, but also a reflection object to be used in a reflection and change process. Components were discussed as black boxes. A number of examples were discussed: the map navigator and the licence platform from VISOK, the mandatory documentation database from BETA. However, all the trouble of making these components fit together was not mentioned.

The meeting defined a sufficient working order where the participants had an overall understanding. If more details had been incorporated the differences between the participants would have become apparent. Most of the discussion was on the technical level and the participants agreed to create a FREELANCE GRAPHICS presentation that described the main content of the new working order. This new order was then spread to the rest of the Statoil organization to reduce the confusion on questions related to future business applications on the Intranet.

7.4 Narratives of VISOK

In what follows I continue the threads that KOT described in their reflection and writing about VISOK after the project shutdown in 1999. I describe what they called a number of narratives or learning histories from VISOK. These narratives describe in more detail what happened with the various perspectives of VISOK, some perspectives that I have shown in Chapter four were born already in 1995. I am grateful to the reflections the VISOK team made on their practice after the closing of the project. Much of the input I use here is the team's own local theories and aggregated narratives of what happened, coupled with my own observations during my fieldwork (and a consequence of feedback gained in the EDN and Statoil Data organizations).

In what follows I have surrended ethnographic authority and present the narratives through the VISOK members own polyphonic descriptions. However, I have chosen (based on input from the project) what were the most important perspectives of VISOK. These perspectives are seen in relation to my research questions, since I am interested in the translation efforts in the more traditional STS sense. There are a several perspectives in VISOK that did not draw that much attention (these are: the health, environment and safety perspective, the external perspective and the balanced score card perspective). These are not presented here. The

perspectives that are most important in relation to my research issues and consequently handled in the given narratives are:

- the geographical navigation perspective
- the work process perspective and related activities
- the retrieval of licence and resource information from the licence platform
- the organizational navigator

7.4.1 The narrative of maps and geographical navigation: or the map as a reference point

The use of maps has been important in Statoil since its start in 1972. The creation of maps has until recently involved special skills in handling, heavy, server-based map systems. Such systems have not been particularly suited for sporadic users. Gregory reports in the narrative of the map navigator:

> The potential in giving everybody in Statoil the possibility to create their own maps has been recognized in some internal environments in Statoil, but until VISOK it had not been exploited. One of the barriers has been the technology. The move to desk top map systems have lowered the user threshold, but it is first with the growth of interactive Web based map systems that it has been possible to offer a simple way to let everybody create their own maps.

EDN used several types of maps in their work and they filled different functions. One of these functions was decision support. Gregory writes:

> Sketches of maps were used (by drawing or scanning) as support for decisions in licence projects, in application of new licences and in early phase projects as ways of assessing future prospects. This meant that maps had an obvious function as a condensed presentation of key properties of a particular area. Maps were used to cover aspects related to Statoil's overall licence activities down to specialized activities in the early phase, project run throughs, evaluations of new areas and smaller project discussions.

The level of granularity and glossiness of these sketches and maps varied considerably. Such maps contained information about the licence situation (who owned the licence and activities), wells, geological structure, prospects, infrastructure (pipelines and installations), basins, faults, offices and onshore plants, environmental data, contours of the land, water depth, seabed conditions to mention some aspects. Maps were the principal metaphor or communication object that enabled a number of different specialist traditions to share a common reference point. They were also increasingly used as a navigation mechanism in Statoil's earth science specialist systems.

In the twenty interviews that the VISOK team conducted in EDN's regions (north, south and west, suppliers (LTEK-PETEK) and IT support in the summer of 1997 in order to gather requirements to map functionality in VISOK, a number of issues came up. Gregory describes a large need to use sketches of maps in daily work activities:

> In spite of different work tasks in different parts of the EDN organization or their suppliers in LTEK and PETEK, all had the need to retrieve, put together and present information from several sources. Maps were often the format of presenting this assemblage of information, but collecting this information was time consuming and difficult. In many cases people from specialist services in LTEK or PETEK, the drawing office or specialist tools were needed to find and present the actual information. Consequently, there was a need to simplify the creation of maps and presentations, perhaps even from the PC workstations of EDN employees without external help.

The need for decision support was another key issue because of the complexity of the specialist systems. A considerable threshold had to be crossed to become a competent user

and most people wanted simple decision support in a new tool. One geological example was that somebody wanted to activate field analogies that described exploration plays in a simple way, or be able to combine categories of map data to illustrate relationships between specific geological interpretations.

Here was a demand to have a tool that could be more than a presentation tool, and incorporate functionality today inherent in Statoil's official specialist systems, or to start up these applications from within VISOK. The VISOK team in collaboration with EDN management decided that the latter should be avoided. VISOK could and should never replace the specialist systems. VISOK's niche was aggregation of input data from these specialist systems, a management information system. Gregory reports two main conclusions from the requirements analysis related to maps:

VISOK should provide some basic decision support and presentation of maps. GIS functionality was to be used for navigation in databases as a basis for selecting data for analysis. Point, click and zoom at geographical elements (wells, geological structure, infrastructure, faults) and retrieve information related to this area or these objects either in the form of complete lists or search after special information (find licences where Statoil has more than X % licence ownership, discovered fields larger than X sm3) was growing in potential.

Still, in the summer of 1997 it was assumed that the use of map sketches would be the most important product of the map functionality in VISOK. These map sketches would be integrated with a digitalization of a number of reference reports, whose data were already available in PROSA, the prospect and resource database of Statoil.

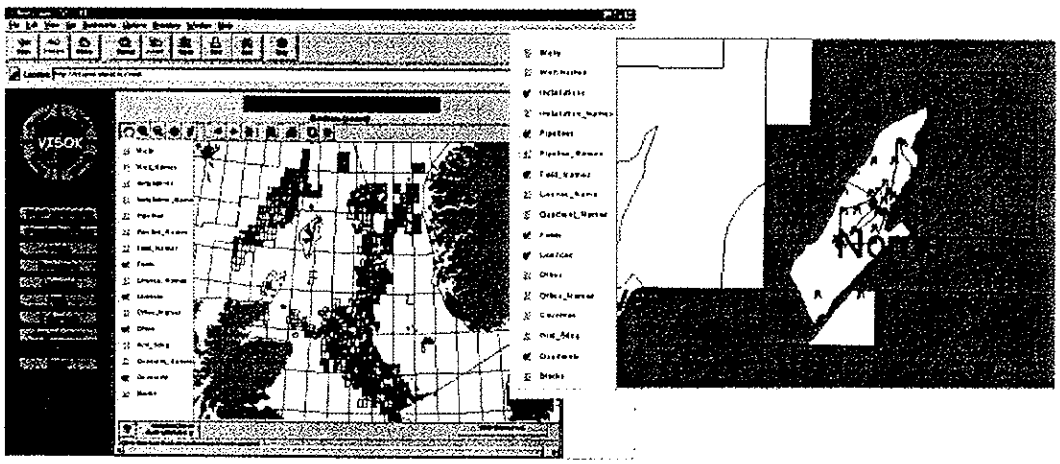

Figure 7.8: To the left the VISOK map navigator where you can zoom in and pick up a number of properties of various licences. Right, the bit-map quality of dynamic non-vector based maps

In spite of the need of map sketches the solutions that were developed in VISOK for presenting such sketches did not become the success the VISOK team had hoped. The "bit map" quality that resulted from the exportation of VISOK maps to another presentation tool did not have the proper quality. In technical terms this meant that VISOK was unable to create vector-based graphics, where you scale down and zoom in without destroying the graphical format. During meetings with licence committees and meetings with people outside Statoil, glossy presentations were needed since good-looking maps were a symbol of professionalism. Statoil takes profiling very seriously.

In most cases the organization had grown used to using the drawing office and most EDN personnel had to improve their own IT skills considerably to be able to create these maps themselves. The VISOK solution implied too much tinkering. EDN management and the IS/IT improvement manager had the final say: the activity on map sketches should not be given more attention in VISOK. The activities on map sketches in VISOK were therefore oriented more in the direction of using a geographical navigator in collecting information of the sorts already mentioned. As Gregory summarizes:

Considering the work on map sketches, there was a mismatch between the expectations to map quality and the quality of the Web-based maps that VISOK provided. In the concept documents and in the series of interviews that were conducted the team announced that the map navigator was a system for map sketches and not for traditional drawing office quality maps. However, this argumentation was never understood by EDN.

In summer 1997, the map team started building an operative system that should present maps. The specification of the map solution was defined together with LTEK. By September 1997 a prototype existed that was presented in the VISOK-EDN management meeting. In order to increase their thrust, the map team took part in setting up a Statoil GIS team in October 1997. There was an increasing need to co-ordinate activities and the data for several environments in Statoil using maps and map systems. Personnel from LTEK (a growing ally of KOT and VISOK) and other GIS related environments and projects met at regular intervals.

From May 1998 it became possible to link up traditional home pages via the map server. This meant that you could navigate in a dynamic map and retrieve the home page of the installations that you passed on your way. Another milestone was reached in summer 1998. Students doing vacation work in Stavanger collected data and created contours of interpretation files (called IRAP files) for use in the map navigator. Now it became possible to create a link between the maps (or interpretation areas on the Norwegian Continental shelf) and corresponding files from interpretation projects. Gregory reports:

This milestone showed that it was possible to click from the map and access a reference where the interpretation files were located. To put it in other words, it was possible to navigate through large amounts of geological data using maps as the key navigator.

In September 1998 a meeting in EDN signalled the beginning of the end of VISOK. Budgets were cut and focus was steered towards a more minimalist solution. The consequence of the meeting was that VISOK should be completed by the end of 1998. For the map activity it meant summarizing the project and handling over the rest to EDN and Statoil Data to keep the map server in production. The ideas about maps did not die, they were taken further in other projects, but it never became the general component (Section 7.3.3.) that KOT and Statoil Data hoped to spread to other parts of the Statoil organization.

7.4.2 The narrative of the work process perspective

In the Norne case and also in KOT's original concept related to the Collaborative Workspace project the development of and visualization of new work processes had a key focus. As I have presented in Chapter five it functioned rather well in Norne through the visualization, description of work processes and enabled access to necessary secondary information. Chapter five showed how the visible result of the Norne project was an application that visualized Norne's business processes through the use of clickable work process maps, with underlying textual descriptions and background information that supported the execution of the work processes. KOT believed that this experience could be taken further in the VISOK project.

In the BRU TF improvement process descriptions of work processes had a large focus. In the first meeting with EDN stakeholders in June 1996 the Norne application was shown and the two stakeholders signalled a clear interest in the future use of such an application in the EDN organization. In the mock up that was presented in the October 1996 meeting, work processes were one of the perspectives and the whole mock-up had the Norne application as the underlying basis.

Both KOT and EDN management had strong hopes that this way of communicating and describing work processes would improve the overall business understanding of the different work processes in the early phase and form the basis for information and new tools that supported the processes. The overall targets of the project contract that was set up in January 1997 had the improvement of work processes as an important item: "develop models of the business within the early phase that enables an improvement of the work processes and more easy access to and sharing of information in these work processes".

Embedded in this overall target was an idea about re-use and further development of methods and solutions based on the experience in the Norne project. Work processes became one perspective in VISOK. In Norne it was the only perspective, other perspectives were handled by other reflection processes in the organization. In VISOK, as we shall see shortly, the attempt was made to incorporate an increasing number of perspectives in order to visualize more aspects of the early phase, or EDN's business. The idea was to create a more total description of the enterprise of EDN, compared to Norne.

The earliest examples of the end product of this perspective in VISOK was based on the same Norne idea, that new work processes should be developed in reflection processes in the EDN organization and then implemented in the work process perspective. In what follows on the work process perspective I am very greatful to Morten who gave me valuable input on the development of the work process perspective in VISOK. In the VISOK summary report of 1999 he argues that:

...compared to other tools that we tried to establish in VISOK, the intentions of the work process tool was directly linked to the good experience from the Norne project. It was linked with evolutionary prototyping. KOT had experience, methodologies and a work process tool that could be reused with success also in the VISOK-project. The intention was that the tool should help us both in the project period (with support) and after the project had ended (business understanding and change support for EDN).

The intention was to use the tool throughout the project to map, document and improve work processes through continuing discussions and change proposals connected to the design/description of the early phases work processes. A number of EDN stakeholders should have important roles, as in Norne. This would enable the project to improve the functionality that had been developed in Norne. As in Norne the intention was to use the work process tool as a support tool for continuous improvement of work processes, where changes in work processes were communicated and spread to everybody in the early phase through the visualization of the business processes. Morten says in his tale of work processes in the 1999 VISOK report that intentions related to methodological support in the project period, enterprise understanding and change support were also the intentions of the other perspectives in VISOK:

A general description of work processes should have been an input area where we could have had success since we had a tested methodology and a general tool that worked in another setting, Norne. In spite of the positive experience from earlier projects, the VISOK project did not succeed with this approach.

After the first presentation of the work process perspective in the mock-up of October 1996 little happened with the work process perspective until the spring of 1997. Small adjustments were made, but these comments were mainly feedback on the visual layout of the flowchart maps: change of colour and the names of boxes. In January 1997 the project started to work with prioritized target areas. A number of work teams were set up each with VISOK project activity leaders and process owners in the EDN organization. These groups were not able to follow up the intentions of the Norne project. The project experienced problems in involving the EDN personnel and the process owners in particular, and there was no active use of the work process tool. Work process maps were developed for a few processes using interviews, but these maps were hardly used as a starting point for further reflection and improvement in accordance with the original intention. Morten says:

> The argumentation from Robert and Ola was that the project had to show progression by making accessible point and click sketches of work processes in the VISOK prototype. In Norne this was easier since it was a new organization that had to define their new work processes if they were to succeed.

Let me now exemplify why this was more difficult in the early phase, which was a mature organization and had an established practice. The prototype, or the Norne "clone" that was used in the early parts of 1997 was not adjusted to become a common and active support tool in the process of mapping activities in the early phase. Too few of the KOT-personnel had sufficient skills in flowcharting and in the use of the tool (transferring work processes to clickable interfaces). Stuart and the rest of the operational part of KOT worked on different projects in the operational communities of Statoil and would not pursue projects in the early phase. Ola was increasingly occupied with administrative work due to the size of the VISOK project. Frank, the skilled NOTES programmer left his job in Statoil and moved to Oslo. This meant that facilitation of work processes became a specialist job that few in the project could do, and it also became a bottleneck to implement new work processes when they were made. New work process maps were not made available right away, because it was a tiresome job that few in the project could do, and those that could were busy with other activities.

In the EDN management meeting that addressed VISOK in May 1997 EDN's most important business processes were discussed. In the discussion that followed, the mapping of work processes was given less attention, and should be halted until the overall issues had been settled. At the same time the licence perspective was under development (access to licence information via underlying legacy systems, see Section 7.4.3). This work kept most of the technical personnel busy. Consequently, there were few people available, with the right skills that could do the conversion of the work process tool. In a meeting on 13 May 1997, with a large group of people from EDN, support functions like LTEK and PETEK were given a presentation of VISOK so far. The work with the work process perspective was again given a new push.

In addition, the fact that VISOK now should have a "Web look and feel" gave the adjustment of the Norne work process application additional issues to address. The adjustment of the application had now become twofold: First, to improve and simplify functionality for maintenance and work process maps (remember the data maintenance problems in Norne) and work process descriptions (making it easier to create and maintain work process maps and descriptions. Second, to convert the application to a "Web look and feel"- application. As Morten and others in the VISOK team claimed, these two activities should be held separate, because what were needed were good methods and tools to map, describe and improve work

processes in the early phase. Then a need for a "Web look and feel" should have been evaluated. Morten said in the report:

I must add that the project could have managed without a data support tool to describe, discuss, improve and change work processes in the early phase, but in a way it was implicit that IT should be exploited also in this work (It was an inscription inherited from Norne)...

After the May 1997 meeting the conversion job was done in a hurry and a coarse adjustment of the Norne application was undertaken. The Norne application was made in NOTES version 4.0 and a number of design features were impossible to align with VISOK "Web look and feel". In the summer of 1997 the situation was as follows. It was possible for non-specialists to create process maps and descriptions but the VISOK work process tool still had a long way to go to become user friendly. Important functionality like data references that proved to be vital in Norne and was used to link up references to mandatory documents had to be re coded in order to achieve the same functionality in VISOK.

Improvement comment functionality to work processes was not in place in the first version of the "Web look and feel". All this work required skilled NOTES/DOMINO competence that was locked in more urgent activities. The threshold to use existing functionality in the tool was still too high and no EDN organization coaching on the tool was prioritized by the project.

However, independent of the problems with the tool, the project had an increasing focus on investigating what was being perceived as the real problems related to the work practice of the early phase. In the spring and summer of 1997 those that could map work processes held courses and participated in meetings with EDN personnel. Some new perspectives like the balanced score card (defines a number of key performance indicators) perspective were taken further into VISOK others were never taken up again. Morten argues:

Up until July 1997, only the staff parts of EDN organization had taken part in VISOK. In a meeting in July 1997 new input from EDN indicated that the VISOK team should have started new interaction related to work processes. New representatives from the line organization or regions had now become involved in the project. These new people from the regions had a different way of seeing the business compared to the staff personnel. Consequently, staff oriented or administrative processes were de-prioritized and more value adding activities were in focus.

The introduction of the new personnel led to a focus on more core business processes in the early phase. Sketches of core processes in the regions were developed and implemented in the work process perspective. These sketches were implemented immediately, but the work was only done once. The maps were never used in any other context or in reflection processes. If we exclude the process maps on the overall level on the work process perspective, there were hardly any changes being done from June 1997 to the release of VISOK 1.0 in February 1998. Several initiatives in the EDN organization were taken to start up the work processing activities again in August 1997, but were cancelled. Improvement and change of work processes witnessed a silent death, as one of the project members said. In his tale of the work process perspective Morten gives an overall characterization of what happened:

It will be too easy to say that the reason why the commenting and discussions of work processes related to the suggested work processes ended because of the work process tool. The tool can be given some of the blame, but there were additional reasons. For instance, the motivation for describing work processes and create process maps of those involved in the early phase was not process change or improvement. Neither was it to create a mutual understanding of work practice, but more an answer to the fact that the VISOK-project and the VISOK-system "demanded" process maps (inscriptions inherited from the Norne application? ref actor network theory).

In the September 1997 EDN-VISOK meeting, work processes were downgraded as an important perspective in VISOK. No concrete activities were defined. As a consequence of low priority, no further resources were given to complete the development of a VISOK work processes modelling tool. After the release of VISOK 1.0 in February 1998, coaching and use of VISOK became more important than work process descriptions in the new phase that VISOK was entering. Morten adds:

"The last efforts in relation to the work process perspective were part of the version 1.2 release in June 1998. Now the updating of LISA/PROSA was shown using VISOK work processes. These maps were however presented through the licence perspective of VISOK".

Spring 1998 heralded another initiative of mapping work processes by the EDN's IS/IT improvement manager. Morten argues:

"Peter felt that the VISOK participants lacked the proper understanding of EDN's business processes. This was true for most of the VISOK team and the intention was good. However, this initiative came too late, seen in relation to VISOK's targets and intentions. Neither the VISOK project participants, nor the EDN organization that was involved understood why this was done now. The EDN organization began to lose its patience regarding interviews, work mapping and improvement work. The added value of this round was minimal and resulted in no changes in updated maps of changes in VISOK work processes".

At the same time the VISOK project was losing its legitimacy. Harald noted:

At the end of the project period VISOK did not have the same legitimacy among users and customers. The customer demanded results aligned with their expectations and higher quality in the project. In the VISOK project the group discussed, if we should avoid using the VISOK name for new activities to avoid being associated with old activities. Some users were cheekly when we arrived: "Oh no, the VISOK people are here again".

In autumn 1998 VISOK was restructured to become an Intranet site. All that was left was an application for news, presentation and navigation of EDN information, meaning a more traditional Intranet application. Most of the modules that were planned in the original VISOK concept were removed (with the exception of the licence perspective and the map navigator). The work process perspective was not pursued any further in VISOK "Next Generation" that was implemented in the first months of 1999. A particular structure for describing the work processes of LISA/PROSA data maintenance was all that was left. Visualization and description of the early phases work processes were not regarded as important any more.

What did KOT learn from the work process modelling activities in VISOK? Morten had the most sophisticated reasoning behind the fad of VISOK work processes after discussing it among his peers:

Experience, methods and techniques are not directly transferable from project to project. What was a comparative success in Norne was less useful in EDN. Methods and tools must be adjusted (due to context dependency) and experience in one project cannot be automatically transferred to another project.

Morten argued in discussing the use of work process descriptions in Norne vs. VISOK:

In VISOK compared to the Norne case, it was not made clear that there was multiple use of the IT support tool in Norne. It was a methodology and schema for the support of process mapping activities. Further, it was a database tool that supported a mapping and change process. Third, it was a medium for navigating to other kinds of information. An experience transfer process or training from persons participating in the Norne project should have been done earlier in the process. The early prototype used to exemplify the end product had not the shape to be used as a mutual and active support tool in the process. Resources should have been brought in earlier to facilitate the improvement of the work process tool, methods and tools that were a prerequisite for a good

process. It had to be there from the start. We should not have converted the Norne work process application so early from NOTES to the Web.

With both the tools available and training in place earlier, the project would have had a better starting point for creating a good process. The project should been more focused on work processes and work practice already in the start of the project. Work process descriptions and a better understanding of the early phase's work processes would have given a basis for implementing changes and the development of potential support tools. Morten sums up:

It is difficult to develop/facilitate IT tools that support processes that are uncharted or not understood... Paradoxically enough, the work processes did not become a part of the VISOK system as it is today. There is no demand for such a description or model of the enterprise anymore. The focus on end products in VISOK modelling activities was not useful and the early phase had little use of the processes. There were no known changes in work practice accomplished by the modelling activities except for the updating routines in LISA. However, the practice of updating information in LISA was triggered by the discovery of poor quality of source data, or a perceived problem. This led to increased attention on the problem and that changes in work practice had to be put on the agenda. A strong management commitment and a change of attitudes were needed.

Harald adds some important points in the 1999 VISOK report:

Process mapping did not work- and there might be many reasons for this. First, the activities of the mapping sessions were not the way we wanted. Second, we tried to map work that had no clear physical flow as in operations. Knowledge work is not so easy to represent as physical work, since there is often no clearly defined sequence and we still mean that the mapping could have worked if we had focused more on the mapping process and less on the maps that were produced.

7.4.3 The narrative of the licence platform (or perspective)

The VISOK 1997 project description stated:

Central in the VISOK project is the development of an enterprise model making it possible for management and personnel to find necessary information used in work and decision processes in the early phase. Information from the computer systems LISA and PROSA will be retrieved through the enterprise model through intuitive user interfaces a la the Internet.

Licence orientation was important in most of the early phase work processes and a simple access to licence and resource information was vital in this process. It meant that most of the perspectives in VISOK had to be licence oriented in one way or another.

EDN personnel claimed that it was a challenge to have easy access to information. One geologist said that his peers used 60 % of their time to search for information. He mentioned his quest for a particular paper report. When he found the right place in the library the report turned out to be on loan and the person who had borrowed it had given it to another person, whom he could not remember. This example showed the argumentation behind VISOK in the EDN organization and in exploration more in general: Highly skilled and scarce personnel were searching for information, doing work that added little value. If they could spend more of their time in front of their computer screens doing their geological interpretations or other kinds of creative work this would most likely have added more value for Statoil. Further, it would reduce the stress and long working hours of key personnel.

Considerable time was used to retrieve presentations that had already been made, presentations that could be "recycled" with small modifications. The consequence was that a number of persons had to spend considerable working hours to create presentations more or less "off the cuff" when being requested to report to the Norwegian petroleum authorities or for licence committee meetings. Other tasks had to be rescheduled as a consequence of this. Another issue was Statoil's poor ability to take advantage of the enormous amount of seismic

information available. Statoil had the far largest available seismic data sets from the Norwegian Continental Shelf.

Another problem was the number of work routines that had developed because of lack of or improper systems to take care of information. Many people had their own private spreadsheets and kept information in their own private computer domain and drawers, inaccessible to anybody but themselves. For some people this information was an asset that they were not willing to share with anybody in the organization. It was their source of power, their chance to become gatekeepers in the decision processes of the early phase.

As a consequence of this, the EDN organization was very vulnerable when key information on EDN's activities were only available in the minds or the office drawers of key personnel. This was the situation in 1997 and the VISOK team's recipe early in 1997 was simple: If more key information is placed in common databases or solutions like VISOK the problem would be solved. This was of course an oversimplified solution, as I will return to later. VISOK challenges seen from the 1997 research report was as follows:

A large challenge for EDN is the way they enter and maintain their data sets or source systems. EDN personnel coached in VISOK argue that data shown in VISOK through the licence and resource perspective is not updated. Since VISOK only pumps data from underlying databases like LISA and PROSA, it is these data sets that are outdated. In order for VISOK to become a success in EDN source data shown in VISOK have to be continuously updated. Only when this happens can we be certain that what is there of information is correct and relevant. The VISOK project must demand the updating of source data

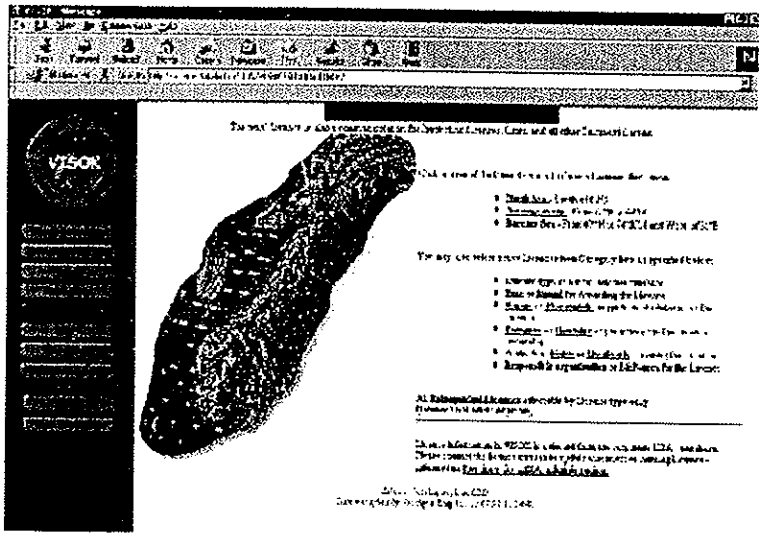

Figure 7.9: The licence platform of VISOK, with access to licence and resource data

The publication of licence information (data via LISA) in VISOK was regarded as critical to succeed with the other perspectives in VISOK.

When VISOK enabled to publish licence information, via middleware on the Intranet through a proper interface this was regarded as a large accomplishment in Statoil, something that several internal IT experts thought was impossible (see Figure 7.9). The problem was that the LISA data had a poor quality. The VISOK team was quick to claim that there were missing routines for maintenance and quality control of licence data in the company.

LISA is Statoil's official database for licence administrative data. All business units that have responsibility for licences in Statoil have a responsibility for the quality of their own data. They are to see to that changes in the situation in the licences are updated in the database and

that this information is "correct". Was improper routines and management procedures the only problem? The VISOK members started to dig deeper into an area that on the surface seemed to be solved by better routines. Those that entered the information did not need it themselves. There was a mismatch between those that entered the data and those that used the same data in another context. Those that registered the data lived in one context that was different from the receiver context. They often lacked a good enough understanding of the data they registered.

I gave Harold Garfinkel's *"Good organizational reasons for bad clinic records"* (1967) to several of the VISOK members. This reference triggered KOT's reflection of these issues. Let us see what Garfinkel triggered. Harald argues in the 1999 research report related to the personal usefulness of VISOK or to what extent activities in VISOK actually simplified the work of customers and users in the early phase or in the project:

A third consequence of perceived usefulness is that you actually do the work. Garfinkel (1967: 194) argues for the importance of perceived meaningfulness to do given work tasks. If work tasks are not given meaning, they will not necessarily be prioritized or done. There were a number of examples in VISOK where the information should flow one way: from regions to management. If the persons in the regions did not perceive this reporting as useful they did not put much effort in it. For some net present value is the only criterion. For others more illegitimate criteria exist: ones liking, chemistry and personal conviction. Garfinkel points to the importance of respectability when it comes to making people prioritize tasks. They have to perceive the tasks as respectable in relation to their own competence and position in the organization.

In their 1997 research report KOT write:

In LISA, LTEK has the job of entering the data, while geologists and economists in EDN use the same figures. Both the motivation and an understanding of what the figures say is not always good enough among those that enter the information, compared to those that use the data. Mistakes and misunderstandings occur as a consequence of this.

They continued on the publishing of resource data through VISOK:

Users do not need outdated resource data. Instead of using one-year-old official data they use unofficial but updated figures. Consequently, a publication of resource data in VISOK will not have a positive effect. If we had a more thorough study of what people actually are doing, and why they do not do it, we could have anticipated that the resource figures would not be of much help to those that needed the latest data.

KOT did not claim that the support functions that entered the information were stupid. The problem was that contexts differed and those that worked directly with information, e.g. with a particular licence or prospect were always able to interpret the data more comprehensibly.

To give an example from 1997 we go to the source database LISA that among other things shows how many wells each licence is commited to drill. These obligation wells are registered in LISA as a number, like 5 together with how many wells Statoil is obliged to drill under certain circumstances if Statoil applies to the licence committee to stop drilling additional wells, according to work obligations, (e.g. two less) because of previous dry wells. This last figure 2 is misinterpreted in LISA as the minimum number of wells that must be drilled. In the example from licence X those that read LISA might believe that at least two wells must be drilled, even though Statoil only needs to drill one well. The three syllables MIN can be interpreted both as minimum and minus, but is to be interpreted as minus. Even though licence managers are aware of their engagements, this figure becomes problematic if it is just aggregated along with other obligation wells in other licences without the proper understanding of what the figure means.

Another of EDN's challenges was to create an increasing awareness related to how personnel in EDN performed their work: Where did they put their data, on what basis did they make their assessments? How did they work across regions? In the allocation of exploration rigs in a heated rig market super regional assessments of data are needed to optimize the allocation of rigs in relation to an expected pay off. If the methods for assessment differed in the different regions this would become problematic and lead to mistaken priorities. The quality of licence and resource data came on the agenda in late 1997 and 1998 when VISOK made the poor quality of data visible through an interface that most people even managers used. The licence perspective of VISOK published this information. LISA's old interface was too complex for average users and the situation was invisible before VISOK. Now the problem of poor data quality became so apparent that something had to be done. Harald reports having participated in a meeting in one of EDN's regions:

"The visibility of poor resource and licence data has led to the fact that all licences in EDN South have been checked and updated. Now everybody can be confident that the information taken from LISA concerning licences in the south region is correct."

"LISA is a horrible tool" one geologist argued. Since LISA had this problematic interface licence information became duplicated and updated in ESOP as well. Since much of the information resources were in ESOP; like administrative information, holiday lists and minutes of meetings, this NOTES application was the preferred system. Lists of licence committee members were updated both in LISA and ESOP. ESOP was a natural place to put it since it was used many times every day. Some information categories in LISA like work programs were too general and could not handle the details that were needed. Consequently, the work programmes existed as text documents in ESOP databases. Harald makes a remark about this in a mail dated 16.04.1998:

The information offered through VISOK is not the information that is used, more detailed plans are updated in ESOP databases. This is a fundamental problem-- shall we make data available from a system that is not used or present data from the sources that are actually used?

Following the initiative of the EDN IS/IT improvement manager some representatives of the VISOK team took the challenge of improving the routines and practices concerning the updating and quality of LISA information. They were to promote a communication and decision process in order to improve routines and practices on the updating of LISA information and to suggest actions to be taken in order to minimize the duplication of information in the involved systems EDN used. Through these interviews and work mapping activities Pamela and Judy saw that different regions and licences had very different practices related to the updating and QA of the information. I am grateful for their work and their feedback in the description that follows.

Those that worked with the licence had to give the same information to different receivers. In general, users did not trust the data in LISA, but contacted the units or persons responsible for the licences directly by mail or telephone to get updated information. A number of problem areas were found. The updating routines were not followed up; poor quality control and unclear responsibilities related to data maintenance routines were reported. Pamela and Judy reported missing co-ordination of input data and bureaucratic flows of information. There was a lack of mutual understanding of concepts and interpretations of data need for training, and duplication of the same kinds of information in many different source systems.

Different business units demanded licence information for various purposes. The responsible licence units were looking for administrative licence data, mainly because of the information

obligation related to other licence partners (partner information, communication). The business development unit needed input to portfolio adjustment in order to increase the portfolio value. Economy and accounting wanted similar information for portfolio analysis related to volume and value. LTEK used it for map-production and map licence co-ordinates. Information on all levels was important in EDN' s overall strategy process.

Through the work that the VISOK team conducted, it was highlighted that something had to be done to improve the situation around LISA. The IS/IT manager held a meeting in July 1998 with representatives from EDN regions and LTEK plus the VISOK team to develop a practical process for securing continuing quality assurance and updating of the licence platform in EDN. The VISOK team presented their findings and the meeting concluded that there was a need for a change in responsibilities and a need to develop a checklist with binding obligations for use in EDN to clarify responsibilities. Marit and Judy reports:

Some prioritized information types in LISA were chosen. These were relations between the licences and other licences/commercial areas, the partner's percentage share and roles, blocks co-ordinates and area (block relations), work obligations, work programmes, activity history of the licence, committees and members of the committees.

In the work that followed Marit and Judy describe how the following suggestions were made.

Licence responsible/project managers should have the overall responsibility for QA. Secretaries were responsible for registering and updating data. LTEK should be given the responsibility for training, to keep up the steam in the quality improvement efforts. The routines were made available in VISOK. A checklist was developed together with the responsible user unit in LTEK and sent out on hearing in EDN's regions. The final checklist was accepted and implemented in EDN management meeting in November 1998. The access rights of LISA was cleaned up, and lists of licences with people responsible plus the responsible persons for updating the respective licences or their substitutes. Administrative licence data should from now on be registered and continually updated in one place, LISA. The managers were given a QA responsibility, had to follow up their engagements and promote the further diffusion of the activities in a satisfactory way. Only through this could a changed practice develop and it was only through this that a new trust regarding administrative licence data accessed through VISOK could be achieved.

In the September 1998 EDN management meeting where further development of VISOK was cancelled, the VISOK team was asked to take a closer look at the development of new practices around the handling of resource data (PROSA). PROSA is Statoil's official database for petroleum resources with appurtenant resource classes. In addition, the system calculates resources in prospects and discoveries in the early phase. PROSA consists of experience data and modules for management reporting. The VISOK team saw the same traits in PROSA as in LISA. Routines for updating PROSA were not good enough and the QA of data was a problem. In the autumn of 1998 VISOK personnel studied why geologists and geophysicists did not use PROSA as intended. The VISOK team suggested actions to change the practice. These results were presented to EDN management in April 1999 after the ending of the VISOK project.

PROSA as LISA had a number of users, at different hierarchical levels, and it was used for many different purposes. On the corporate level PROSA data was used for aggregating data to the annual petroleum resource account (all petroleum resources of Statoil). On the EDN staff or management level it was used for presentations and data for ad hoc use in speeches, strategy work, plans and pictures of the Norwegian continental shelf. It was also in use in other similar staff and management levels in the International and Gas division, of the same reason. On the geological geophysicist level it was used in relation to mapping of the prospects in an exploration play (e.g., location exploration probabilities).

PROSA had around 1400 discoveries and prospects. It consisted of a test database, an official database where all changes were logged related by name, and a historical database where the official versions were transferred for every new update of the official versions. Geologists or geophysicists filled in data on test versions. Few people had access to the official PROSA database. An ID was generated with the change of data. In PROSA a consistency check was conducted before transfer to the official database. Experienced LTEK personnel gave several examples of general mistakes or misunderstandings that developed when data were written into PROSA. These were summarized in four problems related to source data in PROSA.

The first problem dealt with the mix of new prospects and new versions. Prospects were often deleted to become reborn with a new name and new prospect numbers. This made it difficult to automatically track the history of the prospect over time. It also made manual tracking difficult except for those geologists and geophysicists that worked with the prospects and knew their informal activity history. The challenge was that this lost tracking often occurred at the most critical time, in the borderline between prospect and discovery. Often a double bookkeeping occurred.

When prospects were updated in an ordinary manner, the existing official version would automatically become transformed to a historical version of the prospect. When there was a break of history this did not happen and there was a large possibility that the old prospect stayed in place. An opposite problem developed when a new prospect was made as the first version of an already existing prospect. Both projects would have the same ID and when the new one was made official the old one disappeared. One senior LTEK professional describes the following: "There are examples were 10-12 historical versions of repeated old and new prospects have been generated before a frustrated user calls and says that his prospects are disappearing".

The second reported problem dealt with errors in the attribute data that often occurred when a new prospect was developed using a copy of another prospect. This way of working saved much time when the prospects had much in common, and one only had to change what was different to complete the job. The problem was that some attributes were forgotten, and as a consequence; they were not changed. This could be information hidden in data fields that the user did not frequently use. Examples of these data attributes were blocks/licences, discovery well, field name, geological age (i.e. Jurassic) exploration play, resource class, type of trap, reservoir depth and water depth. Some of these are more serious than the user realizes. The most critical occurs when discoveries are given erroneous resource class, field name, discovery well or licence connection.

A third problem dealt with dummy data. Since those that write the input in PROSA did not have information needed to fill in all posts, they filled in dummy information. All posts had to be filled in before a version of the prospect could be saved as an official version. For some types of data PROSA required the input of additional databases, like LISA for licence information and SFINX for well information and GEO X for exploration plays. This information had to be taken from these applications or somebody had to help the person that did the updating to retrieve this information. In some places in PROSA you picked attributes from fixed tables (type of trap, resource class, field name) in other instances you could not do this (reservoir depth and water depth).

The last problem dealt with the naming process, as a senior LTEK professional tells:

"I will not call these errors but man's ability to come up with names or abbreviations that make no sense for others than themselves has no limits. The problem is that these names are used in other connections as well, as names of the maps of Statoil geographical information system (GISMAP). People have grown used to hopeless names of prospects. The Norwegian Petroleum Authorities approves names in conjunction with PUD's so after that phase it is no problem. However, but for some of the discoveries in an earlier phase the creativity among the earth scientists is large. As long as the name is in ordinary use and does not have a bad style of writing it is OK, but names like "Statfjord NNE_seg" is not proper to present to Statoil general management on a glossy piece of paper. Neither is it wise to show that we have Hermod in our lists two years after the official name of the prospect became Grane".

The VISOK team saw that there were professional, attitudinal and technological reasons why the geologist-geophysicist professionals did not use the PROSA information. Marit and Emily asks in the 1999 report:

It seems that the processes/tasks/resources on the earthscientists professional level comes last when the system becomes so complex and is to cover so many needs. Is it possible for a system like PROSA to function according to its intention, when it is to cover both professional geologist-geophysicist work (a tool for prospect evaluation) and aggregated figures or data at the Statoil company level?

In this brief summary Emily and Marit also addressed the ambiguity and challenges of VISOK. VISOK could not possibly be both a management information system and a tool that the earth scientists would find worthwhile to use. In an official report to EDN and LTEK Marit and Emily described a number of challenges related to the use of PROSA. First, there was an inferior quality of the data. The data had to be trusted, each person responsible had to dedicate time to put quality assured data in the application. At the time, technical assistants put in the data, with inferior quality as a consequence. There were no formal requirements for earth science personnel to use the data, meaning that there were no incentives.

In an ideal world earth science personnel should use the database, but management did little to support the use and daily quality assurance work. Geologists used test databases as their work area. They processed the data in the test database and were too little concerned with transferring the data to the official database. Since there would always be a number of test versions in the test database it would be difficult to know where the newest data were at any given time. Routines and focus to put data into official databases were lacking. In an ideal world this updating should happen continuously, quarterly or yearly depending on the criticality of the data.

PROSA was used more as a data store than a simulation tool. Another problem was related to hit probability and discovery rate of new petroleum resources. A large percentage of the outcome could be lost. In Monte Carlo simulation you chose particular parameters, meaning that it was the linking of parameters in PROSA that gave such limitations. In addition, some used spreadsheets or calculators instead of Monte Carlo simulation techniques.

When it came to attitudes, many people lacked the technical computing skills. Judy and Pamela described how many earth science personnel were reluctant about entering data in PROSA. They are "caught in the process", without their ability to describe or fill in the argumentation that supported their conclusions. The categories available in PROSA did not enable them to express what they know. There was too little bandwidth to convey the essence of their calculations. This was because of the uncertainty in the data material at the date of entry, and because there will always be a number of ways of interpreting and evaluating prospects.

Finally, lack of attention in relation to earth science work had been a problem. There had been an administrative focus in the company, only the later years had the earth science community gained prestige and resources. Their systems and IT applications had been fragmented and they had developed a number of "work arounds" or tinkering, to cope in their daily work situations. When there were problems in interpreting the data people tend to call those they know, consulted their own private copies and note pads from earlier projects. They have developed ways of mastering these problems. Because of this administrative focus by management earth science personnel seldom felt rewarded when they did a good job.

On the other hand, aggregated resource data had to exist in order to let management take decisions and earth science personnel did not always have good enough understanding that the data were to be used by management for taking decisions. The feedback from management was evident: Focus less on geology and more on the probability for discovery, discoveries, net present value and quantification of data[28].

7.4.4. The Organizational navigator

KOT had always used pilots to get a deeper understanding of work practices and to develop long lasting relations to environments in Statoil. In VISOK this took time. In the start up of the VISOK project in 1996 and the beginning of 1997 management and the staff organization of EDN filled that role. The VISOK team saw early that this was not good enough, they had to develop stronger working relations with EDN's three regions: north, west and south. In 1997 there was an increasing need to find a smaller group that could set the terms or provide more detailed requirements for the project. VISOK as a concept was too general and in order to develop a more situated understanding of future use in EDN, some of the regions had to be strongly involved. The home base of the EDN North region Harstad, was geographically far away from Stavanger and seemed to be the ideal place for such a pilot.

In the early part of 1997 the VISOK team helped EDN N to set up and coach PROSHARE desktop conferencing equipment in Harstad. The work with the perspectives of VISOK was postponed for the time being. EDN North worked on their own to develop a structure for organizing their information both through VISOK and ESOP databases. ESOP was a LOTUS NOTES project database application developed by Statoil Data that supported asynchronous collaboration. It was a part of the existing LOTUS NOTES infrastructure of which EDN users were getting increasingly comfortable.

When the decision was taken to develop VISOK out of the demands identified in Harstad at the management meeting in September 1997 EDN N had at the same time their own activity which they called the "home page project" or "WEBSOP". This project had intended to cover not only EDN's demands but also the rest of the Statoil organization in Harstad (Norne onshore organization and exploration technology LTEK), because this office had a strong regional cohesion independent of business area location in Statoil.

The work started up in November 1997, and the first meeting was held together with the home page project. The home page project (WEBSOP) had already taken a number of decisions on what kinds of information should be included in their pages (how to structure the information and the graphical layout, see Figure 7.10). The first discussion was mostly around the layout of the Web site. The project wanted resources from VISOK, to define the interface to VISOK, and incorporate VISOK in their home page. They also wanted collaboration to deal with further change processes that would come as a consequence of their home page

project. In a meeting in December 1997, VISOK participants, EDN N and Harstad Statoil Data personnel planned the further development of WEBSOP.

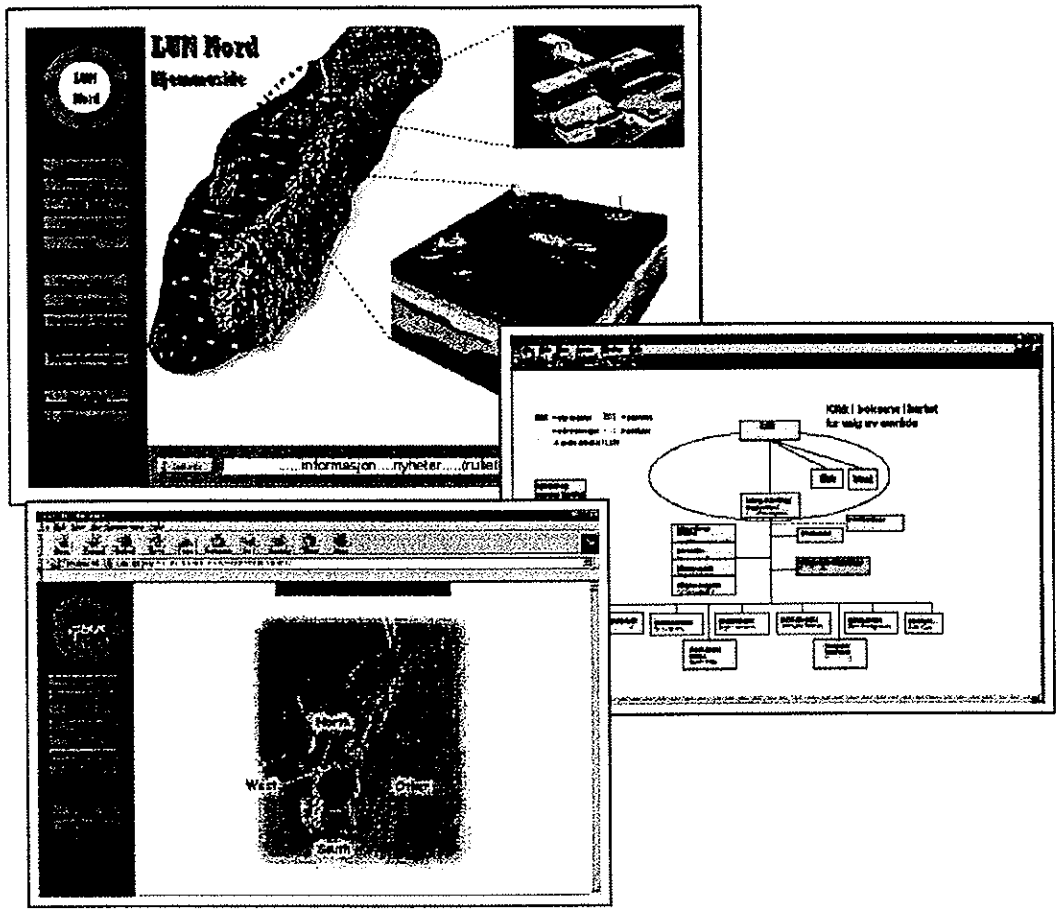

Figure 7.10: The changing interfaces of the EDN N organizational navigator. Back: EDN homepage (Websop) from autumn 1997. Middle: EDN N front-end in LOTUS NOTES December 1997. Front: VISOK organizational navigator from July 1998

One of the Harstad geologists presented a number of slides that visualized the home page that the Harstad organization wanted. He presented it as a general Harstad home page where also the onshore organization of Norne had a natural place. VISOK was placed as a push button on the front page of the Web site (see Figure 7.10). Some of the functionality was overlapping with VISOK, (access to work processes, administrative information, strategies, resource information, general Web resources) but it was a more personalized view in the sense that the individual or a smaller part of the EDN organization was the anchor point. The home page started with the Harstad EDN N user and his or her daily information resources and connected other types of information to these individual and organizational needs. It was to have a general search engine that was to find relevant information in EDN N administrative systems. VISOK did the opposite. It forced people to navigate in general information before they could retrieve more detailed information of EDN's regions. Harald describes:

One of the requirements of the home page project was an organizational navigator, or how to use an organizational map for EDN N as a general navigation mechanism to find information in ESOP databases. EDN N had begun to use ESOP, but it was not a proper tool to store much of the large files that earth scientists developed in their presentations. ESOP collapsed under the weight of these large files.

The use of a Web interface would make it easier to integrate information that up to now had been fragmented in the NOTES-UNIX divide, or a general divide between administrative systems and earth science specialist systems. To integrate ESOP databases through a Web browser was problematic because ESOP databases could not be reached via a Web interface at that time. However, it was easy to implement in NOTES. Harstad's first requirement was to be able to reach a common workspace through an organizational navigator, and they agreed that NOTES would do for the time being. Real user functionality was more important than the question of Web interface or not. Since I was participating I asked the EDN participants in the meeting if they wanted such a NOTES application right away? The answer from the Harstad participants was clear: "if that is possible, yes!"

Within two hours on the 10 December 1997 a NOTES front page was set up. It linked up a number of EDN's ESOP-databases and Statoil Data Harstad took the system management of the application (see Figure 7.10). This ability to take quick action created enthusiasm in Harstad and gave the Harstad VISOK team considerable goodwill. It gave the VISOK project more time, and developed confidence among the home page project participants. Confidence in relation to a group that had felt that VISOK people were messing up their own home page ideas. The meeting concluded that the study of EDN N's work processes should form the basis for additional work in 1998. With a better understanding of the work processes and their information requirements, the project could continue in 1998.

The feedback from the rest of the VISOK team concerning the EDN N NOTES front page was not that positive. The IS/IT manager of EDN was the only one who said directly that it was a good idea and thanked for the initiative. The NOTES navigator to ESOP databases was felt as and described by several as a threat to the VISOK application. During KOT's morning coffee sessions, this controversy was discussed several times in the time that followed[29].

The Harstad incidents created two discussions in the VISOK project. The home page project had many concepts in place, ideas that in many cases went against several of the VISOK principles. Instead of VISOK challenging the project, the IS/IT improvement manager of EDN suggested that the two projects should be integrated. In a mail dated 17.01.98 he says: "If WEBSOP is released as a project on its own outside VISOK it could confuse people in the EDN-organization, and throw away resources on developing double functionality". In a planning session a few days later the amalgamation of the two initiatives was further developed.

EDN wanted an organizational navigator that could not be used with Web technology in Statoil at the time. However, ESOP had been tested on DOMINO servers, which showed that data could be retrieved; solutions would become available in 1998. It was very much about publishing ESOP databases on DOMINO-servers, but it was a read only functionality. To be able to search the databases was a more problematic job, but Statoil Data people in the VISOK project were assigned the task. The project had gone for "a Web look and feel" and hoped that the access of ESOP databases would be solved later in 1998 through systematic Statoil Data efforts. In spite of the feedback given by EDN N on the needs for better NOTES functionality, the VISOK project ignored it as old-fashioned and conservative. As several of the VISOK participants argue in the 1999 research summary report:

When the VISOK project had taken the "Web look and feel" decision they ignored the collaborative functionality of the LOTUS NOTES infrastructure. To the interactive collaborative groupware functionality of NOTES, VISOK could not compete. It was a tool for presenting information in a Web platform and had hardly any collaborative functionality at all at the turn of 1997-98. The Web was perceived to be the future and to go back using NOTES was not a step in the right direction.

The Harstad VISOK team had planned to embark on a more thorough process in 1998 together with the home page project. A three-month project was planned, with an EDN N manager as the project manager where the intention was to involve all organizational functions in Harstad. The targets for the first months were to have quicker access to information, have a Web version of the home page up and running, active use of PRO-SHARE, implementation of ESOP and systematic feedback on the use and future development of VISOK.

First, to develop a search engine that searched multiple databases and get a first prototype of the EDN N home page up and running that could access ESOP databases. Description of work processes was also high on the agenda. WEB SOP and VISOK were slowly aligning their interests. A presentation regarding the EDN N pilot in VISOK was developed by the home page project and the VISOK team for the EDN N management meeting on 26 January 1998. The VISOK team and the EDN N project manager had spent considerable time putting together a concept that could create further support of the project in Harstad. In mail discussions and preparations the last week before the meeting the following agreement was found:

Here comes the clue in the presentation —VISOK and the EDN N home page melts together in such a way that EDN N home page becomes a pilot in VISOK. By cutting the home page name and calling it the VISOK pilot, we depart from what is traditionally a home page and over to mapping of work processes to gather information requirements.

Visually (related to user interfaces) this meant that the geographical bias of the Harstad home page was put to silence. It was a compromise. VISOK should implement an organizational navigator that had Harstad as one of three regions. EDN N was the first region to have a home page in the organizational navigator and the other regional organizational navigators should come later. In spite of the argumentation to incorporate the two projects, this did not happen. Harald describes:

EDN N did not become the pilot the VISOK project wanted. After an assessment of the size of the activity and other activities that popped up (the decision to focus on the introduction of ESOP, the coaching of VISOK being launched in February and a number of additional IT related projects that EDN participated in SAP-implementation, datawarehousing) the home page activities were stopped. Plans to develop the home page of Harstad were therefore put on ice for the time being. Management in EDN N wanted to focus on application of existing IT solutions before developing new functionality. The VISOK team was told to come back at a later date when ESOP was implemented and in use (ESOP was to be implemented with local resources) and when the project could document the added value of VISOK. Much effort was invested in coaching VISOK and train new users in the EDN organization.

In an EDN N management meeting in April the VISOK team presented a prototype of the organizational navigator and were given a "go" to continue. In spite of VISOK attempts to document the added value of VISOK through success stories of VISOK.

EDN N never became the pilot that the VISOK team hoped, and the VISOK team got caught up in other activities prioritized by EDN management to be more important in the spring and summer 1998.

The organizational navigator was implemented in VISOK 1.2 in June 1998. It had a sophisticated search functionality that could perform searches in all EDN's ESOP databases. Studies of the user log show that it has hardly been used. Harald that participated in the Harstad work describes the home page and VISOK project as a conflict of interests that was never reconciled:

The home page project tried to develop the best possible solution for each member by adjusting the workspace for individual use. VISOK were forcing people to see the big picture before they could find their own information.

7.5 An epilogue of VISOK

For KOT the perceived failure of VISOK proved to be the beginning of the end. KOT tried to develop a new concept called "Global and distributed collaboration". In the climate that developed after the fall in the oil price, no customers were willing to invest efforts in such a project. In the large reorganization effort that started in 1999, many projects were ended and few initiatives were started before the new situation was in sight.

VISOK had given the remaining KOT personnel two major lessons: They should never again embark on a large IT project of VISOK's size. "Small is beautiful" was argued and the considerable size of the VISOK project had given the use of information technology its own momentum, a force KOT was not able to handle. In the future organization development would be high on KOT's agenda again, and optimism related to the use of IT had been given a serious drawback. KOT argued that their use of IT should be restricted to improved use and coaching of the installed base of collaborative technologies (NETMEETING and ESOP). One of those that left KOT argued:

"I got the feeling that VISOK came two-three years too early. We started when the organization had no ideas about what an Intranet was, when the technology was immature and fragmented. However, what has the Statoil organization learnt from our efforts? Today the organization cries for "portals" and consultancies compete in marketing their portal concepts. This is the new fad. VISOK was an early portal, but using a portal on the top of information systems will most likely meet the same problems we experienced: poor quality of source data and a work practice that is far away from the way people ideally should use the portals".

However, without customers KOT's income vanished. The loss of customers coincided with two additional incidents. First, research budgets were cut and co-ordination technology, or new forms of collaboration enabled by information technology, was taken out of the strategic research areas. Second, Statoil general management heralded a two-year freeze of IT investments. The installed base of software and hardware had to do for the time being and new initiatives in the field of new collaborative technologies would not be tolerated in the period of the freeze. These phenomena seen together led to the slow death of the KOT environment. Key personnel had already left in 1998, but in the autumn of 1999 and spring-summer of 2000 half of the remaining personnel left for other positions within Statoil, or left Statoil altogether. Those remaining were relocated to other research projects in the reorganization of the company and the TEK division that followed in 2000.

Chapter 8 The Collaborative Workspace and VISOK, an analysis

8.1 Introduction to the drama of VISOK

The improvement project BRU TF and Statoil's evaluation of the need for a large increase in future oil and gas prospects led to a *breach* in the status quo situation of Statoil exploration activities in 1996-97. This breach coincided with KOT's willing assistance in EDN's initiative to improve work processes in exploration. EDN management wanted to change and improve the present way of conducting exploration activities and initiated this breach deliberately. With this initiative EDN management signalled a breach of regular, norm governed social relations between persons and groups within the EDN organization and its collaboration partners (i.e. LTEK, PETEK).

The idea was to change the crucial norms regulating the intercourse of those collaborating in the early phase in the light of the BRU TF recommendations. The BRU TF report addressed a number of issues that had to be handled if EDN should improve its ability to meet its 2010 targets of 500 000 barrels. VISOK was to be a part of this effort of a breach with the established exploration practice.

The VISOK project started when a new working order in the social field of the early phase was under establishment. Different perspectives of the business existed in different part of the early phase's social field. Unresolved problems, conflicts and antagonism were visible. Heterogeneous perspectives were abound; those of the earth scientists, EDN managers, administrative functions, economists and others. As Geoff Bowker reports (Bowker 1994), earth scientists like geophysicists and geologists share a mutual suspicion for each other.

In this new situation where new perspectives were developed and new factions were formed VISOK had to navigate. The point of entry in the VISOK project as in Norne is that the social order cannot be taken for granted. It must be established and be continuously reformulated to remain a working order. To establish this working order groups use different forms of material or immaterial symbols of which in the Norne analysis (and of which I will continue here) were called intermediaries and boundary objects. The working order becomes coherent via boundary objects, since they are concepts and objects that inhabit several intersecting social worlds and satisfy the construction of meaning in all of them.

A discourse between participants in the social field is needed to create the outcome: interpretations of new social practices and artefacts in the early phase. As Victor Turner (1974:38-39) describes, this second stage, *crisis,* is always one of those turning points or moments of danger and suspense, when a true state of affairs is revealed and an old working order cannot be healed. When the VISOK activities started to gain a certain momentum, these activities themselves provided material for this crisis, like the visibility of poor quality of licence and resource data. Not only was the VISOK project accused by EDN of painting the picture darker than it really was. The development of VISOK itself was a direct manifestation of the crisis. It pointed out that communication within and between EDN regions, LTEK and other EDN collaborators had an improvement potential, and that decision processes and quality of licence and resource data had to be improved.

Throughout the period of VISOK, from late 1996 to 1999, EDN conducted a number of efforts to improve this situation. In the narratives of VISOK I have given a number of examples of how EDN tried proactively to handle the situation. They invested efforts in an IS/IT manager to put improvement issues on the management agenda, focused on improved quality of resource and licence data through improved organizational routines and metering.

EDN defined a more regional focus in developing new businesses to avoid licence sub-optimalization and finally invested efforts in new work practices like peer assist, peer review and Exploration forum. All these were activities purposely conducted to gain control over a situation by those considering themselves the most legitimate or authoritative representatives of the early phase community, EDN management. In the light of Victor Turner's drama stages: the above action can be interpreted as *redressive* means, taken to avoid a crisis from further developing.

The social drama of VISOK ended with the termination of the project in the end of 1998 and a reconciliation of the contending parties in the light of the problematic financial situation. VISOK as a consequence of this did not have a final act in terms of reintegration. It ended as a "Web site" or as "VISOK next generation". The terms of VISOK's ending were merely conditions under which new social and technological dramas in the early phase might arise. KOT had to reconcile themselves with the fact that they were not able to succeed with VISOK's ambitions in the dramatic financial situation that followed the rapid fall in oil prices in 1998-99.

For the EDN organization the social drama around VISOK suspended at least to some extent normal everyday workpractices, interrupted the flow of social life and forced EDN to take cognisance of their behaviour in relation to their own values, even to question at times the value of those values. In other words, the drama of VISOK, in spite its moderate success, induced and contained reflexive processes.

It generated new cultural frameworks in which reflexivity could find a legitimate place. Frameworks that could provide some new questions and answers: how should we improve our data maintenance routines, how should we work with peer assist, how can Internet technologies help us have better access to key information? VISOK also provided an opportunity both for the VISOK project participants and EDN for taking stock of lessons learnt, improved practice and increased efficiency. KOT evaluated the project in their 1999 experience report. EDN had a thorough process before taking a tough decision to stop the VISOK project in the end of 1998.

In what follows is the analysis of the VISOK project[30]. I interpret the dramatization of the project and try to analyse the project in the light of technological dramas and actor network theory. This drama consists of actors that form actor networks via inscription and translation efforts. I analyse the development of a new actor network around the work that the VISOK project did in EDN (8.2). I start with the existing inscriptions in the CW project (8.2.1), and then put special emphasis on the development of a working order around VISOK (8.2.2). Further, I look at the nature of classification and sense making in VISOK (8.3), mainly through the development of VISOK perspectives (8.3.1) and discuss to what extent VISOK was a boundary object. Finally, I look at legitimating and justifying narratives (8.3.2) in the enrolment of VISOK in the early phase.

8.2 The drama of an actor network in VISOK

Pfaffenberger's technological drama enables us to look at the full range of technological activities and organizational activities in the VISOK project, the many discourses of socio-technological statements and counter statements. Here, as in Norne, activities can be interpreted as a process of communication in which each new act is interpreted in terms of acts already performed, or programs- anti programs in the language of Bruno Latour.

For KOT to gain support for their VISOK ideas the project had to do two things at once. To enrol some part of the EDN organization so that the early phase would take part in the development of "integrated organization and IT development" of VISOK. Second, to control the behaviour of the enrolled EDN organization. The simplest way to keep a set of allies in line, or as a whole act as one is to tie the assembled forces to one another, to build a machine like VISOK or a digital enterprise model that was believed to be the recipe both in Norne and EDN.

In Pfaffenberger's terminology a process of technological regularization had to be initiated, and in VISOK as in Norne a phase of *technological regularization* started the technological drama. EDN and KOT/Statoil Data, the design constituency, appropriated and wanted to modify the early phase's work processes. The best way to do this is to find people who believe in the concepts, cater for these people's explicit interests and offer new interpretations of these interests to the latter groups. An alignment of interests between EDN management and the VISOK team was realized in the aftermath of BRU TF: "we want what you want".

As in Norne cascades of increasing inscriptions and translations create the VISOK application. In the light of ANT, the CW project, the drama related to the VISOK project is the development of a new heterogeneous actor network in the early phase, with both human and non-human nodes. It is a drama with many trials of strength (Latour 1987:200) that pragmatically reveal and test which link is solid or weak. The processes and IT artefacts generated in the technological regularization of VISOK became subject to multiple interpretations and became challenged in the discourse that developed as a consequence of the VISOK project.

The regulations that VISOK tried to establish created areas of inconsistency, ambiguity and interpretative flexibility, even contradictions. The more the VISOK project tried to put regularization into social life, regions in EDN and earth science personnel affected by the regularization resisted it by arranging their immediate situations, ignore VISOK altogether, or interpret the ambiguity in the design discourse of VISOK. A "game of cats cradle" is even more proper to describe the ingenious interaction pattern, the development of a dramatic

pattern, or the active productive skills in the early phase that the VISOK project could partly control in the design discourse around VISOK.

Metaphorically speaking KOT and Statoil Data provided even less of the material for the strings and less of the rules of the game than in Norne, and had hardly any control of the patterns and variations that developed as the strings passed along in the drama. At the start up of the project the idea was that VISOK should be a collaborative project with peer groups. This thinking was also manifest in the first project contract with EDN. In 1997-98 the project became more and more a traditional systems development project with customer (EDN), vendor (KOT), and sub vendor (Statoil Data). As Harald and Morten summarized in the report:

> One consequence of a traditional distribution of tasks in the project was that the work practice of an integrated and evolutionary IT and organization development not functioned properly. Few prototypes were developed and few cycles in the development spiral were undertaken before the content was closed. In that way the method was more in line with a traditional, linear construction development, but with an improper specification phase (i.e. got the worst from both approaches). A more traditional development approach would have worked better since we would have focused more on a specification.

In the terminology of ANT the early phase consisted of one or several existing actor networks with varying spokepersons or social actors (the diverse earth science community, EDN regions, EDN staff and EDN management to name a few), that were not aligned and which had reached a phase of irreversibility. The strength of the existing inscriptions and translations in the early phase made it difficult to reverse the existing network's implications through a new alignment. Inscriptions and translations make an actor network stable when a non-aligned group of interests are aligned under the umbrella of acceptable truths, a situation that was possible in Norne in 1996.

Given the stability and institutionalized setting that existed in the early phase it took much more to change the situation. Existing translations in the early phase, meaning the existing order of human and non-human materials were so were so taken for granted, or de-signified, in the language of Pfaffenberger, that it was natural to go against the translations of the VISOK project and EDN management. KOT was not able to define and enrol process owners and working groups in such a way that it catered these groups self interests.

The early phase was a mature organization that had institutionalized a particular order, so very different from the newly recruited organization of Norne. In addition, it was 4-5 times as large as the Norne organization if we include the EDN collaborators like LTEK. The array of existing computer systems and institutionalized practices, earlier referred to as "work arounds", were far more complex. Both these issues added additional factors to the challenge of enrolling VISOK in the early phase.

Actors working together in the early phase came from different communities of practice and to develop a new working order was problematic, even though the VISOK project initiated a process that consisted of communication as well as creating new intermediaries and boundary objects in the early phase. They found out that their artefacts and methods signified different things in the different worlds of EDN and their collaborators. Each community translated, debated and simplified elements of the VISOK project, and the thrust of the project was not large enough to establish and maintain a working order around the CW project in the early phase.

My examples from the work practices around LISA and PROSA in the VISOK narratives hint to us how contexts differ and how interpretations of the same data can be problematic when aggregated without a proper situated understanding of the resource figures and their basis. Categories in VISOK (tables of data sets published from LISA and PROSA) did not give the earth science personnel the necessary ability to present enough of the preconditions or argumentation behind their estimates of uncertainty related to hydrocarbon resources.

The early phase had existing "work arounds" to deal with the problems that VISOK made visible in the publication of LISA and PROSA data. The data was retrieved through numerous channels and informal networks. VISOK was interpreted in the light of the past where management had focused on administrative processes and not given the earth science community proper attention: little credits for their work and fragmented IT systems. In spite of the fact that a earth science professional might find it difficult to quantify and categorize prospects with large uncertainty, management needed such figures to improve exploration activities, for reporting within Statoil and to the Norwegian authorities, area development, portfolio adjustment and other activities.

The design discourse, or drama, that initially had laid the foundation for a technological regularization of VISOK in EDN also led to processes of *technological adjustment* or *technological reconstitution. Technological adjustments*, or the second phase of the technological drama existed in a number of VISOK narratives. The VISOK narratives show how the IT system VISOK provided flexibility, and were implemented in contexts in EDN or among their collaborative partners, where it could be easily ignored. Inscriptions and translations initiated from the VISOK project could be easily set aside by competing or existing translations. The existing actor network of IT-systems, methodologies, "work arounds", and improvizations embedded in established work practices could very easily handle the translations of the VISOK project.

One major exception is the presentation of licence and resource information that amplified a problem previously invisible for management, and developed a problematic situation that had to be resolved. The most frequent response when being confronted with VISOK's technological regularization processes in one way or another was an adjustment strategy of ignoring it altogether. For instance, the work situation of the earth scientists were of such a character that VISOK had little if no meaning in relation to their work activities. The VISOK team discovered this when they started to look into the work practices of LISA and PROSA. Most people in the early phase did not see VISOK inhabiting a force that staged major limitations in their work. VISOK was hardly thought of as adding substantial value to improve their work practices or translation of their own interests.

The VISOK application was *not seen as a good material for making translations.* Consequently, there were few examples of active campaigns against VISOK, but also few examples of strong support. The concept of an Intranet that was something else than static HTML pages was more or less unknown in the early phase. Many people in EDN had hardly used Web browsers when release 1.0 was implemented and users had stereotyped notions about what the WWW was.

The only substantial resistance to VISOK can be read in the action of EDN N related to their home page project presented in the narrative of the organizational navigator. This can be interpreted as an example of Pfaffenberger's technological reconstitution phase. The people who are challenged when a new Intranet application is introduced engage in strategies to

compensate for the loss of regional focus (Harstad or EDN N perspective) in the light of standardization and administrative focus of VISOK. In their early discussions with the VISOK team the Harstad home page project tried to keep control of their own situation, secure their immediate needs and alter the discourse: to make life bearable in the face of regularization and standardization.

It was a *technological reconstitution* meaning that one impact constituency reversed the implications of a new technology and tried to reshape VISOK. The Harstad home page project (Figure 7.10) not only attacked the foundations of VISOK, the home page sketches were examples of counter artefacts as well. EDN management and the VISOK team aligned the two projects through a compromise. This action signalled a *reintegration* effort.

In Pfaffenberger's description of a three-stage drama one final outcome can be that the drama drops out of the technology, meaning that the connection between technological activities and social meanings seems susceptible to erosion. This de-signification, or black boxing, (or a level of irreversibility) never developed in VISOK. VISOK never became taken for granted, were hardly seen as routine, and did never become a part of everyday life in the early phase. Let us now take a closer look at the dramatization of an actor network in the VISOK project.

8.2.1 The embedded inscriptions of the CW project in 1996-1997

In Chapter four I presented the initial inscriptions or perspectives of the CW project and in Chapter five and six the additional inscriptions that had been placed on the CW project as it increased its thrust in the Norne pilot in 1996. In what follows I describe the major inscriptions, or assumptions about future use that the VISOK project tried to take further into the early phase.

Even though KOT spoke directly about what they called "closed processes" (repetitive processes in operations that could be described in flowcharts) and "open processes" (knowledge creation processes with larger input of reflexivity and problem solving that had vague linear characteristics and clear-cut products) KOT still believed in the development of an enterprise model for the early phase based on the same principles as in Norne.

This inscription was founded on the belief that the challenge was to describe the physical workflow, the work processes and products in exploration activities. To say it in a simpler way, that it was possible to map and visualize the main work processes and information sources of the early phase and present in an overall digital model. The thrust behind the urge to continue with work process modelling or flowcharting was so strong that it was almost becoming an interaction ritual (Goffman 1967).

Morten argued in Chapter seven that flowcharting was an inscription from the Norne pilot. It was an inscription that had partly worked there, but would it work in EDN? The NOTES application itself had an interface (front end or graphical user interface) that supported such descriptions (navigation in flowcharts). KOT assumed that such an interface would be important in VISOK as well.

KOT had little experience with data maintenance, and key individuals in KOT firmly believed that once database access (via middleware) to legacy systems was taken care of other things would come by themselves with the help of coaching and process support. The system with process owners and flowcharting groups, which had proven successful in Norne, was believed to be of help in this process in combination with cyclic prototyping. Cyclic prototyping had

been an ideal way of working in the development of a new organization like Norne where both work processes and information systems could be developed in tandem. KOT believed that this cyclic methodology was just as proper to use in the development or inscriptions of new organizations (Norne) as in mature organizations (EDN).

Such a tool could be used in integrated processes of organization and IT development regardless of context. In a mature organization the thrust to change existing inscriptions, translations and form new alignments would be more problematic since a more complex situation existed, but the same principles could be applied. KOT had little experience with the complicated climate of the early phase and their ideas were mainly based upon ideas coming from experience from operational environments.

Elements of a Collaborative Workspace, described in Chapter four, continued to live on as inscriptions. The enterprise model described above was just one example. There was the inscription of a navigation space that should give access to key information, different metaphors to access information (organization, map, geography, physical workspace).

An ambiguity existed in the CW project that soon would become apparent. One aspect of this ambiguity was related to presenting and aggregating key business information, an inscription of a management information system (MIS). Another aspect was related to a Collaborative Workspace as a collaborative tool for overall everyday use (Norne operators, earth scientists) to support integrated "specialist" collaboration and less management reporting. Inscriptions were of such a character that both perspectives might be realized in VISOK, but was it just one or the other, or could both be realized in the same effort?

Another inscription was related to the more general development of information technologies. Web-based applications were believed to be the future and to continue efforts on another platform was not considered proactive by KOT. KOT's major issue was of course to make sure that the application developed could be run on the wide area computer network (WAN) of Statoil, if not "diffusion" of VISOK would be impossible.

KOT also had to rely on the support of Statoil Data to maintain the applications they developed and their help to contribute to the further spread of system tools that were developed. An installed base of hardware and software influenced the work in Norne and also increasingly in VISOK. Statoil's dependence on a LOTUS NOTES-based collaborative infrastructure made both KOT and Statoil Data very dependent on the inscriptions or functionality of future versions of LOTUS NOTES.

Several VISOK narratives hint to us that the overall design decisions in VISOK were dependent upon LOTUS migration from proprietarity to WWW interfaces (NOTES to DOMINO). It was the LOTUS Corporation that provided the overall design space of VISOK, with its weaknesses and possibilities, as I will come back to shortly. The overall design inscriptions of LOTUS, KOT and Statoil Data had less chance to influence even though additional technologies were combined with DOMINO (i.e. like the various components of VISOK).

In KOT's notion of the future of the WWW, collaborative groupware functionality would soon be developed that outnumbered LOTUS NOTES. In their contact with GMD in Germany, KOT were given detailed input on the BSCW tool (www.bscw.gmd.de), an early version of a Web-based project collaboration workspace. Examples of JAVA based

applications run within or without a Web browser were indications in the eyes of KOT, that LOTUS would soon have serious Web-based competitors in relation to groupware. As a consequence, inscribed in VISOK was a believed necessity to change to a Web interface, it was just a question of picking the moment when LOTUS could present proper Web interfaces (the introduction of LOTUS DOMINO in autumn 1996 to spring 1997).

The belief in the Web platform was so strong that the VISOK project for a long time ignored all design recommendations that suggested future improvement of existing LOTUS NOTES applications and infrastructures. VISOK could publish static NOTES documents via DOMINO in a Web browser. This was an amplification, but all the interactive collaborative functionality of NOTES had been sacrificed (and become invisible) in LOTUS' efforts to have a Web solution up and running. It provided substantial reductions in the language of Don Ihde.

However, the existing installed base and irreversibility of NOTES could not be forgotten. LOTUS NOTES had by 1997 been used for a number of years in Statoil and most people had grown used to it. It was an installed base that was impossible to ignore when developing collaborative tools: NOTES was in control of the mail boxes, time schedulers and project databases of all Statoil employees, and was increasingly becoming a black box. This insight came too late in 1998 when the VISOK project had established a firmer understanding of EDN and their collaborators' work practices. It must be added retrospectively that in 2001 LOTUS NOTES is still the main collaborative groupware tool in Statoil.

8.2.2 The development of a new working order around VISOK

I will now interpret the development of a new working order around VISOK. In 1996 and 1997, considerable confusion existed regarding the development of future collaborative tools. Statoil had a solid NOTES infrastructure but the WWW was growing outside Statoil. The development of Intranets had started on isolated islands in the company.

When the VISOK project started in autumn 1996 and in its early phase in 1997, few used Web browsers in Statoil for business purposes and access to the WWW was restricted until January 1998. The Norne pilot had made KOT and Statoil Data into close collaborators and a neat division of labour had developed where KOT could develop new applications and Statoil Data could support and spread new applications to a larger Statoil organization. VISOK was aligned around the BRU TF improvement efforts in 1996 and was to follow up the EDN improvement work.

Therefore, VISOK was thoroughly backed by business targets. A strong alignment between KOT and some key EDN managers developed in the autumn of 1996 and spring of 1997. This alignment was possible because of the work that KOT researchers had done in BRU TF and the credibility the work in Norne had created in the larger Statoil organization. The alignment that was developed in the early phase in 1996 and 1997 was more or less related to the administrative functions of EDN and most of the core business activities of EDN's regions were outside the design discourse. The project tried several times to mobilize a broader support, but they had problems conscribing for VISOK activities in a busy EDN organization. Those that responded were administrative functions and managers. Given the prestige that KOT had invested in the project they could not back out. On the day of the official release in February 1998 the project had not been successful in involving the earth scientist community both in and around EDN.

From the first VISOK mock-up in the fall of 1996 to the "Web look and feel" version, the VISOK application and its methods and work processes should provide the material for enrolling the EDN organization. Cyclic prototyping and flowcharting methodologies were meant to be additional materials that should make enrolment even more effective. The arenas for design and inscription where after the release of VISOK, coaching and fieldwork-debriefings, project meetings and customer meetings. Before the 1.0 release, the project had been very dependent on dedicated management meetings of which mostly EDN management participated. EDN was tried enrolled through the use of the perspectives in VISOK. The map perspective, the licence perspective and others, should provide material for EDN's and the early phases translation of VISOK to their settings. The metaphorization of the early phase activities through perspectives were meant to provide a language for reflection in VISOK, more about this in Section 8.3.1.

Enrolling EDN was one thing, but in order to succeed with their efforts the VISOK project also had to enrol the entire assembly of new technologies (DOMINO, ESRI, map servers, components) and the existing IT infrastructure (LISA, PROSA and others). As VISOK was increasingly materialized as an IT application, the IT system activities developed its own momentum that the project could only partly control and barely escape. In addition, the VISOK project became enrolled itself by Statoil Data's effort to implement LOTUS DOMINO as the basis for further Intranet development in Statoil (by letting the project use DOMINO servers free of charge and put programming and coding skills into the VISOK project). By enrolling KOT via VISOK, and also BETA in another enrolment process, Statoil Data secured the further growth of a LOTUS-based development of the Intranet, keeping VISOK and BETA away from other competing Intranet platforms.

VISOK IT activities were tied up in EDN deliverables and engagements. These IT activities soon became very complicated and tied up considerable project resources. As KOT argue in their 1999 experience report:

> The VISOK project started to use new technology or technology that we had not used in a comparable setting before.... One reason why the technology was not good enough was that we used technology that was newly developed and was in the front. LOTUS DOMINO was one such example. We were among the first to use this kind of solution in Statoil and had all the bad experiences of detecting errors and malfunctions with the technology. Another example is that of middleware. This was not tested in Statoil before and nobody had experience with it. There is a lot of tinkering behind the solutions that eventually became the VISOK application.... One consequence of poor technological quality was that we had to use considerable resources to develop solutions with a satisfying quality. This had consequences for the progression of the project... The reason was that we wanted to deliver functionality that we thought was vital for the users, and with a technology we thought were future oriented.

In Chapter six I argued along with Kathryn Henderson (1999) that new technologies inhabit a certain *high technology aura* that disappears in the spreading of copies and increasing organizational domestication. In 1996 NOTES was losing its aura of high technology in Statoil and those that wanted to stay ahead (like KOT and the VISOK team) had to look forward to the high technology to come: WWW technologies. Notions of high technology made it impossible to continue the trail of using NOTES. When KOT started to experiment with DOMINO and Web servers in 1997 it was still uncertain how fast this transfer to Web-based technologies would proceed. DOMINO was a new technology. However, it was placed on top of NOTES, where Statoil was very competent.

If we look at the amplification-reduction structure of LOTUS NOTES compared to that of LOTUS DOMINO employed in VISOK we see the following. To export Web pages from

NOTES to the Web interface was rather simple. DOMINO made it possible to publish old NOTES databases on the Web, an *amplification*. Hardly anybody in Statoil had key competence on issues related to employing DOMINO in relation to data pumps and middleware. The publication of legacy data could also have been implemented via the NOTES interface with the exception of the map interface. This idea was soon forgotten, in spite that this solution could have made VISOK capable of using the existing collaborative functionality of NOTES.

The quest for a "Web look and feel" was so strong that all potential NOTES functionality (that was available in the Statoil infrastructure) of which most people in the early phase were familiar (mail, bulletin boards and project databases) were completely ignored until around the turn of 1997. The Web interface of DOMINO that was implemented could only retrieve information, which was a considerable *reduction* feature compared to NOTES. It was merely a navigation repository and not a Collaborative Workspace at all, since all transactions (except the feedback functionality and search mechanism) had to he handled outside VISOK via telephone, face to face communication or via NOTES mail and project databases. If we leave out the search functionality even the organizational navigator perspective had "read only" functionality. KOT's reflexivity concerning these issues grew as the project developed, as Harald sums up in the 1999 experience report:

> An important question is related to who defines what is useful for others? In the VISOK project the participants described what was useful for others than themselves. In real life this did not work and functionality ended up not becoming useful for anybody. One example can be the choice of the technology in the VISOK project: Web was assumed to be the future, and we believed that the Web would be perceived as useful for the users. In practice several of the applications would have been more useful for the users if they had been implemented in LOTUS NOTES, i.e. access to ESOP project databases, because retrieval could be combined with editing in a simpler way.

The work to develop and implement DOMINO, map servers and middleware to a decent level of usability drew considerable resources from the project. Patching or keeping the system of standardized components (which was anything but standardized) in line tied up much resources throughout the project. The lack of experience with similar issues let the project participants underestimate the costs of enrolling and keeping DOMINO and the components in the project. The enrolment of DOMINO, components and keeping them in line, required so many resources from the project team that fieldwork activities and collective reflection were losers at the end of 1997 before the formal release of version 1.0. It was when this IT systems design discourse started to become strong, in the autumn of 1997, that organization development issues in VISOK started to lose focus.

Since VISOK was a front end to a number of legacy systems like LISA and PROSA these also had to be enrolled. Around them were a set of work practices that had to be aligned at the same time if VISOK should gain a certain momentum. There is a similar amplification and reduction structure in the use of middleware. Let us look at the inclinations from the licence perspective. Middleware, as it became implemented in VISOK, amplified management information and the requirements of managers. The reduction was apparent in the invisibility of earth scientists' work practices. The data sets that were published from PROSA data tables were to a large extent de-contexualized and meaningless for this community[31]. It reduced the ability to associate uncertainty in risked resources and figures almost to a mono-dimension in the language of Don Ihde (1979).

Another issue of conscription is the enrolment of new personnel in the project. In the Norne work KOT had mostly senior personnel that knew operations fairly well. KOT was divided at

the start of VISOK, and new people had to be recruited. These novices had to develop a situated understanding of Statoil and exploration activities. Competence development, project management, work methodologies and problem-solving techniques also had to be conscripted. In 1998 KOT lost several of the senior staff, like Robert and Christian that had worked as important lobbyists in the larger Statoil organization. These persons and their skills were never replaced.

VISOK also had to develop a working order with other Intranet initiatives like BETA and OMEGA. Both these initiatives grew out of contact with KOT in one way and another and they needed the support of KOT to start their own enrolment process. The argumentation about niches in relation to this working order is important. When these niches were defined the various initiatives could continue with their programs without interfering too much in the work of the other initiatives. In the hidden, all three initiatives drew upon the same Statoil Data DOMINO enrolment process and needed this support to go through with their own programs. For a while this working order persisted until OMEGA became the obligatory passage point and both VISOK and BETA had to conform to OMEGA's translations, related to quality checks of information and standardized Intranet templates.

With the release of version 1.0 in February 1998 VISOK had gained a sufficient usability, even though middleware (licence perspective) and the map server went off line now and then. The enrolment of the regions of EDN and the larger earth science community started in late 1997 and the early parts of 1998. In release 1.0 the work of the earth scientists was more or less invisible in the perspectives.

VISOK was a management information system that published aggregated data sets in relation to predefined tables from legacy systems. VISOK did not have a proper pilot, and without a pilot the project struggled to develop credible material for their translations. EDN N was tried enrolled, via the Harstad home page project. This initiative failed, and monthly EDN-VISOK customer meetings hardly created more VISOK conscription. Patching and development still tied up considerable resources. Without the pilot VISOK was forced to continue with interviews, do some participant observation and coaching in less focused settings in the early phase.

However, these project activities did not provide the situated details of work practice that the project needed, hence the invisibility (reduction) of the earth science community and the lack of functionality that the latter would find useful. The work with LISA and PROSA data maintenance that was initiated in 1998 was of course a way to create visibility of the latter work practices. The VISOK team and EDN management had hoped that by enrolling peer assist-review activities, LISA and PROSA data maintenance routines VISOK would increase its thrust. These activities came too late in the project around the time when the oil price had started to drop and could not sustain VISOK.

However, the sporadic use of VISOK in administrative and management functions led to amplification of certain elements of exploration activities. The publication of licence and resource data made a new phenomenon visible: poor quality of licence and resource data. VISOK was dependent upon the quality of source data, since those that read the data through VISOK thought that the mistakes were errors in VISOK and not in the LISA-system.

In Section 8.2.1 I argued that there was a major ambiguity in the inscriptions of VISOK. The ambiguity inherent in VISOK was too large to be able to mobilize and enrol both those

interested in translating VISOK into a management information systems and those wanting to translate it into a more earth scientist tool that should empower: let earth science personnel produce their own maps, easy access to daily information and make their own reports. The project tried to the bitter end to combine these two perspectives. In the terminology of ANT the VISOK project team was not sufficiently able to translate their efforts to fit other groups' programmatic goals. It was not possible to create an alignment of interests around VISOK when VISOK had two diverse inherent programs (MIS vs. earth science support tool).

As a consequence of their failures in trials of strength, KOT started to lose credibility during 1998. The group could no longer function as an obligatory passage point. Strong lobbyists like Robert, had by then left KOT. What eventually crashed the VISOK actor network was the new imposition in the fall of the oil prices in autumn 1998. Statoil Data, and INF through their OMEGA effort, had gained control of the Intranet. INF as one of the obligatory passage points on Intranet information content and information templates killed the remaining interest of VISOK, because almost a year went before VISOK was adjusted to the new official Intranet template. The presentation of LISA data in VISOK was successful, but plans had already been taken to replace LISA with a new administrative licence system, the last connection in the actor network of VISOK was broken.

8.3 Grasping the nature of classification and sense making in VISOK

The analogies chosen in the design and change of organizations like VISOK is a fundamental starting point to understand the subsequent inscriptions and translations. Analogies, like flowcharting used in the Norne work made it possible to develop a new kind of experience through making influences from the flowchart analogy to other actions. It was a method for sense making.

In Norne the basic analogy were the flowchart and the machine, and different methods were employed to create discussions on what flowcharts and the enterprise model rendered invisible and how the invisible could be handled. In spite of its narrow bandwidth the flowchart developed meaningful activities that triggered translations among actors aligned with other activities in the preparation for operation in Norne. Flowcharts were objects employed in a process of organizational reflection. Reflection and translation found a match. In VISOK the perspectives or analogies were much richer and provided a more total description of the setting. However, the perspectives were seldom used as reflection objects in a reflection and change process, even though the project put much effort into realizing this, viable translations seldom developed.

8.3.1 The development of the VISOK perspectives

KOT tried to enrol EDN through the use of the perspectives in VISOK. In Norne the key analogy was the flowchart. In the VISOK project, there were several analogies in terms of perspectives. Still, the perspectives, or the analogies, did not trigger the reflection and subsequent change and translation processes in the early phase that the project had hoped. Was the space of possibility closed too soon? Did the wrong people pick out the perspectives too randomly? Harald summarizes after KOT's discussion on the development of VISOK perspectives:

In the VISOK project, managers functioned as stakeholders in the project. Seen retrospectively this was unfortunate since managers were not necessarily users of most perspectives in VISOK, and still set the

requirements for the project. In spite of this it was the manager perspective that was heard, without us discussing it in the project... Just as the project lacked an understanding of their own work practices, the problems of EDN stakeholders and their insight in their own work processes were missing. It might be bold to suggest it but it is in line with what Suchman says[32]: if you are not in the middle of the work activities yourself they might look quite simple, no matter what organizational unit you work.

In the translation processes that followed the Norne work process activities the people that were to work with the activities and use the functionality set the requirements for the content. Chapter seven indicated that this was different in VISOK, as argued by KOT in the VISOK 1999 report:

In VISOK there were several examples that people had the role of making requests for functionality on behalf of others: They should not use the application themselves, but use the results/outputs (other people should enter the information that others should use). Several of the perspectives of VISOK were designed based on wishes and input from others than those that in the end should use it in their work...One of the consequences of this was that several of the perspectives were hardly used. Those that set the requirements for the design of the perspectives did not need it, and those that presumptuously should use it did not experience it as useful enough in their job.

In discussing why the organizational navigator was hardly used the Harstad VISOK team argued: "One explanation can be that the requirements were not founded in a work process, but were ideas of individuals. We did not do a proper job to do a quality check of the requirements". The perspectives in VISOK were closed rather early in the process and little input to new perspectives came after release 1.0, except the organizational navigator. Much IT and programming efforts had been invested in the perspectives and they seemed more and more irreversible.

While the Norne application followed espoused work practices by navigation, the VISOK perspectives were mainly information categories and not directly linked to work practices, except the work process perspective that never became a success. There was no "licence perspective", and "map navigator" work process but a conglomerate of formal and informal practices that might use information from these perspectives.

KOT did substantial work to analyse the development of the VISOK perspectives in relation to inscriptions and translations in their 1999 research report. KOT could argue with legitimation that the main reason why a perspective or area was chosen was that it was associated with perceived challenges and problems, like the licence perspective or the map perspective requirement analysis and interviews. This argumentation was sound in several examples. The areas and perspectives perceived as evident were defined rather early in the project. However, they were based on input from EDN managers and administrative functions. The latter is also reported by KOT to be the second major reason for the choice of input to perspectives. Those with authority wanted functionality and translated this into VISOK:

Sometimes these requests were well founded and brought forward with great strength. At other times less founded ideas popped up. In spite of all it was important to try to satisfy the requests from people with authority, i.e. managers.

The third reason is described by KOT as more arbitrary, meaning that they met somebody with clear opinions, who spoke out loudly and thereby were trying to translate their interests. In the quest for collaborators it was easy to help those that spoke the loudest, them being the thankful customers. Lack of collaborators in the early phase was also described as one reason for the choice of perspectives; the VISOK team took what was available:

A precondition for prioritizing a target group is to find somebody that really wants to be a target group. To be a prioritized target group demands that time and efforts is to be mobilized in the work. In VISOK it was difficult to find such groups. We found individuals that were very interested but it was more difficult to find groups. Peer assist was one such group that we mobilized with success. Here it was easier to focus on what the peers did and produce proper results.

The fourth reason for choosing particular perspectives was what KOT described as project managed functionality, meaning that the VISOK project had technology and solutions that they wanted to test, a translation of project participants interests into VISOK. As I have described already in Section 8.2.1, the CW project had a number of inscriptions that directly or indirectly influenced the choice of perspectives that were chosen to be the key perspectives of VISOK.

The discussion with the perspectives ended up in a number of questions regarding the quality of VISOK. The project got much feedback on the perspectives to offer functionality that was not practical or not cost efficient to implement. One requirement here was the drawing office quality of digital maps that would be impossible to develop without vector-based graphics. However, most of the concern dealt with issues related to the quality of KOT's own deliverables in relation to the perspectives of VISOK, which KOT described as far than good enough.

One reason was missing information in the perspectives. Users expected information available in all the information buttons in VISOK, while many of the buttons were put in as "place holders" to show possibilities without linking to further information. This was perceived as irritating and as lack of quality by EDN...some people meant that the VISOK system did not have good enough data quality. The best example is LISA. Even though VISOK could not be blamed for the systems not being updated, LISA and VISOK were interpreted to be the same system. When there were errors in the data in LISA it was believed to be an indication of poor quality of VISOK.... A consequence of the varying quality of deliverables was dissatisfaction among the users. It was difficult to see what was related to the basic technology (in real life uninteresting as long as the user is dissatisfied). Dissatisfaction is converted to reduced confidence and trust, and finally lead to fading priorities.

I argued in Chapter six that the Norne digital enterprise model was a multiple boundary object. It was not designed to be a boundary object, which Bowker and Star (1999) argue is impossible. It evolved into such an object as a consequence of the technological drama. The character of the "Norne digital enterprise model" made it possible to maximize the autonomy and communication between different worlds within Norne like onshore-offshore, and in relation to Statoil Data and KOT. It enabled the different social worlds that participated in the project to maintain a large portion of autonomy in their daily work.

Only given parts of the work in Norne (or those of importance to maintain coherent information in case of the enterprise model) were pooled in the intersection of information, the rest could be left alone. In Norne boundary objects were produced when researchers, Norne personnel and Statoil Data collaborated to develop representations of a future organizational practice in Norne.

Did the VISOK- application become a boundary object as a consequence of the technological drama it participated in and that KOT and EDN management tried to stage? VISOK had too many apparent inconsistencies, like the MIS vs. collaborative tool inscriptions, and a too large design constituency to let the diverse number of users develop meaningful interaction with the VISOK application. VISOK remained too abstract since it had competing and fragmented perspectives and was not concrete enough related to its accompanying work practices. As a consequence of this it did not develop the same local meaningfulness as the Norne application.

If we go back to the characteristics of boundary objects (Star and Griesemer 1989) VISOK had a repository structure. It was organized according to a number of perspectives, focused loosely around the notion of a licence. All these perspectives could be further decomposed and VISOK could be used as a pile of references when different groups in the early phase assembled data and figures for numerous presentations, reporting and management purposes, information obligation to licence partners, portfolio adjustments or analysis, volume and value of prospects, map production and map licence co-ordinates.

The second boundary object is the ideal type, which are objects as diagrams and atlas of which the map navigator is the prime example in VISOK, but also the general navigation perspectives. The third type of boundary objects had coincident boundaries, or were common objects that have the same boundaries but different internal contexts. These might also arise in VISOK when different groups in different organizational and geographical settings used the same data sources published from LISA and PROSA for different purposes like Marit and Judy reported in the licence platform narrative of VISOK. The result is that work in different sites and with different perspectives can be conducted autonomously while co-operating parties share a common reference. The last object type is standardized forms that are boundary objects devised as methods of common communication across dispersed work groups. The VISOK project tried to standardize a number of work methodologies. Flowcharting never became a success, data maintenance routines of LISA and PROSA proved more successful.

VISOK had elements of a boundary object but was not invested with the same meaning as the Norne application and as a consequence it did not have an evocative and strong mobilizing character to align a stable working order.

However, an example in Chapter seven (Section 7.2.3) does provide an example of a successful boundary object between KOT, Statoil Data, BETA and datawarehousing initiatives. In the winter 1998, 40 Intranet initiatives existed, and Intranets are taking over the role of more traditional IT systems (LOTUS NOTES and legacy systems) in information sharing. How do the major social actors understand this situation? They have to develop a sufficiently consistent understanding of the new situation, a new way of classifying systems, data and interfaces. This standardization had to handle how the existence of superstructures on top of existing IT systems should be interpreted.

In the world of engineers, standardization is often chosen as an answer to this problem. Standardization both meant a library of components (middleware) that could be reused like LEGO bricks, and the categorization of three levels that would make standardization possible. First, an enterprise level or front end, that was adjusted to any customer requirements and did not mess up the underlying structures. Second, a standardization of components in the middle, that is adjustable to any situation and requirement, and finally, the existing messy infrastructure of computer systems at the bottom.

In this meeting the major participant groups never had a shared understanding of this picture. The concepts related to enterprises, components (LEGO bricks) and data sources also had a number of inconsistencies. The enterprise level could be a graphical user interface (GUI) as Statoil Data saw it or a reflection object as some in KOT saw it. The components were of a heterogeneous type, far from being LEGO bricks. In the espoused version these Web-based

components were standardized but considerable tinkering and patching was needed in VISOK to make them fit a new context.

However, this working order was never questioned even though all the participating groups had very different understandings of the symbols. The boundary object of enterprises, components and data sources, related to Figure 7.7 had a multi-vocality that created a sufficient working order. This working order enabled the major social actors to continue their work in separate domains. It was in the interest of the social actors defining the new order to keep the boundary object vague and sufficiently concrete so that they could continue with their work without being hampered by the others.

8.4 Legitimating and justifying narratives in the enrolment of VISOK

I showed in Chapter six how, to be able to function in an organization like Statoil, KOT had to legitimate its existence and justify its projects both in reason and nature. The continuing spread of new ideas and concepts related to collaborative technologies like VISOK is dependent on a discourse that can create interpretations of new social practices and artefacts.

Because of the work done in Norne, that had created substantial credibility in the Statoil organization, KOT had gained a temporal legitimation. To maintain and increase its legitimation KOT had to go further. In the VISOK project KOT convincingly argued that people in the early phase used too much time searching for information. VISOK should give simple access to key information, so that more of the time could be used for value creation and knowledge development and less time spent in seeking for information.

In the beginning of the project KOT found its legitimation in reason and nature via the BRU TF improvement effort. The belief in the enabling powers of IT was growing in Statoil and KOT no longer had to argue for the sensibility of spending corporate money on IT. Before the 1.0 release of VISOK, the team tried to gain legitimation by overselling what VISOK could provide in its first release. This created less legitimacy because the release was postponed one month and created an image of lack of professionality. As in Norne KOT tried to manage a number of legitimating and justifying narratives, and picked up formal ideas, structures and concepts that were well aligned with formal structures in the organization.

While the aura of BPR had dominated the Statoil organization around the Norne work, the introduction of knowledge management was on its way in Statoil. KOT's major dichotomy between closed and open processes added input to narratives that supported this line of thinking. Even though that KOT argued that they did not believe in the buzzwords of knowledge management[33] (KOT seniors argued that consultants used knowledge management as another name for information management), this was a business management theory that much of the Statoil organization had started using and discussing to deal with perceived problems.

To be taken seriously KOT had to take up this new thread and it also provided new materials that could be aligned to support KOT's work in the early phase. It provided ideas and legitimation on how knowledge development and learning in companies were initiated and spread. Knowledge management thinking and argumentation grew stronger in the project as the focus on work process modelling and flowcharting slowly vanished.

KOT tried throughout the VISOK project to develop convincing narratives on the successful use of VISOK, for instance in relation to EDN N management in the organizational navigator narrative and the need for a Harstad pilot. Some of these strongest legitimating and justifying narratives were related to the LOTUS DOMINO platform and the need to go from a NOTES interface to a Web browser interface. KOT's legitimation effort here was linked to the development of WWW and Internet technologies. LOTUS NOTES was increasingly becoming domesticated in Statoil and not perceived as high technology anymore. A co-ordination technology group would be taken more seriously if they used the "highest" technology at the time.

When KOT had linked the narratives to new information technology and new production technology like the Norne ship this had created a particular credibility. In Chapter six I argued along with Kathryn Henderson (1999:198) that high technology confer status on the corporate possessors and producers not because the new high technology may get the job done more efficiently but because it signifies power and prestige more efficiently within the pertinent social networks of importance.

Pragmatic tests in the early phase hinted that the Internet technology of VISOK was insufficient as a collaborative tool, and that the price of patching and tinkering related to "high" technologies was considerable. VISOK turned out to be a repository that provided little input to collaborative processes in the early phase that mainly continued to use LOTUS NOTES, and would continue to use NOTES for a number of years.

The project had problems finding legitimation in the early phase, because of restricted interest from the EDN organization and the EDN regions in particular. As a consequence, the project had few successes around which legitimation could be built. Much of the interviews and participant observation that were conducted had few visible deliverables except input to VISOK perspectives. All coaching activities should give feedback to the functionality of VISOK, this continued until the first quarter of 1998 when LISA/PROSA routines and peer assist was attempted to be enrolled.

To focus on what did not work in the early phase, painting dark pictures, hardly added legitimation. Nor could KOT expect legitimation for their work methodologies either, because these practices were poorly communicated in the discourse with EDN and never understood: why did the VISOK project participants always have to work in pairs, what was fieldwork? The whole idea of cyclic prototyping, developing new features on the way, empty "place holders" in the perspectives, was perceived as lack of quality in the eyes of EDN people that wanted a "finished" system here and now.

There was a missing understanding in the early phase of the VISOK project's work methodologies. Trials of strengths and pragmatic tests showed that some of KOT's major work methodologies did not work properly in the setting (flowcharting and cyclic prototyping). All this made the VISOK project lose even more legitimation.

Work methodologies that do not work cannot be aligned with reason and nature. If it cannot be aligned with reason and nature it cannot create legitimation. In the situation that developed in 1997 and early 1998 more and more of the legitimation of the project was anchored in VISOK the IT system. The IT system was tangible, a product that could be used to legitimate the VISOK project compared to intangible or "softer" activities that were non-understood or hardly visible in the EDN organization.

To mend VISOK's invisibility various profiling activities and artefacts were employed: stickers, posters, sweaters, handouts and a release campaign in February 1998 that was considered extravagant by those working in the early phase. That the project later started to focus on data maintenance routines of PROSA and LISA was a consequence of this invisibility. Such routines were more tangible and could be indirectly linked to VISOK.

These activities did however start too late to add much legitimation to the VISOK project. When the project started to initiate legitimation for VISOK in peer assist, peer review and Exploration forum the entrenched image of VISOK as an IT system was so strong that nobody in EDN saw the connection between VISOK and peer assist. Hence, it created no new legitimation for VISOK. Strong seniors had left the project by then, leaving it up to the juniors to sustain legitimation.

In the end the legitimation of VISOK was so poor that the project participants wanted to avoid being associated with VISOK when conducting activities in the early phase. With this poor legitimation VISOK was deemed to be one of the projects that were abandoned in the dramatic autumn of 1998. The lack of legitimation that persisted did not only deplete the VISOK project, but eventually also the KOT group.

In the low oil price scenarios that dominated Statoil in 1999 and the two-year freeze on IT investments no part of the Statoil organization would invest efforts in projects of the character of which KOT had run in the past. When given no access to new organizational settings KOT could not develop legitimation for continuing their work. As a consequence, the reason why KOT should continue to exist was also put on the agenda.

Chapter 9 The career of an integrated organization and information technology Concept

9.1 Introduction

Through out this thesis I have looked into organization and IT development in Statoil in the last half of the 1990s and given empirical examples on how ideas, concepts and solutions in relation to use of collaborative information technologies (i.e. LOTUS NOTES and Intranet applications) have developed and spread. It is now time to tie up my research questions.

Let me first repeat them. If we look at organization and IT development in Statoil in the last half of the 1990s, how were ideas, concepts and solutions in relation to use of collaborative information technologies (i.e. LOTUS NOTES and Intranet applications) developed and spread? The following sub-questions were covered in relation to this overall question: 1. How are ideas and concepts related to use of collaborative information technologies developed and spread in organizations? 2. What are the roles of human and non-human actors (information technology) in the development and diffusion of collaborative information technologies? 3. What becomes visible and invisible as a consequence of such a process? 4. What can be done to deal with this invisibility in organization and IT development projects?

The structure of this final chapter is as follows. I start with pulling the main threads from the narratives together with the theories I have employed in relation to my research questions. I start looking at research questions one, two and three (Sections 9.2 and 9.3) and conclude with question four (9.4). Here I use the metaphor of a circulatory system to integrate the many threads of a translation approach in the study of the career of my IT and organization development concept. Finally, in Section 9.4 I use ANT's descriptive position as a starting point to create a normative *praxhos* position to organization and IT development. The descriptive and the normative is tried to be handled through what Bruno Latour has called a "due process".

9.2 The career of an organization and IT concept and the roles of humans and non-humans in keeping it alive

I have discussed mechanisms at work that might enable ideas and concepts related to use of collaborative information technologies to develop and travel in organizations like Statoil. Further, I have tried to be specific about what are the roles of human and non-human actors in the career of collaborative information technologies. I started in my introduction by looking at diffusion vs. translation as a model for the development of new organization and IT concepts.

Through my thesis I have tried to go beneath espoused idealized versions of an integrated organization and IT development, the front stage, and present some of the mechanisms at work that can both enhance and restrict such an integrated development process, the backstage. The fieldwork led me into a political field, a cultural domain where paradigms (like how to conduct organization and IT development) were formulated, established and come into conflict. This gave fieldwork data that supported the translation approach.

My work shows that *translations transform the programs of KOT and the CW project into questions of technique, a dramatization that mobilizes both humans and non-humans to keep them in line for support.* I showed the many leads, pathways that gave the CW project its birth (Chapter three) and transformations that have moulded it into the concept that developed in the empirical Chapters five and seven. It is time to pull together all the unpredictable and heterogeneous links that gave birth to the CW project, gave it additional energy and finally caused its depletion.

In doing this I will use a similar metaphor as Bruno Latour uses in his description of "science life blood", or the circulatory system of scientific facts (Latour 1999: 98-112). I will adjust his circulatory metaphor to make it fit the development of IT and organization concepts like the CW project instead of scientific facts. Based on my narratives I have sorted out five types of activities, or loops, that can describe the career of the CW project as an organization and IT development concept. These loops coincide with those of Latour's circulatory system but are adjusted to my setting.

The first loop is *activities that mobilize the world.* If we look at the CW project and the work of KOT there is an *increasing mobilization of non-humans into the situations in which both KOT and the CW project move.* It is KOT members and CW project participants' problem-solving and use of their active productive skills towards the world that create this mobility, and keep people engaged in the activities that are undertaken. KOT went to MIT to bring back new ideas, visited conferences, listened to consultancies like Gartner and Meta group, and other industrial companies (like General Electric) to find the latest ideas of what was perceived to be given by nature and reason in relation to organization and IT development.

These actual places were also settings in which the objects of this world were assembled and contained. The assembly of up-to-date management theories that are found in Boston (MIT-Harvard), and IT conferences (COMDEX, Lotusphere) gave input to the latest software products. The same ideas were often bundled with instruments or tools of various sorts, BPR, flowcharting, java script, LOTUS DOMINO, LSX, software components, coordination technology, prototyping, knowledge management and software engineering just to mention some. The growth of the Internet, restructuring efforts in the North Sea oil business after NORSOK and the favourable price of crude oil were other elements. When we follow the mobilization of elements in the world in the narratives in this thesis, through for instance Robert's slide presentations and KOT's supportive Trondheim university professors prospects

on the future use of IT, we see that they present themselves in forms that are useful in the argumentation and discussion that those taking part in the CW project have with their colleagues. Analogies (in terms of elements of a workspace) are used systematically to develop the new CW concept, as a way of structuring the claims.

Through this mobilization elements in the world are transformed to arguments or claims useful for organization and IT development. An isolated element like a new version of LOTUS NOTES can be connected to new forms of collaboration. BPR can be connected to a cyclic prototyping methodology, or other elements connected to claims, that promise to enhance the relationship between new work practices and IT. These elements are also important to develop a rationale for action or to make sense of a new situation. They are not just put together to dramatize elements for gaining project support. Still, many of the elements that are taken out are fashionable and tend to be bundled, like BPR and IT. Elements address problems that are seen as up-to-date and real. Heterogeneous engineers like Robert and the BETA project manager are able to take out elements that seem to be ripe at a given time.

However, to convince somebody, KOT needed more than elements of future organization and IT development to argue for its CW project. It also needed someone to convince and people to enrol. The second loop is related to how KOT finds colleagues. Latour (1999:102) calls this loop *automatization*. In my narrative it describes how KOT (in Chapter three) grew up in its niche to become something else than KIT, Statoil Data and the human resource (HR) units.

The KOT group became independent, formed its own criteria of evaluation and relevance through their legitimating and justifying narratives. This naturalization process made KOT into a legitimated social group. They recruited new personnel along the way, developed competence related to organization and IT development more or less from scratch. Colleagues in the group developed complementary skills based on their backgrounds in the engineering and social sciences. New collaboration and communication mechanisms, particular values and rules of the game were also established.

This loop, as the other loops, caused considerable work throughout the CW project. New people had to be recruited and trained to grasp the necessary values, competence and skills. This process itself was one of continuous enrolment and alignment since many of the new colleagues did not automatically understand the work practices and methodologies of the group. KOT's project groups consisted of people from both Statoil Data and customer organizations like Norne and EDN and made this a demanding task.

There also had to be *other institutions* that could keep the KOT colleagues together and develop a climate in which the CW project could circulate; their scullery work environment, KKG funding, the technology strategy, obligations by Statoil management to support research and technology development and an existing IT infrastructure that could be used (LOTUS NOTES and Intranets) just to mention some of the elements.

The skills required in taking out elements and mobilizing the world described in the first loop, and of which the KOT collaborating professors were very good, is a different one than the group needed in team based collaboration (like in the development of the CW concept in Chapter four), since it focuses on transferring these claims to a meaningful discussion and cultivate good abductive analogies together with colleagues in the development of a new concept. The discussion on the metaphors in articulating the CW concept in Chapter four is

one example of such a process of group dynamics. It enabled maximum information by using the least amount of energy.

Circulation of the concept cannot possible stop at this second loop. KOT could not develop their methodologies and concepts or become autonomous as an institution without a third loop in their development of the CW concept. This loop Latour (1999:103) calls *alliances*. I argued in Chapter five and seven that there were at least five strategies for enrolling others, like; I want what you want. To create support for the CW concept others than colleagues had to be enrolled as supporters.

KOT had to develop a number of alliances to let the concept grow and to develop an internal market for these kinds of ideas (which was not simple when IT in Statoil was regarded as an expense until the mid 1990s). The challenge was to find a proper setting where the concepts could be tried out in pilots. Norne was considered as sufficiently large and secure to enable the CW project to exist and endure in 1996. Still, this was not enough, a natural niche had to be developed where Statoil Data saw KOT (and the CW concept) as a collaborator and not an opponent.

If KOT was unable to develop an interest in Statoil operational units, the CW project would deplete, or just remain a possibility, without a world in which it could be realized. It had to enrol Statoil Data who was the obligatory passage point for all IT infrastructure and IT development, have a go for Norne becoming a corporate pilot from general management and "enlist" the LOTUS Corporation to create a workable technical realization of the concept. These alliances took a number of forms both human (Norne management, Statoil Data gatekeepers, and Norne process owners) and non-human (LOTUS NOTES r 4 navigators, INTERNOTES).

When all these alliances were *added,* the CW concept began to gain a certain momentum. There was *no a priori connection* between many of these human and non-human elements. *It was the enormous labour of persuasion and liaison conducted by the CW collective that established this connection.* Norne had to be convinced that LOTUS NOTES R4 would meet their requirements in a situation when the focus on Internet technologies was increasing. EDN had to be convinced that new IT could improve accessibility of key data. The stronger the relation was to the ongoing corporate agenda, the stronger the link to the new CW concept became. Still, co-ordination technology as a key target area for research in Statoil was not enough for the CW project to survive.

The CW project had to mobilize Norne, the summarizing symbol of the new era and to address key exploration challenges in EDN. The relevance to Statoil business activities had to be fleshed out. As Latour (1999:104) argues: "This inclination, this *clinamen* has to be created, the social and material world has to be worked on to make these alliances appear, in retrospect, inevitable". Alliances were also needed to handle competing concepts like BETA and OMEGA and develop niches where each could continue their work.

The skills required in creating the above alliances are also different from the skills needed in the previous loops. KOT might have been good at picking up and mobilizing elements in the world and create a concept in collaboration among colleagues, but to make new people interested in these claims, persuade them and to navigate in the conglomerate of existing institutions to start a pilot project with KOT requires different skills.

Given that KOT had mobilized ideas from the world (perceived to reside in nature and reason), if the KOT group had been trained in methodologies and had skills to work with organization development and IT, and a number of institutions within Statoil, like Statoil Research and KKG funding, and Statoil Data provided IT infrastructure support, we saw from the Norne and VISOK narratives that considerable work was still to be done. Up till now the only frail connection the CW concept has to the organizations of Norne and EDN is through a number of organizational gatekeepers and managers. These gatekeepers and managers might believe in claims related to new collaboration enabled by IT and BPR but they hardly represent the organizational underworlds and the situated work practices of their organizations; those of Norne mechanics and exploration earth scientists.

These novel ideas that gatekeepers in Norne and EDN accepted did in several examples represent a challenge to the existing work practices and cultures of these collectives. It threatened to modify the present configurations of people and things. There were a number of such examples in the career of the project: the controversy KOT and Norne had over technologies in the early parts of the pilot in 1996, the clash between the home page project in Harstad and VISOK and the consequences of the visibility of poor quality licence and resource data.

The same KOT members, like Robert, that mobilize elements in the world, convince their colleagues and develop alliances also have to meet the everyday activities of people in the organization. KOT had to meet the Norne operators and mechanics, adjust the flowcharting methodology to approach issues that were rendered invisible. They had to convince earth scientists that VISOK was important for their work. This fourth loop Latour (1999:105) calls *public representation*.

Most Norne personnel and exploration earth scientists lived a different life from that of the strategic agenda of the allies: Norne, EDN management and Statoil Data gatekeepers. The latter's notion of the terrain was often different from that of management, like the discussion on the major reasons behind the poor quality of source data between staff managers and earth scientists. This situated understanding brings in the need for other competences and qualities into the loop, and that of a different context, ranging from the details of offshore maintenance work in Norne to the geological interpretations and exploration plays of the early phase.

How do these people grasp the idea of organization and IT development in the light of their lived experience and past reorganization efforts? As Tommy in Norne asked himself: "could they trust civil engineers and anthropologist project managers?" New ideas had to match existing classifications in for instance maintenance.

In Norne the enterprise model evolved into a potent boundary object that developed connections between life worlds. The Norne application boundary object also created new alignments. It became known as a symbol of co-ordination technology in the technology strategy that again supported future KKG funding. VISOK never developed into the same potent boundary object because the ambiguity in the concept was too large (earth scientist application vs. management information system). VISOK was not successful with the public representation loop. It had no proper pilot and the alliances developed were with staff functions and managers, gatekeepers and too few of the masses in the EDN regions.

The CW project also had to develop a niche with other collectives like BETA and OMEGA, through many trials. This loop also requires an additional set of skills. The person that is good

at developing alliances with management and Statoil Data might be useless in discussing the implicit details of the life worlds of mechanics and earth scientists. Does he or she have facilitating skills and the ability to grasp the social nature of work? As Latour argues, this fourth loop is the most important one because the other loops rely on it. *This loop places the organization and IT concept within the everyday activities and trials of strengths, via the pragmatic tests of people in the organization.*

This loop, more than the others, can provide the litmus test that can prove if the concept is a viable one. If the majority of the people in the organization, and the existing collective do not "buy" the CW concept and start translating their interests in relation to it will not continue to circulate. It will become depleted and die. The further career will also be revealed through the relationship it develops with other concepts that travel in the same setting, like BETA and OMEGA. Who becomes the obligatory passage point? In Intranet development in Statoil this turned out to be two actors in the end. Statoil Data became the passage point for the information technology to be used in corporate Intranets while INF through OMEGA earned the passage point for information content, quality control and Intranet templates.

Finally, having followed the four loops, or the veins and arteries in Latour's circulatory metaphor, we end up at the pumping heart, or *links and knots*, which is the fifth loop. Latour calls it a loop instead of a concept (to avoid objectifying it). It is much harder to study than the other four loops because this hardness is not that of a pit inside the flesh of a peach (Latour 1999:106).

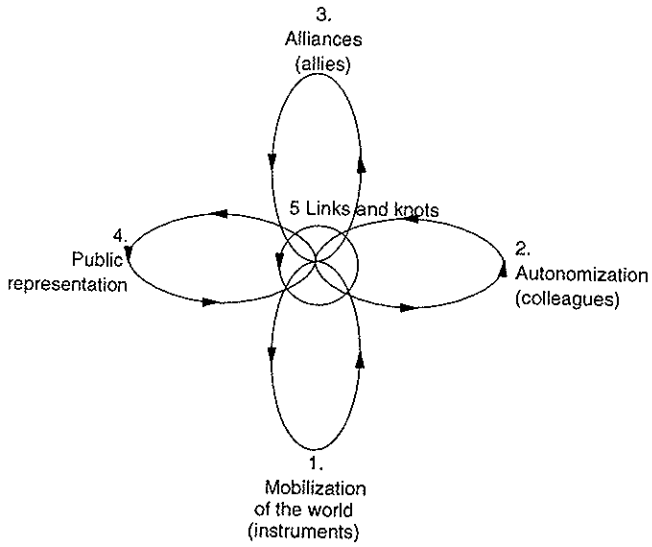

Figure 9.1: The circulatory system of Bruno Latour (Latour 1999)

The CW concept or project is therefore the tight knot at the centre of the net (see Figure 9.1). *It is hard to the extent that it is able to hold the many heterogeneous resources together*, as Latour argues (1999:107-108):

"There is indeed a conceptual core, but this is not defined by the preoccupation's located at the *furthest remove* from the others; on the contrary, it is what keeps them all together, what strengthens their cohesion, what *accelerates their circulation*". Employing this insight I argue that the *CW concept is what holds a collective of humans and non-humans together and it grows by linking together more and more elements in bigger and bigger collectives.*

Even though we can look at the CW concept in isolation (or the fifth loop) as separate from the four other loops, as an object, it makes little sense. The first four loops will die without

the concept. The mobilization of the world would dissolve into unconnected fragments. Colleagues would move to a new location (or a new project) and allies would lose interest and the larger Statoil organization would never gain much interest. The second loop is another example here; it shows how vulnerable the group was when senior personnel left and newcomers had to be socialized in a new setting. An unbalanced number of juniors in relation to seniors created problems for the project in the VISOK part of the CW project.

At the same time the fifth loop would be depleted and die without any of the four other loops. It would make little sense having a concept that mobilized essential parts of the world, if there were no colleagues to develop it; no supporting institutions, no alliances and collectives to put it into circulation, and no public everyday activities that could provide pragmatic tests on its applicability. In the end this was what happened with the CW project. Vital parts of the world mobilized against it, low oil prices and freeze in IT investments. Collectives like BETA and OMEGA grew stronger. Institutions fell apart in the large reorganization effort of 1999. Vital colleagues left Statoil and old KOT alliances evaporated in the vacuum that developed during the latter reorganization process. The CW project depleted but it also terminated KOT as a group.

Throughout my doctoral work I have referred to the American school of philosophical pragmatism to develop an understanding of technology that was rooted in my symbolic interactionist past. The contribution of the American school of philosophical pragmatism is increasingly manifest in the STS (Bowker & Star 1999, Latour 1999). Gaston uses instruments as a tool to translate his interests for particular ends. He uses his active productive skills in this process of settling a problematic situation. Cascades of programs and anti programs lead to stability or consummation. Trials of strength are found all the way through the circulatory system of facts (Latour 1999:122-124):

> Why is an actor defined through trials? Because there is no other way to define an actor but through its action, and there is no other way to define an action but by asking what other actors are modified, transformed, perturbed or created by the character that is the focus of attention. This is a pragmatist tenet... The accuracy of the statement is not related to a state of affairs out there, but to the traceability of a series of transformations. No experiment can be studied only in the laboratory, only in the literature, or only in debates among colleagues. An experiment is a story, to be sure - and studiable as such - but a story *tied* to a situation in which new actants undergo terrible trials plotted by an ingenious stage manager; and then the stage manager, in turn undergoes terrible trials at the hands of his colleagues, who test what sort of *ties* there are between the first story and the second situation. An experiment is a text about a nontextual situation, later tested by others to decide whether or not *it is* simply a text. If the final trial is successful, then *it is* not just a text, there is indeed a real situation *behind* it, and both the actor and its authors are endowed with a new competence...

9.3 Circulation in relation to key factors of the CW project

The circulatory metaphor and its loops (activities that mobilize the world, automatization, alliances, public representations and links/knots) gave input to understand the life cycle of the CW project's career. If the Norne and VISOK pilots are compared as separate projects, what can they tell about what enhances and restricts circulation in the careers of organization and IT concepts more in general? In what follows I describe six properties of this circulation process based upon the empirical chapters and analysis of this thesis.

1. If a new organization and IT concept is to start its circulation; a working order among communities of practices must be created or renegotiated. Norne was a new installation and a new working order had to be developed to start the operational activities. The VISOK project started when a new working order in the social field of the early phase was to be initiated after

the BRU TF reorganization effort. In both pilots' different perspectives of the business existed among the participating persons and groups. Unresolved problems, conflicts and antagonisms were visible. There were numerous heterogeneous perspectives in both pilots. In the Norne pilot these ranged from the perspectives of KOT, Statoil Data, Norne employees, onshore-offshore functions and Norne management. In VISOK such heterogeneity was visible through the action of the earth scientists, EDN managers, administrative functions, economists and others.

The point of entry in the VISOK pilot as in Norne is that the social order cannot be taken for granted. It must be established and be continuously reformulated to remain a working order. A discourse between participants in the social field is needed to create the outcome: interpretations of new social practices and artefacts in the early phase or a new Norne organization with new operational practices. New elements and claims that developed in the CW project had no inherent connection. They had to be connected, argued for and legitimated. Basic categories of interaction have to be agreed upon and go through a naturalization process.

In both pilots, tensions, unresolved problems, ambiguity, conflicts and antagonisms existed and had to be handled all along the work, in spite of organizational targets and the best intentions of all organizational actors. Targets in organizations are in general vague and have to be multivocal in order to provide flexibility for action. Still, in the two pilots of the CW project targets were much clearer in Norne: develop a new organization to produce oil. In VISOK both the targets and the process of creating new knowledge and products were much more vague and knowledge intensive.

To establish or negotiate the working orders of the CW project, pilot groups used different forms of material or immaterial symbols of which in both pilots were called intermediaries and boundary objects. The working orders of both the Norne and VISOK pilots became coherent via boundary objects. Boundary objects were concepts and objects that inhabited intersecting social worlds and satisfied the construction of meaning in all of them. The activities undertaken to develop these boundary objects were in both pilots developed through systems design, or integrated organization and IT development as KOT called it. Construction, evolution and intervention were ways to create such working orders or to accelerate the circulation of the concepts to make them stable. Flowcharting was the main circulation device in the Norne pilot. In VISOK a number of information perspectives were to do the same. The CW project through its phases in Norne had elements from both construction and evolution but less from intervention.

2. *Boundary objects are a precondition for the circulation of new organization and IT concepts to gain strength.* How can coherence be developed between the diverse social worlds the CW concept travels throughout its career? In each loop and through numerous stages in the career *boundary objects grew up to create working orders between actors in an increasing collective.* Boundary objects must exist both to create interest and initiate translations. They provide the foundation for boundary work and infrastructual work. New boundary objects often create new alignments in the collective, because boundary objects translate meanings to enable them to become more coherent. The CW project with its various materializations developed only modestly to such a boundary object. Elements of an enterprise model developed a successful boundary object in Norne operations, but aligned non-technical staff functions to a lesser extent.

The description of enterprises, components and data sources in VISOK, in Figure 7.7, created a working order between OMEGA, BETA, Statoil Data and VISOK. In these examples the goals of each group could be lined up and the working order was upheld because each of the groups had satisfactory work to do in each world. They were plastic enough to mean different things for different people and groups. In both Norne and VISOK boundary objects maximized the autonomy and communication between life worlds. The Norne pilot provided more autonomy and communication than VISOK.

The lessons from Norne and VISOK in the CW project indicate that it is difficult to look at a boundary object and describe what elements are successful in facilitating circulation. The Norne enterprise model had a mono character, using a simple machine and flowchart metaphor to portray a future practice and to mobilize the Norne organization. This metaphor and methodology were indeed reductionistic. Still, its simplicity and combination with other elements did in fact enhance circulation of the CW concept. VISOK on the other hand had multifaceted metaphors with much stronger symbolism that portrayed more of the enterprise than the Norne model. Still, the Norne enterprise model was the more successful boundary object and had a stronger mobilizing character.

If we go back to the properties of boundary objects both Norne and VISOK applications had elements of properties Star and Griesemer ascribe to boundary objects. *The lesson from the CW project is that the circulatory potential of the new heterogeneous element, claim, symbol, artefact, CSCW application (meaning its prospect to become a boundary object) can only be understood in relation to other elements and loops of the project's circulatory system.* KOT had problems understanding why the work methodology and digital flowcharts proven successful in Norne did not become a success in VISOK. The reason must be found elsewhere than in the flowcharts and the methodology itself, some factors are: Norne a new organization vs. EDN a mature organization with a strong existing order of humans and non humans, process owners like Tommy and Norne operational managers vs. EDN staff managers and economists.

The above elements are only loosely connected to the boundary objects themselves but are perhaps the major reasons for the CW projects circulatory potential. *Circulatory power is not inherent in the objects alone and this is the main reason why boundary objects cannot be engineered.* The success of a boundary object in creating circulation will only reveal itself after a working order has been successfully created or negotiated, and various translations have found a form through trials of strength. It is possible to describe *features* of successful boundary objects *retrospectively*. Still, when we try to recreate them in *new* situations (as KOT tried to do moving elements from Norne to VISOK) and settings, we are unable to describe and engineer the heterogeneous network of circulatory factors that *made* it into a successful boundary object. The boundary object itself is connected via many threads and share the properties of links and knots that hold the scientific facts of Latour together.

3. Cascades of inscriptions and translations that are enrolling increasing numbers of heterogeneous forces via trials of strength improve the circulation. Both Norne and VISOK pilots show that the supporting role of management in mobilization and circulation is important but far than enough. Management planning, meetings and management decisions cannot decide that circulation is to take place. The latter group is only a small part of the assemblage of humans and non-humans that must be mobilized and enrolled to make the concept circulate. Latour's strategies for enrolment of interests presented in Chapter six and eight provided insight in this process. The circulation is also eased via the mobilization of key

symbols. An alignment between the CW project and Norne was one example that gave the CW concept more circulatory force.

The strength and mystical powers of the aura of high technology for circulation is something I will come back to later in this section. If we go back to the process of creating translations and inscriptions I used string figures and a "game of cats cradle" to describe features of a circulatory process that is less Machiavellian than that of ANT. String figures, or the concepts of the CW project, were passed back and forth in the hands of several players, who added new moves in the building of increasingly complex patterns.

String figures provide the tone or rhythm of the circulation. This circulatory game invites a collective work in which one person is not able to make all the patterns alone. String figures have rules, but they are few and flexible. Any number of people can play, for any length of time. The string can be made from any material. Old figures can be repeated or new ones invented. It can be played competitively (who will mess up first) or co-operatively (how long can we keep the figures moving). It can be played in any location, by anyone invited to join. Patterns that emerge with each move owes at least as much to the moves that have gone before as it owes to the ingenious variations introduced by the present player, as Emily Martin (Martin 1998) has argued.

A "game of cats cradle" will according to Emily Martin, Donna Haraway and Ernst Gombrich always be two-sided. *To make progress after a number of moves the strings have to be handed over to another player.* This is similar to our circulatory view of translation. If translation ends, the circulation stops. The Collaborative Workspace project needed at least two sides, that of KOT and the others (Norne, Statoil Data, EDN and others). These had to be different from the KOT group to provide additional perspectives. The CW project provided much of the materials for the strings and some of the rules of the game but fewer of the patterns and variations that developed and became translated as the strings travelled along in the circulation of the concept. Most inscriptions made by KOT in the CW project were flexible and did not create situations of inflexibility (like the system 56 example in Chapter five).

KOT could only be partly responsible for the ingenious variations that developed in the process. KOT and others taking part in the CW project must be seen as co-participants in the processes by which boundary objects do or do not become part of the lives of people within a working order. This is also related to the issue of instrumentalism, discussed in relation to pragmatism. Even if actors pursue their programs almost instrumentally, what they eventually get are much more (or something else) than they have bargained for.

Technologies have properties that we only experience as a consequence of use, properties that designers and engineers never imagined. *This naturalization in action enables technologies to develop intrinsic meanings that are not directly aligned with the extrinsic features.* New meanings and translations develop as the strings (read technology) travel. These are often features that were never intended in the first place, like the sequence of programs and anti programs of Gaston.

4. Irreversibility of the existing actor networks in the established or renegotiated working orders are vital to understand the further circulation of the concept. This issue addresses how stable the network is, is it reversible, meaning: is it possible to go back to a point in time where particular interpretations were one among many and the extent to which it shapes and

determines subsequent translations? Irreversibility depicts how translations in actor networks have become stable, or how they can stand up against competing translations.

Can VISOK as a new translation compete against the existing translations of earth scientists in their use of information technology? The CW project never reached a phase of irreversibility. It had such a potential through the Norne pilot but the existing actor networks, or assemblage of humans and non-humans were too strong to create the expected changes that KOT envisioned. Given that we have a situation where a new stability is developed, *is stability a loss of circulation?* No, in the light of social and technological dramas, reintegration, black boxing and designification are starting points for new dramas. The circulation continues but black boxing and designification have *made the circulation invisible.*

5. *Legitimating and justifying narratives are needed to place the concept both in reason and nature throughout its circulation.* The need for such narratives is stronger in the early circulatory history of the concept and relatively unimportant once the concept is black boxed or designified. Pragmatic trials of strength show if the concept is viable, if it really can be ascribed reason and nature. Examples from both Norne and VISOK pilots indicate that if these legitimating and justifying narratives can be linked to objects of power and status this creates a particular credibility. The CW project was linked to Norne, the icon of the new times.

The mystical force in relation to the aura of high technologies must not be forgotten. High technology is an attractor; it has a large emotional appeal among those that want to be among the leading users of information technology. For this group the aura of high tech is a good material for translations. Legitimating and justifying narratives also had a function to be able to think out of the box and trigger more unconscious abductive processes. In the early part of KOT's projects in Statoil it was a counter narrative to that of IT as an expense and prepared grounds for new thinking.

Such narratives provided metaphors that enabled a walk in the direction of the perceived future or a new potential pattern. Legitimating and justifying narratives were also part of an adaptive mechanism needed to maintain a logical framework to reality. They provided answers in situations of uncertainty, being a kind of sense making for handling IS/IT issues. We saw in both pilots that fashion (BPR, knowledge management and other management theories) provided energy for the circulation of these narratives within the CW project. Legitimating and justifying narratives were themselves becoming boundary objects when they united persons and groups around concepts, like the notion of IT as an enabler brought KOT and Norne management together.

Via the circulatory metaphor of Latour, in Section 9.2 and through the first five factors in this section I have described how ideas, concepts and solutions in relation to collaborative information technologies are developed and spread via comparing the Norne and VISOK pilots. Further, I have also described the roles of human and non-human actors in the same process. It is time to look at my third research question: what becomes visible and invisible in the career of an organization and IT development project? This brings me to the last factor I relate to circulation.

6. Previous inscriptions and translations in both human and non-human material create both amplifications and reductions in the further circulation of the concept. Translation as a way to dramatize phenomenon in the world is important here. The drama analogy enables us to see

humans placed in situated settings and contexts lived through bodily experience. It shows the performative nature of Latour's programs-anti programs, like in the Gaston example of Chapter two. The drama analogy is also relevant to understand the dramatization of amplification and reduction mechanisms at work in Technoscience. Gaston as a good bricoleur takes what at hand and translates his interests into the cat flap. What is seemingly an instrumental act is dramatic because it dramatizes particular aspects of elements in the world into an acting situation.

Those that participate in the CW project through its various loops must *dramatize elements of the concept to fit situations in which they act.* In Norne the flowchart methodology was dramatized via Norne employee's flowcharting in groups, picking out relevant elements for a future operational situation. The loss of legitimation in relation to public representations in VISOK is just as dramatic and enacted. The project lost trials of strength related to VISOK's applicability in the organization. KOT portrayed a dark picture of the EDN organization. The KOT group's work practices were barely understood. All the active profilation work that the project conducted did not work (the 1.0 release campaign and VISOK college shirts). Cyclic prototyping was perceived as signs of failures because of empty placeholders and missing functionality. All these performances added up grew into the following manifestation: *work methodologies that do not work cannot be aligned with reason and nature.*

I used Victor Turner's original four phase social drama and Pfaffenberger's technological drama in my narratives in Chapter four, five and seven to show how amplification and reduction of certain phenomena are important elements in the constitution and life cycle of a drama.

The circulatory process of the CW project itself consisted of repeating cycles of dramas and their phases. Victor Turner hardly discussed the role of technology, but he describes how phase one *breach* is dependent on some political assemblage to portray, describe and challenge elements of a status quo into a new situation, thereby amplifying particular aspects of a situation. The second phase *crisis* is only possible after an amplification of particular aspects of phenomena, and fractions or oppositions develop as a consequence of this. Paradigm conflicts arise over exclusion rules he argued.

In Bryan Pfaffenberger's technological drama his first phase *technological regularisation* is an example where a design constituency like Norne gatekeepers, KOT and Statoil Data, amplifies particular aspects of a technological production process, an artefact, user activity, or system in such a way that some of its technical features embody political aims (or intend to allocate or reallocate power, prestige or wealth in social groups). In his second phase, *technological adjustment*, the people who are challenged by the new amplification engage in strategies to compensate the loss of self-esteem, social prestige and social power caused by the technology. Phase three, *technological reconstitution* is a discussion or struggle between those that do the amplification and those that feel reduced.

Turner's *redressive* phase is only possible when mechanisms are used to reconstitute or institutionalize given amplification and reduction mechanisms. In Turner's last phase *reintegration* these mechanisms have found their form and are up and running smoothly.

In Pfaffenberger's last phase *designification* the struggles over amplification and reduction have found its permanent form. It becomes a black box, meaning that the connection between technological activities of amplification/reduction and social meanings seems susceptible to

erosion. The circulation does not stop but it becomes invisible as I argued earlier in this section. Concepts become taken for granted, routine and part of everyday life. Still, in a world of repeating cycles, like the world of Turner, the black box might become material for future social dramas, and consequently, additional amplifications and reductions. Since the reduction is not perceived as dramatic as the amplification it will have a recessive character and tend to become invisible and forgotten.

New NOTES r 4 navigator functionality in the Norne application dazzled the users to an extent that discussions on work practices might have become invisible. There were latent telic *inclinations* made possible through the use of the IT systems in the CW project, inclinations that favoured certain perspectives. Remember the Janus face of LOTUS DOMINO, if accessed via a Web browser all collaborative functionality disappeared. When accessed via the NOTES client proper groupware functionality was accessible. What was won in Web access (amplified) was lost in collaborative functionality (reduction).

LOTUS DOMINO matched Don Ihde's description of inhabiting a particular instrumental style (Ihde 1979). LOTUS DOMINO could as a consequence of this not just embody any human aim or interest. It embodied the aims of the CW project in *certain ways. The instrumental style of middleware and components amplified VISOK as a management information system precisely because the requirements of staff managers were visible in the published data sets while the work practices of the earth scientists continued to be invisible.*

The CW project through VISOK chose to use the Web interface of DOMINO. As a consequence, the other possible inclinations became forgotten. Inscriptions and translations made earlier in the project, cannot be escaped. The prestige associated with continuing activities that already had started followed its own trail both in DELPHI and all along the career of the CW project. KOT could not back out because their work were tied up in deliverables, contracts and many informal relations and alliances. Inscriptions and translations already made in Norne, like flowcharting, became a problem in VISOK.

The existing collective of humans and non-humans that were already enrolled reduced flexibility. LOTUS was enrolled as the key technology supplier something that gave possibilities but also a number of challenges. The consequence of enrolling Statoil Data in the CW project meant continuing along the trails of the present IT infrastructure. This enrolment gave both possibilities and limitations. The "high technology" notions that were prevailing made use of the NOTES-client out of the question in VISOK. Patching, coding and IT activities developed their own momentum, and to keep IT components and middleware aligned required considerable work.

Organization and IT development is a process of increasingly narrowing a space of possibilities, an inevitable process of amplifications and reductions. The main issue is not about preventing amplification or reduction from taking place, but how the process is undertaken and what values lies beneath the many choices taken through action. As Don Ihde (1979) argued, high contrast and a vertical instrumental possibility are also the preconditions for further knowledge development and more hermeneutic interpretations of technology. It is also important to ask if the technology and methodologies used in the process of narrowing this space of opportunities is aligned with such values, i.e. like the Norne values in Section 5.2.1. This leads me to the last research question: how can we handle questions of visibility and invisibility in the career of an organization and IT development concept?

9.4. Due Process: on handling invisibility in the career of an organization and IT development concept

Now given that we have the insight provided by ANT, seeing the world through translations and circulation, what can we do with it? The last research question remains: what can be done to deal with invisibility in organization and IT development? ANT has given an insider *praxhos* a fine-grained perspective to understand the intricate mechanisms - some technical and some not - that shape social action (that is, how specific elements and functions of an information system relate to organizational issues).

I argue that this granularity is important for three major reasons. First, ANT can give a new understanding of the term "stakeholder" and the process of involving stakeholders, since ANT gives a language to describe the heterogeneous network of people, artefacts and concepts that moulds a social reality, opening up for examination the power of non-human stakeholders. Second, ANT provides a framework to describe with necessary granularity how translations of stakeholder's interests and the institutionalization of claims take place on a concrete level. Third, ANT provides a retrospective description of who the human and non-human stakeholders were, how these inscribe their interests into various materials and describe the degree of irreversibility of the inscriptions of particular actants or stakeholders. It can present the many trials of strength that showed which links in the collective of humans and non-humans were solid or weak. Finally, ANT gives a language to describe what becomes invisible, what voices are not heard and why. These are questions of large importance to those interested in organizational reflection, development and democratic change in general.

There are a number of weaknesses in ANT's perspective on stakeholders a consequence of its descriptive project. ANT has been reluctant (or more correctly, claiming that it is not its project) to give recommendations on how, or if, actor networks (meaning collectives of humans and non humans) should, or can be changed, and how stakeholders might be involved in such a process.

If we follow ANT to its limits, no stakeholder cause is more just than another; it will be a matter of negotiations and a question of building consensus. ANT will not reject that some stakeholders have a more just cause, but deny that there is a general validity behind such a claim. An insider praxhos that has reflection and change on the agenda (e.g. to help a group that wants to improve their situation), needs additional input than ANT's retrospective description of the development of the collective. Since there is no natural a priori link between elements, ANT is ill equipped, or not interested, in dealing with the future, to become a theory of future action. It can end up becoming part of Davydd Greenwood's (1999) inaction research paradigm.

The historical description, or the interpretation of actor networks and the related processes of building and changing such networks in Norne and EDN presented in the preceding chapters, would alone give a platform to inform action, but would be not sufficient to guide the many decisions embedded in IT design and organization development. Such an approach does not try to scrutinize the quality of the constructed outcomes.

Faced with the multifarious claims of stakeholders we require a prescriptive stance that goes beyond ANT towards intervention and conceptualizations of what is good/no good in the particular context, which was Statoil in my situation. I therefore go beyond ANT to find a

normative basis for the involvement of stakeholders in organization and IT development processes.

My use of ANT and this normative position is that of a *gestalt switch.* They cannot be united but provide two perspectives of a unity. In Chapter four I described three methods of information systems design: construction, evolution and intervention. Up until now I have not given *intervention* the proper attention. What in the pages to come is called a "due process" is an example of an intervention process, *a continuation of interventionist design with ANT means.*

Let me before I continue argue why I focus on stakeholders in relation to my last research question. To answer this issue I go back to punctualization, defined in Chapter three. I defined it as a situation that develops when an actor has gained the privilege of representing an actor network, or a particular collective of humans and non-humans. In this situation we see order instead of a complex network and the many links that create this order is invisible.

Punctualization makes it possible for social actors to serve as spokespersons for a complex network of humans and non-humans. Further, punctualization tends to lead to aspirations for power and control, because translated sub-networks become resources that can be controlled. In the CW project various participants spoke on behalf of different collectives of human and non-human actors. EDN staff managers spoke on behalf of earth scientists, their work practices and IT systems, claiming to represent this collective. They argued that a particular functionality was needed in VISOK that published particular licence information of which they argued the earth scientist also had to find relevant. Statoil Data spoke on behalf of the existing IT infrastructure, a heterogeneous collective of humans and non-humans, and future IT development. KOT spoke on behalf of new functionality that they wanted to implement like the GIS functionality in VISOK.

When social actors cry out, a controversy regarding a feature in the Norne or VISOK IT system, or a claim related to work practices (poor quality of resource data) in VISOK, negotiations must develop to make sure that the collective of social actors come to some agreement, then practice can change. They must discuss; what facts are the most critical, are the claims real and just, can this actor represent this collective and claim, if not, what additional actors must be enrolled? New claims for existence in the collective appeared through numerous arenas: project meetings in the CW project, search conferences, flowcharting sessions in Norne, bulletin board discussions in the Norne NOTES application, EDN-VISOK customer meetings and through the coaching process. The cyclic prototyping methodology was an example of a dynamic design process that resembled that of a human-non-human negotiation.

To sum up so far, the CW project consisted of both human and non-human stakeholders that each had claims for the new hybrid collective growing up in Norne and EDN through numerous circulation processes. A traditional action research stakeholder analysis, as KOT partly used in Norne, involved major human stakeholders. However, the CW project was also very much about the design and implementation of new collaborative technologies that had voices that could not be ignored. We see for instance in VISOK how design decisions taken related to component use created its own strength that the project could hardly escape and barely control. IT activities tied up considerable resources throughout the project, resources that could have been used elsewhere in a project that had the ambition to be an integrated organization and IT development project.

My point here is that middleware and components in this example were stakeholders. They drew attention and required resources to stay aligned. Priorities had to be set up between activities. One had to ask: what is most important in relation to our values and in relation to what we want to achieve? In VISOK the espoused value was organization development, but much action and priorities signalled technology development to be more important way into 1998 when peer assist, coaching and fieldwork activities started to increase its focus.

Can an insider *praxhos* position that is deemed to be normative be combined with ANT's descriptive position? Can this help us to handle the involvement of stakeholders' interests and what will such a process that tries to evaluate the propositions of both human and non-human stakeholders look like? Bruno Latour has in French (Latour 1999c) (and quoted in Mc Master et al. 1998, Whitley 1999) spoken up against the previous criticism of ANT (lack of prescriptive theories and relativism) and tried to develop a way to use ANT in prescriptive ways, as a theory of action. This concept coined "due process[34], is a systematic attempt to involve and exclude stakeholders/ actants in an actor network, or collective, and describes a four-step decision process that includes or excludes stakeholders[35].

It is a process that stands firm of the tradition of dialogue and communicative action (Greenwood & Levin 1998, Gadamer 1975, Habermas 1984, Toulmin & Gustavsen 1996). Due process is also a circulatory process. It shows the dynamics in network creation and how actants or stakeholders are enrolled into a network and become transformed by networks of associations. Implicit in "due process" is the same heterogeneous effort to treat humans and non-humans as part of the same collective. In the discussion on which should be included in the actor network, the question of choice and coexistence is important and involves a process of wrapping up facts and values, and then wrap them together again into an integrated or aligned network. I have picked out elements from the Norne narrative in Chapter five to exemplify properties of a four step "due process". The facts that developed in this work in 1996 are a consequence of a process that tends to follow the circulatory loops I described in section 9.2 and 9.3.

Many claims never get very and far and never develop the strong legitimating and justifying narratives and experience pragmatic tests to support them (like cold fission and extra terrestrial life in science). The work in the Norne narrative had at least two steps, the step of perplexity (determining if a phenomenon/claim exist or is important). Once this question has been defined as positive the institutionalization of the "facts to be" can start. Values share the same properties, they are often expressed in terms of hierarchy, and the creation of values involves a consultation process. Values evolve through reflection on and in action, through discussions with others.

A "due process" means unpacking facts and values from the worlds of nature and society and replacing them through the process into a single collective. The phases of perplexity and consultation are periods of claims and counterclaims, programs and anti-programs, of successful translations and rejections (Mc Master et al. 1998).

Let me describe the four phases in more details, see Figure 9.2. When the local stakeholders around the collective of Norne brought new candidates for existence or claims forward, whether these were concepts like the flowcharting methodology, claims like NOTES release 4 and WWW access, they did not bring clarity and were thus not accepted as a social fact at

once. They created "perplexity" or confusion (Step 1) because they had to be seen in the light of the past.

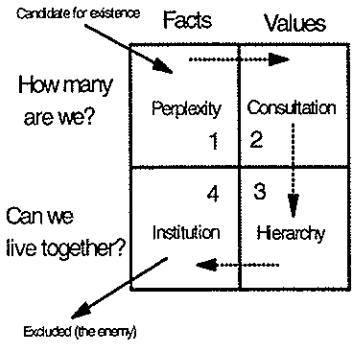

Figure 9.2: Bruno Latours (Latour 1999c) "due process" (Mc Master et al. 1998).

Norne, a new organization, had to develop a new organizational reality, but people carried with them their experience from past installations. Nor had they a shared history. Questions regarding membership and status in the new collective were daily questions met by Norne employees, system developers and facilitators in the Norne effort. The operational strategy was formal, lacked context and Norne had to start with describing the most important work processes. There was considerable uncertainty on what the Norne NOTES application should look like and what organizational objectives it should support. It ended up in a division of labour between the human stakeholders (process owners, super-users, Norne operators, the Norne management, Statoil Data and KOT researchers).

The question of what kind of software should be used, NOTES or more Web enabled technologies caused discussions. All these were candidates for the heterogeneous collective. New mental representations on the technology had to be developed moving from version 3 to 4 of NOTES. IT had to fit the existing infrastructure. The methodology and the concepts of flowcharting had to be so simple that it was possible for the Norne people to find it useful in their preparations for operations. Membership rules for the collective had to exist, or rules for deciding which entities are to be included or excluded: "how many are we?"

The acid test of new candidates was a two-step process. First, a process of "consultation" (Step 2) that dealt with the legitimacy of the candidates in relation to the others. The suitability of the applicant for inclusion in the network had to be assessed, and the new entity's position in the hierarchy of things had to be settled. The arenas available here for discussions among the stakeholders were: search conferences, the project meetings and the day-to-day reflection in action in Norne. The cyclic prototyping and the NOTES application tried to capture important elements of this process in flowcharts.

This process of consultation elapsed into hierarchy (Step 3). "Hierarchy" is the process of understanding how the new actant will be positioned within the collective, to become acceptable to the current configuration of people and things. These hierarchies were not just made up; they were also a consequence of dialogue. New candidates had to match the value-statements or the requirements defined early in the process, see Section 5.2.1. New candidates for the collective should have these embedded qualities: not monitor people, give extended responsibility, give minimal critical specifications to work and improve quality of working life, to name a few.

In the period of consultation, the positions of the most important stakeholders were externalized, via daily activities in planning for operations, through flowcharting, cyclic prototyping, coaching and ethnography. There were numerous results here; those related to the IT application (developed through the cyclic prototyping) were a list of entities (programs, interface devices, functions) to be included in the project and a list of those to be excluded (no mining into existing legacy systems, no expert oriented modelling tools and no use of VISUAL BASIC).

The next step was to decide the status of the different entities, and a hierarchy of needs was required. To implement push buttons for improvement comments was more important than creating default font sizes. Steps 2 and 3 were a process of involvement, where different arenas were used to make stakeholders reflect on their situation and make value-laden choices of what outcomes they wanted to create, a process of mobilization and enrolment.

Only then could facts be accepted through institutionalization (Step 4) and become part of organizational routines and the Norne culture. At this point in time "facts" brought safety back into the Norne collective, since they had been coloured by values through "consultation" (Step 2) and "hierarchy" (Step 3).

The alternative to institutionalization was rejection, because the candidate did not match the existing order of the collective. There were numerous examples of rejections throughout the project. WWW technology was rejected in 1996 in favour of NOTES. FREELANCE GRAPHICS was enrolled as the flowcharting tool because it was simple to use and matched the competence of the users. Object-oriented modelling tools were rejected for the opposite reason, they were too complicated, had to be operated by experts and would have created a distance to the Norne users. Some middle managers were rejected membership as process owners because they did not support the new Norne values and could not function as facilitators.

Latour argues that even if candidates are excluded, they can appeal to come into the collective at a later date. In our two examples of rejections, this was exactly what happened. WWW technology as a stakeholder was partly rejected in 1996, through a gateway solution, but reappeared as a new strong candidate in 1998 with BETA and the Statoil Intranet. The middle managers' claims were kept down and rejected in 1996, but when operations began, they again appealed their candidatures. Their operational skills were needed.

The last feature of "due process" tries to handle attempts to shortcut this four-step process and move the candidate from step 1 (perplexity) to step 4 (institutionalization) directly. This course of action does not involve the collective of stakeholders on the diverse arenas described here to enable this necessary colouring of values, develop a hierarchy of things and exclude or include the proper candidates. It does not allow the proper circulation of the claim through its various loops. As a consequence, the chance of it becoming a fact is small. It will remain a management buzzword, a claim consisting of unstable and disintegrated elements void of public representations and pragmatic tests. As a consequence it will inhabit little circulatory strength.

Mc Master et al. (1998) use the legal proceedings of a court of law as a metaphor to describe elements of a "due process". Edgar Whitley (1999) uses Habermas' (1984) *Theory of Communicative Action* to portray the proceedings of a "due process". It is a discourse where stakeholders seek to convince the collective through the force of the better argument, a

dialogue situation that includes freedom of access, equal rights to participate, truthfulness on the part of the participants, absence of coercion in taking positions, and so forth.

In Norne, the courtroom could be named other arenas like project meetings, search conferences, flowcharting work groups or management meetings. It was a sufficiently small organization of around 100 where people could represent themselves in the planning for operations phase. Giving improvement comments was one additional feature for making individual voices be heard. The other alternative was to have key people or "advocates" present their perspective, through the flowcharting work. Somebody should also represent the non-humans and make their claims visible.

The Norwegian Petroleum Directorate represented themselves and their interests (claims of documentation) in their periodical revisions and audits. Frank and Statoil Data spoke on behalf of the non-human NOTES application. An example from a project meeting with the most important stakeholders (management, process owners, R&D facilitators, programmers, users) in May 1996 shows that this is not necessarily so absurd in the light of pragmatic discourse logic a la John Dewey and Jürgen Habermas.

The best argument presented seen in relation to given position of values wins. The idea was to make flowcharts for navigation purposes, and one idea was to open up more of the information resources Norne needed. To link up NOTES databases was no problem and had already been implemented. Process owners and users wanted to start up the proprietary mainframe plant maintenance system and go to a specific screen menu (create a work order), to enrol a new candidate. In the discourse situation that developed, Frank, the programmer (speaking on behalf of the non-human NOTES-application) had to say that given the present functionality of the system mining into an old mainframe system would be very difficult and expensive.

The process owners and users were persistent and a compromise was achieved based on the dialogue. It would be possible to start up the plant maintenance system from the application (by building a start-up engine from NOTES to the mainframe application) but not go down to the "create work order" menu directly. This dialogue involved a consultation between human and non-human (the programmer represented the IT system) actants and the only appropriate solution (seen in relation to the hierarchy of things: costs vs. new functionality) was the better argument that institutionalized a new feature in the application after that meeting. Credibility of the candidates were discussed in similar ways, on the other arenas as well; in the flowcharting groups, meetings between process owners and the search conferences. If no agreement was reached, the Norne management meeting had the final say.

The significance of "due process" can be seen in the light of Gadamer's (1975) critique of Habermas' "Ideal Speech Situation". In Hans Martin Gadamers *Truth and Method* he describes the former theory as a piece of naive idealism and advocates a more complicated combination of dialogue, mutual interpretations and eventual but seldom everlasting fusion of experiences and horizons. Gadamer, redefines the project of hermeneutics from mainly a method for thinking to a form of acting, what John Dewey would have called a way of keeping the conversation going. Bruno Latour's "due process" might be interpreted in this light: an attempt to see ANT more as a form of acting. Its major contribution compared to that of Habermas and Gadamer is that it gives technology a concrete form (as a framework or language) that makes it an integrated part of the discourse.

To conclude, a "due process" is a process of trying to develop what I earlier referred to as a working order, conditions for keeping the conversation *going* between life worlds. "Due process" is also a mechanism of amplification and reduction, since some elements or candidates are included while other candidates are excluded. This process *unpacks* information and values from the outer world as well as different life worlds into a *single* collective. Most of this congregation is *invisible,* and *has* to invisible to work.

The conceptual framework of the "due process" is therefore fit to understand *how* the questions of invisibility is dealt with in the career of concepts for development of organization and IT, and – even more important – it seems also to fit to understand how this question *ought* to be dealt with. Also STS and ANT have provided important insights to understand the intricate mechanisms of human and non-human elements that mould a social reality in relation to organization and IT development. It is now time to *use* this insight in intervention research within organizations. I hope that the *praxhos position*[36] that I have tried to develop and advocate throughout this thesis may give a further push for some students and scholars of Technoscience in this interventional direction. The time of anemic science has come to an end; the raison d'etre of the life sciences is to animate, to circulate and translate their knowledge as the blood of life in the *action of work.*

Abbreviations and Definitions

Aasgard	A Statoil offshore installation.
AR	Action Research.
ARC/INFO	Is a component made by the GIS software company ESRI used to extract (takes out chosen data from raw databases) foundational data for the GIS-application in VISOK.
ARCVIEW	Software by ESRI used to retrieve coverfiles (or data prepared to be used in the GIS navigator of VISOK).
AST	Anthropology of Science and Technology.
B&B	The unit in Statoil that plans and executes drilling and well activities from the exploration throughout the operational phase.
BETA	A Statoil Intranet application with computer-based training and knowledge management functionality.
BPR	Business process redesign (or re-engineering), a popular management theory from the mid-1990s.
BRU	Stands for better and faster development projects. A Statoil change project conducted in 1994 to improve project development of new installations via reduced development costs, improved vendor collaboration and new forms of collaboration.
BRU TF	A continuation of the BRU project that aimed at improvements in Statoil exploration projects and activities. BRU addressed development and BRU TF exploration activities.
CSCW	Computer Supported Co-operative Work, a multidisciplinary research community aligned around collaboration, groupware and the study of work.
CPSR	Computer Professionals for Social Responsibility, a world-wide interest organization for computer professionals that are engaged in civil rights, quality of working life and democratization in general through their work practices.
Criticality	Criticality related to maintenance is differentiated in three levels, 3 for most critical and 1 for non critical. Norne have defined border values for the three levels and classification of equipment can vary from installation to installation in Statoil. The value standard is the effect of breakdown or malfunction in relation to safety for

	personnel and environment, in relation to consequences for production and production capacity and consequential costs on equipment and installation as a consequence of the malfunction or breakdown.
Cyclic prototyping	Cyclic prototyping became a new platform for taking out the alleged synergy between IT and organization development. The basic idea behind this was as follows. The group started with fieldwork in a given setting to grasp the local work processes and the social aspects of work. A simple prototype of a standardized tool, like a LOTUS NOTES database was made with little efforts. This tool was implemented on local Statoil servers so it could be used by a small group of users from the start in real life settings. KOT-people participated in the life of the local organization, they observed and were given input to how the application was used. This triggered ideas to improve or increase the functionality or interface of the application. The amount of users was gradually enlarged as the system found a more stable form. KOT participated in the training of new users, worked as facilitators and helped the organization in their improvement processes.
Data warehousing	The presentation of extracted data from different data sources into one tailored user interface adjusted to particular user/organizational needs.
DELPHI	A LOTUS NOTES application developed by KOT and STI in 1994-95 that enabled digital distribution of mandatory documents and that had functionality to support experience transfer in relation to the latter documents.
DELTA	The amalgamation (or compromise) of DELPHI and SAREPTA into a LOTUS NOTES application for distributing mandatory documentation.
Discovery	To be defined as a discovery, the discovery well must be tested with a positive result. Technically recoverable petroleum resources must be brought to the surface.
Doc-link	A hypertext function in LOTUS NOTES that create links between LOTUS NOTES documents and databases.
DRO	The main corporate division that organized Statoil oilfields after the reorganization in 1995.
EDN	Exploration and Development Norwegian Continental Shelf, the organizational unit responsible for developing promising part of the NCS to a PUD-decision
E&P	Exploration and production, the major corporate division of Statoil that was called DRO from 1995-1998.
Earth scientist	A knowledge worker working within Statoil underground activities, ranging from geologists, geophysicists, petro physicists, reservoir engineers and others.
Enterprise model	A description of vital aspects of a company's activities and information requirements in terms of input and output processes and how these parts function together.
ERGODESIGN	The method of ERGODESIGN suggested that the following processes should be included: *Mapping experience transfer to goals*, *Acquisition of experience* and *Qualification of experience.* Mapping experience transfer to business goals meant that a systematic effort in experience transfer should be restricted to specific knowledge domains which were considered to be of particular importance and value in supporting the achievement of business goals. Mapping experience transfer to business goals was crucial in developing the kind of shared mental models, language and organizational culture required among the actors of experience transfer processes. Mutual cultural assumptions and mental models were believed to be the basis for the coordinated behaviour of and the motivation required by experience transfer. In the acquisition of experience different disciplinary perspectives of the experience

	domains should be included in the acquisition process. However, separate acquisition processes should be carried out for each technical discipline in order to avoid dominance from a subset of disciplines. The knowledge acquisition processes should be managed by facilitators that have some familiarity with the experience domains. This eased the experience elicitation process. A variety of qualitative techniques were applied in the acquisition process such as search conference methodologies, informal interviews, participant observation and job walk-throughs on-site observations. The objective of the qualification process was twofold: first, to qualify the experience recordings from the acquisition process across source disciplines; second, to qualify the experience material with respect to different receiver categories as a sort of reliability control. Competing and conflicting viewpoints should be brought into the open to enrich the qualification, compare areas of agreement or disagreement and avoid predetermined schemes of technical viewpoints being imposed.
ESOP	ESOP is a collaborative tool developed in LOTUS NOTES by Statoil Data to solve various kinds of unstructured tasks, where the flow is not predefined. ESOP offers a structure to this flow by giving the unstructured tasks a predefined structure. The tool consists of case folders, which contain all the information related to one case. ESOP is a database with a number of case folders, folders that may contain administrative information, tasks and all kinds of documents that belong to a given case. A case cover is a collection of tasks and documents produced and found in connection with a certain case/project. A case manager can create a task folder that holds information about the task. Documents (word processing, spreadsheets, presentations) that are being developed are stored within these task folders. Tasks and folders that are completed can be exported to an electronic archive (ELARK). Everybody in Statoil has access to ESOP databases, but the same people can only create folders and documents in ESOP databases where they are defined as users of the cases.
ESRI	A leading manufacturer of GIS software.
Exploration play	Is a family of prospects, leads, theoretical traps, discoveries, fields, and drilled dry anomalies that have or have expected to have the same main reservoir hydrocarbon system and regional top seal.
Flowcharting	Is a method to catch the structural aspects of a work process through a machine-like metaphor of input and output. It describes elements of a work process as objects and draw linear links and connections between them.
FREELANCE GRAPHICS	A slide presentation tool by the LOTUS Corporation used to draw flowcharts in Norne.
Frontend	A graphical user interface to a number of underlying information systems.
Gatekeeper	A person that has formal or informal power and communicate efficiently with stakeholders in the organization. These persons gather and translate both internal and external information and adapt this information to the business agenda. He or she is a respected person with a large informal network, an opinions maker who is able to influence decision processes, meaning that managers listen to their advice before taking major decisions.
GIS	Geographical Information System.
Groupware	A particular kind of software like LOTUS NOTES that is developed less for individual work and more for groups working together.
Gullfaks	A Statoil offshore installation.
Heidrun	A Statoil offshore installation.

HTML	Hypertext Mark-up Language, the programming language behind the Internet.
INF	The corporate information and public relations unit that developed OMEGA.
INREG/STID	Statoil's official information system for technical information on installations.
Installed base	The existing corporate structure of information system hardware and software.
INTERNOTES	A software product by the LOTUS Corporation that developed a shortcut access to defined WWW resources. It was used in Norne in 1996 to access vendor documentation on WWW. Disappeared with the introduction of LOTUS DOMINO.
Inspection	An activity undertaken to monitor the technical condition of a production facility.
Intranet	Is a network of resources for spreading information within a closed environment, often separated from the Internet by a firewall.
Intranet template	A standardized user interface that is developed to secure a proper profiling and consistent structure on all Statoil Intranet sites. Those units, groups and persons that want to present information on the Intranet have to use this standardized format.
ISO 9001	A particular system of quality control. ISO stands for International Organization for Standardization.
JAVA	An object oriented programming language (a variant of C++) developed by Sun Microsystems that makes it simpler to create interactive Internet applications: animations and updating functions compatible with HTML that is used to developed applications on Intranets and the Internet.
KF	Stands for quality improvement and is Statoil's TQM methodology.
Killer application	Key functionality or a given application that will enable large use of the application and turn it into a success.
KIT	Corporate information technology, a corporate staff unit that handled strategic issues related to future information technology and infrastructure in Statoil until mid 1990s.
KKG	Statoil's research funding structure during the CW project.
KOT	Department of co-ordination technology at Statoil R&D.
LANDMARK	An integrated computer system for underground earth scientist activities ranging from seismic interpretation, graphical well log editing, analysis and interpretation, 3D interpretation and visualization, framework to build complete 3-D and 2-D earth models, well bore management, visualization and integration of geoscience and engineering data and seismically integrated geological modelling and geologic information to mention some of the applications.
Legacy system	Large and important enterprise computer solutions like LISA and PROSA.
Licence	A particular part of the Norwegian Continental Shelf that is awarded to oil companies through concession rounds. Licences are for limited duration in order to undertake exploration for hydrocarbon reserves. The Norwegian government gives one or several oil companies rights to explore and produce oil from concession areas and ownership to the produced hydrocarbons. This exploitation permit forms the basis for a licences enterprise. The government selects the operator of the licence, defines the licence partners, their percentage share and the voting rules of the licence. A collaborative agreement is set up that describes the relation among the partners and their relation to the Norwegian State. When signing this agreement the partner form a joint venture with the purpose of exploring and exploiting the hydrocarbons within

	the concession area. This joint venture is a responsible unit where the partners are economically responsible in accordance with their percentage of ownership. The steering committee is the management level of the joint venture, all owners are represented here and it takes decisions that commit the partners. A number of advisery special committees are set up in addition to the steering committee in the life cycle of a licence: exploration, reservoir, technical, economic & financial committees.
LISA	Statoil's official database for licence administrative information.
LOTUS NOTES	Is a groupware system developed by the LOTUS Corporation to support communication and information processing in an organization. It is an asynchronous tool that can be used by individuals and work groups accessing shared databases in local, distributed or phoned up computer networks. LOTUS NOTES consist of two main parts. First, the server that is used for both storing and replication of shared databases and personal post boxes across the network. Second, clients, which are the workstations of users. Any user of NOTES is linked to a server via the client. He or she can access shared databases and send and receive electronic mail. The basic information element in NOTES is the databases and the documents they contain. Replication is done to update databases distributed on several servers and across geographical locations, enabling any of the locations to have updated access to information. Servers contact each other at fixed time intervals to replicate the documents of the database, access lists and design elements of the NOTES databases. NOTES is designed as an open database tool and is delivered only with a mailbox. The user organization must develop databases for their own needs. All databases have split interfaces in forms and views. A "form" is a template where the information is registered. A "view" is the interface that presents the information.
LOTUS DOMINO	LOTUS DOMINO is LOTUS NOTES' upgrade to version 4.5 and above. In this upgrade LOTUS has implemented a Web interface to the data in the database. Technologically speaking R 4.5 is the same as the previous, but a new communication interface in placed on top of the old database design. Because of this a Web browser can communicate with the database. This new communication interface is a Web server that can be run with any browser. At the same time old NOTES information can also be accessed if placed on a DOMINO server.
LSX	A particular middleware used in VISOK (like the licence platform) to extract predefined data sets from existing legacy systems.
LTEK	The unit in TEK responsible for exploration technology and that is used by EDN to do exploration activities of various types, i.e, maintenance of data in LISA and PROSA.
Mainframe system	A computer system developed before the development of PCs and client server technology.
Mandatory documents	They are procedures or written descriptions of an espoused work practice. Such documents range from detailed descriptions of how particular work is to be executed (like a safe job analysis) to more overall requirements to work practices, like how health, environment and safety issues are to be undertaken in everyday operations. Mandatory documents tend to have a particular structure that added up form a quality system like ISO 9001. Some of these documents are company or even installation specific, others are sector specific, meaning that the Norwegian Petroleum Authorities set requirements for all NCS operators. Norwegian Petroleum Authorities demand that all oil companies operating on the NCS have documentation that describes their espoused work practices, and their audits and revisions take place in order to evaluate the correspondence between "the map and the terrain".
Middleware/ components	Software device often in-between the user interface and the database level that extracts data according to a predefined data set and publishes them in a front-end format (LOTUS NOTES, Web browser).

MIS	Management Information System.
MIT	Massachusetts Institute of Technology.
Monte Carlo simulation	Is a particular simulation technique or an analytical method meant to imitate complex phenomena (when other analyses are too mathematically complex or too difficult to reproduce). The spreadsheet models often used in examples in Chapter seven reveal a single outcome, often the most likely or average scenario. A spreadsheet risk analysis like Monte Carlo simulation uses both a spreadsheet model and simulation to automatically analyse the effect of varying inputs on outputs of the modelled phenomenon. It randomly generates values for uncertain variables over and over to simulate the phenomenon. Games of chance like dice and roulette wheels exhibit random behaviour. The random behaviour in games of chance is similar to how Monte Carlo simulation selects variable values at random to simulate a phenomenon. When you roll a dice, you know that either a 1, 2, 3, 4, 5, or 6 will come up, but you do not know which for any particular roll. It is the same with the variables that have a known range of values but an uncertain value for any particular time or event (e.g. interest rates, staffing needs, stock prices, inventory, phone calls per minute). What do you do with uncertain variables in your spreadsheet? For each uncertain variable (one that has a range of possible values), you define the possible value with a probability distribution. Distribution type chosen is based on the conditions surrounding that variable. A simulation calculates multiple scenarios of a phenomenon by repeatedly sampling values from the probability distributions for the uncertain variables and using those values to come up with an interpretation.
Navigator	A new feature in LOTUS NOTES r 4 that made it possible to develop rich clickable texts/pictures and mimic the functionality of the WWW.
NCS	Norwegian Continental Shelf, the Norwegian Sea to the 200 km territorial line.
Net Present Value (NPV)	Net present value assessment is an investment calculation. The objective is to uncover the financial consequences or profitability of planned investments. The general problem is uncertainty. In a profitability calculation of an investment the prospects of the future are evaluated, and the longer an investment ties up capital the larger the uncertainty. A certain amount of uncertainty can be taken into consideration in a calculation by using a high interest rate. An investment like a new oilfield and installation will lead to large disbursements at the time of the investment. Such a major investment, that can be i.e. NOK 10 billion, leads to additional yearly income payments (oil and gas sale) and yearly disbursements (like operational costs). If the investment is to be profitable the incoming payments have to be larger than the disbursements over a defined time period. Incoming payments and disbursements that we will have for some years from now do not have the same value because of the effect of interest. The net present value method makes all incoming payments and disbursements comparable reckoned in terms of a given point in time. It discounts all amounts to present value, or the time of the investment. A calculation interest rate is used to be able to perform these calculations and convert future incoming payments and disbursements to the time of the investment. This interest expresses what Statoil expects as return on the investment in order to make the investment profitable. The size of this calculation interest is dependent upon the return of alternative investments, risks and uncertainties in the project (field development, properties of the reservoir or resources), the borrowing rate, the level of inflation and the estimated price of oil/dollar. The difference between incoming payments and disbursements, meaning the cash flow, is converted into the value it has at the time of investment. One demand for profitability is that the present value is positive. The projects with the largest net present values are in principle the most valuable. One example taken from (Banken & Busch 1983).

Year	0	1	2	3	4	5
Incoming payments	0	400	500	800	800	800
Disbursements	1000	200	200	300	300	300
Cash Flow	-1000	+200	+300	+500	+500	+500

If the calculation interest is 20%: **Year 0** -1000 **Year 1** x 200 = +166.660 **Year 2** x 300= +208.320 **Year 3** x 500= +289.350 **Year 4** x 500=+241.150 **Year 5** x 300=+120.570. Adding up figures gives a net present value of: 26.050.

NETMEETING — Software from MICROSOFT Corporation that enables collaboration across geographical distance via audio communication and application sharing.

Norne — Statoil's first offshore production ship.

NORSOK — A committee set up by the Norwegian authorities to improve the future competitiveness of the NCS and led to a number of structural changes in the NCS: standardization of equipment and work practices, new types of vendor collaboration, new installation concepts and shorter development cycles of new installations.

NT-server — A particularly stable server by MICROSOFT.

OMEGA — A Statoil Intranet project that developed quality requirements for information content, a general search mechanism for the Intranet, news, help functions and a general navigation structure.

ORACLE — A particular vendor and manufacturer of relational databases.

P&O OLU — The corporate staff human resource unit, that deals with competence development, team building and management training.

PAINTSHOP PRO — A software-imaging program used in Norne and VISOK to paste bitmaps into navigators.

Patching — Bricolage inspired coding and improvement of computer program code often done to make the computer system, or elements of it to function better.

PES — A project started in 1993 to improve standardization and development of shared practices and mandatory documentation in E&P and of which KOT's experience transfer methodology ERGODESIGN became a part.

PETEK — Petroleum Technology, an organizational unit in TEK, with the responsibility for improving the recovery percentage of reservoirs in production.

PROSA — Statoil's official database of hydrocarbon prospects and resources.

Process owner — An insider and facilitator in the Norne and EDN organizations with the task of involving others in the undertaking of reflection processes within a particular domain, such as maintenance.

PROSHARE — A desk top conferencing application by INTEL that shares images of those participating, has a shared electronic whiteboard and application sharing (meaning that two people can work jointly on for instance a slide presentation or text document from remote locations).

Prospect evaluation — It is the basis for decisions on the acquisition of new licence acreage, exploration and appraisal drilling, disposal of licence interest and the formulation of exploration plans and strategies. Consequently, prospect evaluation is done to inform Statoil

management on where the money should be invested, what are the possible results, what is the risk, what is the result of the comparison of different investment opportunities. This advice is given in a number of settings and scale; the world, a particular basin, a prospect, a discovery or a field. A number of professions collaborate to develop the evaluation of the prospects: geology, petrophysics, geophysics and geology professionals and reservoir engineering, technological and economic analysis all collaborate to estimate the costs, risk and resource uncertainties related to the prospect. The process that leads to a prospect evaluation consists of two interactive steps. The first is basin evaluation, that tries to evaluate the basic properties of the basin: source rock, reservoir rock, seal rock, overburden rock and the general properties of the oil, gas and water properties of the reservoir. Play evaluation is the next phase. A play is a family of prospects, leads, theoretical traps, discoveries fields, and drilled anomalies that have or are expected to have the same main reservoir, hydrocarbon supply system and regional top seal. This process leads to resource estimation, a trap and reservoir evaluation (sealing closure area, reservoir thickness, net/gross ration, porosity, hydrocarbon saturation) and a source rock estimation (thickness, area, quality, maturity and migration loss). Along the basin and the play evaluation a technological and economical evaluation is conducted. The result of the prospect evaluation is an estimation of the recoverable hydrocarbon volumes.

PUD

Plan for development and operations of a new oil installation that is sent to Norwegian government for approval.

Push/pull

Describes two ideal ways of relating to information. Push means that information is sent to you by for instance electronic mail. Pull means that you actively get the information you need at particular places and when needed, and enter particular databases or places to find this information.

QA

Quality assurance or quality control.

Requirements specification

Is a written description of the main functionality of the computer system.

Reservoir

The development of hydrocarbons in a reservoir is a process that can take several hundred millions of years. Hydrocarbons are made when dead animals and plants end up in the mud on the seabed. The amount of oxygen must be small in order to avoid the organic material rotting. The first step of creating oil and gas resources happens when anaerobic bacteria start a chemical decomposition of this organic matter. This process is dependent upon high temperature, a temperature that is increasing with 30 degrees Celsius for each kilometre of depth in the direction of the core of the earth. The heat transforms sand and mud to fixed sandstone and mudstone. Grains of sand and mud particles are cemented together through minerals that are created through the given temperature conditions. In-between the grains of sand and the particles there are open spaces or pores that makes the stone porous. These small spaces of pores will in most cases be filled with ground water or seawater. The open spaces between the grains of sand are so big that water, oil and gas can penetrate through the surface of the stone. At the same time that the grains of sand are converted to sand stone, the carbon material from the animals and plants starts to transform. At around 120 degrees Celsius oil and gas will sweat out from mudstone rich in carbon and penetrates more porous rock types which it comes into contact with. A porous rock type that can easily be penetrated by oil and gas is called a reservoir rock type. Mudstone has too small pores for streams of gas and liquid to penetrate it. Porous spaces in the reservoir rock type have been filled with water all the time. Oil and gas is lighter than water and goes upwards when penetrating a new rock type. In a traditional reservoir we find gas on the top, oil in the middle and water at the bottom. A prerequisite for the creation of oil and gas reservoirs is the existence of a tight layer over the reservoir rock type that has the function of trapping the oil and gas so that the further migration of oil and gas is stopped.

Revisions and audits	Are activities undertaken by the Norwegian Petroleum Authorities or Statoil internal quality control units to check the state of the art within critical elements of the business such as health environment and safety work practices.
Round project	The round project works out terms of reference, clarifies the scope, content, organization, resource needs in terms of personnel, cross disciplinary responsibilities/ contribution, time schedule, costs and QA in accordance with the requirements and directions of the Norwegian authorities.
Safe job analysis (SJA)	A safe job analysis is done to study all possible circumstances that might lead to damage to life, health, environment, material and production. These evaluations should be done before the tasks are started and performed in such a way that potential risks are assessed and the necessary steps are evaluated and taken. The people that will do the job do the analysis. Examples of work or maintenance that require safe job analysis are: hot work on the installation (work with fire sources), crane and lifting operations, work with radioactive sources, explosives and chemicals, work on systems under pressure or in operations, work with dangerous material and others.
SAP	Is a German software company that delivers integrated software solutions for accounting, plant maintenance, human resource, logistics and which from the mid 1990s gained a strong foothold in large companies and in the oil industry worldwide.
SAREPTA	Was originally a NOTES application developed by Statoil Data to distribute digital documents by push functionality. Later a shared workspace application in LOTUS NOTES marketed by IBM that replaced ESOP.
Search conference	Is a work methodology that makes it possible to gather a large amount of people in a reflection process. Through the mixture of heterogeneous and homogeneous group work and plenary sessions facilitators help the group to develop a joint understanding of this history and future challenges, set up efforts to change this situation and start planning this process of change, see Greenwood & Levin (1998).
SCORE	SCORE (Statoil CORE business) was a three-year (1998-2000) programme that focuses on the fundamentals of Statoil's business: finding oil and gas, deciding whether such discoveries are commercial and bringing them on stream. This project set up along with the implementation of LANDMARK to improve work processes and the quality of information and source data in exploration.
Statoil Data	Statoil internal IS-IT division with the responsibility of running the existing infrastructure of hardware and software.
Seismic shooting	Seismic shooting offshore is done when a ship drags a number of hydrophones (microphones that can sense sound waves below the water level) after the vessel and fires air cannons that send signals that penetrate the rock structures under the seabed. The sound waves are reflected in the boundary surface of different rock types, i.e. in the borders between sandstone, slate stone and limestone. Where different types of rocks change their elastic characteristics (sound speed and density) the sound waves are reflected and sent back to the hydrophones.
SKR	Central control room of an oil installation that controls and monitors all technical systems and production processes in Norne.
Stakeholder analysis	Is an analysis that is undertaken at the beginning of a project to map the major groups and stakeholders (their aims, positions and attitudes) that is important to involve in a change process.

STI	Standardization and Technical Information, a unit in TEK responsible for mandatory documentation. A collaborator of KOT in the development of DELPHI and home of the BETA project.
STS	Science and Technology Studies.
Systems development/ design	Is the business of constructing computer systems for the use of human beings in reviewing, processing, storing and communicating information (Dahlbom & Mathiassen 1993:47).
TEK	Statoil's technology division.
Tjeldbergodden	Statoil's methanol production plant.
TQM	Total Quality Management, a popular management theory from the early 1990s.
Troll	A Statoil offshore installation.
UBT	A organization unit within TEK that evaluates and creates technological and economic estimates of new offshore development solutions.
Upstream activities	This covers the exploration, drilling, production and transport to land. After the refining of oil or gas conversion, activities are termed downstream.
Value chain	A method for analysing the processes an organization performs and how the processes interact. Michael Porter (1985) set up five primary processes: 1. Inbound logistics, where the material or information is brought into the company. 2. Operations, operating on the materials or information. 3. Outbound logistics where the material or information is sent out. 4. Marketing and sales, where the products or the information is marketed. 5. Service, servicing the information and products.
VISOK	Enterprise Description Norwegian Continental Shelf. An Intranet project initiated by KOT in collaboration with EDN and Statoil Data.
VISUAL BASIC	Software for creating front ends and graphical user interfaces to databases of various sorts.
WAN	Wide area network of computers between office locations.
Web server	A server with an Internet Protocol (IP) number containing particular software to enable information located there to be accessible via the WWW.
WEBSOP	EDN's idea of a home page project that should enable access to a number of ESOP NOTES databases and make them searchable via a Web browser.
WINDOWS 3.11-95	Computer operative system developed by MICROSOFT Corporation.
WWW	World Wide Web or the Internet.

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Footnotes

[1] Gregory Bateson (1936) was among the first in anthropology to start this line of thinking. He described the term schismogenesis. In his description of this process conflict is escalated through antagonistic groups working at cross-purposes. As a consequence of this conflict the symbiosis/structural order is transformed and reinterpreted to fit the needs of the factions, often with little regard for the integrity of the established order. Bateson argued that schismogenesis was an attempt to bring light upon the factors at work in states of disequilibrium. He describes two types. Symmetrical schismogensis develops where individuals in two groups have the same aspirations and the same behavioural pattern, but are differentiated in the orientation of these patterns (clans, villages, nation states). The binary span between similar entities (rivals or factions) is amplified. The second form is complementary schismogenesis in which the behaviour and aspirations of the members of two groups are fundamentally different (classes, age grades, caste, man-woman). Both types contain dynamic elements, meaning that when certain restraining factors are removed the differentiation or split between the groups increases progressively towards a breakdown or a new equilibrium. William Partridge (1985) argues that Victor Turner is influenced by Bateson's schismogenesis.

[2] Is a diverse tradition within social constructivism. It refers to refer to the influential "Social Construction of Technology" (SCOT) approach that was outlined originally in Pinch and Bijker (1987). STS also includes "social shaping" approaches (e.g, MacKenzie and Wajcman 1985), and the actor-network approach of Bruno Latour, Michel Callon, and John Law (Latour 1987). It is possible to subdivide the tradition into strong and weak constructivism. Strong social constructivism includes the SCOT-approach. Technological change is here explained by reference to social practices, particularly by reference to processes of interpretation, negotiation, and closure by different actors and social groups. Technology is a genuine social construction, that is, a stabilized technology can only be explained by reference to the social elements (including other socially constructed entities) that have produced its stabilization. No "properties", "powers," or "effects" can be attributed to technologies themselves. Strong social constructivism is criticized for giving special preference to social elements, such as social groups and interpretation processes, on which its explanations are based, whereas natural or technical elements, such as natural forces and technical devices are prohibited from being explanatory elements in explanations. Mild social constructivism is the more moderate approach, that sometimes go under the name of "social shaping". Social shaping approaches retain conventional distinctions, between the social and the natural, and between the social and the technical, and study the way in which social factors shape technology. They do not reject a role for non-social factors in technological change, and are also willing to attribute properties and effects to technology, although these properties and effects are usually claimed to be defined relative to a particular social context. Because technologies are socially shaped, these properties and effects are in large part social properties and social effects, that can be attributed to social biases or politics "built into" or "embodied by" these technologies. Actor-network theory another mild contructivist theory, is sometimes simply called "constructivism" or even hybrid constructivism, is a third influential approach. It studies stabilization processes of technical and scientific objects as these result from the building of actor networks, which are networks of human actors and natural and technical phenomena. It is a heterogeneous network of entities that participate in the stabilization of a technology (Latour 1987). Actor-network theory also allows for technical devices and natural forces to be actors (or "actants") in networks through which technical or scientific objects are stabilized. By an analysis of actor networks, any entity can be shown to be a post hoc construction, but entities

are not normally socially constructed, because stabilization is not the result only of social factors. (See Brey 1997:3-5). I represent the latter constructivist position and not the position of "SCOT" and "Social shaping".

[3] There is still a controversy in the STS community if there is a distinct anthropological flavour to this tradition. I do not intend to address this question in more detail in this work, since it is a question of its own. (See Hess 1992, Martin 1998, Forsythe 1994 and Hess 1997 for more details)

[4] The notion of praxhos shares many features with *phronesis,* a concept Aristotle defined in his *Nichomachean Ethics* (Aristotle 1975). Being a practitioner of praxhos means more than just technical skills and ethical principles. Aristotle assigned a notion of practical wisdom to the concept: "The most characteristic function of a man of practical wisdom is to deliberate well: no one deliberates about things that cannot be other than they are, nor about things that cannot be directed to some end, an end that is attainable by action. In an unqualified sense, that man is good at deliberating who, by reasoning, can aim at and hit the best thing attainable to man by action" (Aristotle 1141b9-14 in Ostwald 1975). A practitioner of praxhos must deliberate well and arrive at suitable conclusions through reasoning or deliberation. The conclusions developed must be attainable by action and finally, the things to be done must be something good. Such a position has consequences. First, the phronesis or praxhos of an insider anthropologist is tied to that person's everyday behaviour as he or she practices in the organization. It is something practically acquired in the world of experience and daily living and not something that can be picked up by private studies. Second, it is an ability that must be acquired through action. Third, it requires a context in which the principles of phronesis can be lived.

[5] Digital data sources of a number of NOTES databases and digital archives (Norne, EDN, Statoil Data, KOT), e-mail communication, Intranet sources, KOT internal research reports, text-based data of internal and external newspapers and magazines, 40 Semi-and non-structured interviews from various positions and functions and feedback via discussion in groups and in presentations and colloquiums.

[6] The field theory of Kurt Lewin (1948, 1951) is the "proposition that human behavior is the function of both the person and the environment: expressed in symbolic terms, B = f (P, E)." This means that one's behaviour is related to both one's personal characteristics and to the social situation in which one finds oneself. Lewin is known for his work in the field of organization behaviour and group dynamics. Lewin argued that learning is best facilitated when there is a conflict between immediate concrete experience and detached analysis within the individual. His cycle of action, reflection, generalization, and testing is characteristic of experiential learning. Lewin struggled to adhere to his self-imposed vision of the researcher who maintains a "constant intense tension" between theory and reality. His favourite metaphor was that of a bridge, connecting research with action, laboratory with community.

[7] Another issue that must be handled is the concept of the "*schema*". Schema theory started to become popular in cognitive psychology and cognitive anthropology in the mid-1980s and has to a large extent been interpreted as mental structures inside people's heads (or an internal conception of culture as meanings taken away from their material instantiation). If interpreted in this light, schema theory is incompatible with the notion of artefact mediation and STS in general. An alternative is to argue that scripts are not uniquely inside-the-head but, like all artefacts, participate on both sides of the "skin line" (Cole 1996:128). Roy D'Andrade (1995:179) describes the relationship between the world and its symbols and schemas as a tight connection between symbol/schema and artefacts. The schema that represents the sound of a word and the schema that represents the thing in the world referred to by that word are entirely different, although tightly connected in that the schema which represents the sound of a word signifies (has as its meaning) the schema which represents the thing in the world. Cultural schemas and scripts can therefore be seen as essential components of a cultural tool kit. They partake of both the ideal and the material: materialized and idealized (reified) in the artefacts that mediate people's joint activities. However, scripts and schemas are always insufficient to account for thought and action. D'Andrade (1990:98) describes how every schema leaves out an enormous amount of the potential visual, acoustic, sensory and prepositional information that could be experienced. As a consequence, the individual humans engage in juggling and interpretation in figuring out which schemas to apply in what circumstances and how to apply them effectively.

[8] Larry Hickman (1990:XII) says: "The feature of Dewey's critique of technology that renders it unique is his contention that tools or instruments cut across traditional boundary lines such as those between the psychical and the physical, the inner and the outer, and the real and the ideal. This idea, which Dewey cultivated and nourished until it grew into a methodology, was Dewey's instrumentalism". What is Dewey's definition of technology? It

is a word he uses to characterize a number of activities, but it is the appropriate transformation of a problematic situation, undertaken by means of the instrumentalities of inquiry (in whatever form). Larry Hickman (1990) puts it another way and says that inquiry is a technological activity because where inquiry takes place there is a shift from passive acquiescence towards the beginnings and endings of nature, its contingencies, to the active construction of artefacts to effect their control. Dewey defines inquiry as a kind of control: "Inquiry is the controlled or directed transformation of an indeterminate situation into one that is so determinate in its constituent distinctions and relations as to convert the elements of the original situation into a unified whole" (Dewey LW12; 108;LTI:104-105) in Hickman (1990:45). Dewey meant that science is a subdiscipline of technology, ideas that Done Ihde has taken further in regarding science as an instrumental realism. Hickman (1990:61) says: "Technology may thus be thought of as a family of methods and tools that evolves in response to the needs and goals that it is called upon to serve, and in response to the uses to which it is put. In this regard Dewey argued quite forcefully, for example, that major advances in productive skills had been achieved as a result of the expanded use of instrumentation that was an essential part of the rise of modern science and industry...For Dewey, productive skills that are prescientific and those that are scientific exist along a continuum of ever more complex and fruitful articulation of instrumentation in the broad sense of the term- including tools, methods, means, meanings, and even language, which he calls 'the tool of tools'".

[9] Larry Hickman (1990:43-44) asks how one is to understand this position? Is it not problematic to reduce all inquiry to technological activities? This is an unwarranted lumping of inter-organic and extra-organic tools together, mixing the mental and the physical. In traditional thinking technology has often been denoted to extra-organic or physical activities. Further, this characterization of inquiry is technological reductive: reducing the function of many tools to the extra-organic, meaning that the functions of inter-organic tools have been assimilated to the roles played by those that are extra-organic? Hickman argues that all these objections presume that there is a sharp dividing line between organism and environment, mind and body, a dualism that Dewey rejected. Dewey argued that any line drawn between organism and environment will have to be drawn elsewhere than in terms of inquiry. He argued that for purposes of inquiry, the skin is not a very good indicator of where the organism stops and the environment begins. Hickmans quotes Dewey here: "There are things inside the body that are foreign to it, and there are things outside of it that belong to it *de jure*, if not, *de facto*... On the lower scale, air and food materials are such things; on the higher, tools, whether the pen of the writer or the anvil of the blacksmith, utensils and furnishings, property, friends and institutions- all supports and sustenances without which a civilized life cannot be". Dewey's perspective of body and mind shows how well he is aligned with an ecological cognitive anthropology, he argues: "'Body' in 'body-mind' just designates the aspects of an organism that are 'continuous with the rest of nature', whereas 'mind' indicates the characters and consequences which are differential, indicative of features which emerge when 'body' is engaged in a wider, more complex and interdependent situation" (LW: 217; EN: 232 in Hickman 1990:44).

[10] Victor Turner (1986:35) argues: "In other words, it (an experience) does not have an *arbitrary* beginning and ending, cut out from the stream of chronological temporality, but has what Dewey calls "an initiation and a consummation". Each of us has had certain "experiences" which can be formative and transformative, that is, distinguishable, isolable sequences of external events and internal responses to them such as initiations into new life ways (going to school, first job, joining the army, entering the marital status), love affairs... Some of these formative experiences are highly personal, others are shared with groups to which we belong by birth or choice... having a temporal or processual structure - they 'proceed' through distinguishable stages".

[11] Bruno Latour (1999b: 15-21) argues that a network means a series of transformations that Latour shows cannot be captured by traditional terms of social theory. It does not mean transport without deformation or unmediated access to every piece of information. He argues that by following circulations we can get more than defining entities, essence and provinces. Like ethnomethodology ANT is a method to access sites, a way to travel from one spot to the other (or one field to another). It is not an interpretation of what actors do glossed in a Universalist language. The aim is to record the world building abilities of the sights to be documented and registered. It does not claim to explain the actors' behaviour but to find the procedures which render actors able to negotiate their way through anothers' world building activities (Latour 1999b: 21).

[12] Abduction is defined by Charles Peirce (1887) as a method of reasoning by which one infers to the best explanation. Peirce first introduced this notion in an attempt to classify a certain form of syllogism. Abductive syllogisms are of the following form: All beans from this bag are white. These beans are white. Therefore, these beans are from this bag. This inference results in an explanation of the observation in the second premise. Though this form of reasoning is logically unsound (as the beans may be from a different source), Peirce argues

that scientists regularly engage in this sort of syllogistic reasoning. Though scientific hypotheses are not valid by virtue of how they are abduced. Abductive reasoning was thought to constitute a "logic of discovery" in one of Peirce's four steps of scientific investigation. These steps are: 1. Observation of an anomaly. 2. Abduction of hypotheses for the purposes of explaining the anomaly. 3. Inductive testing of the hypotheses in experiments. 4. Deductive confirmation that the selected hypothesis predicts the original anomaly.

[13] Every word and concept has a context which must be taken into account in order to make sense of its meaning. People interpret what is given in each situation as instances of something more general, but this general never appears except in particular situations. We never meet general things in real life only particulars and we interpret these as instances of the general thing. The context is crucial but it often has to be taken for granted that people know what the setting is. This is the phenomenon of indexicality. Any particular item of significance is an index of what lies underneath. There is a further context that is taken for granted and so on. The strongest example of this is what linguists' calls indexical terms; words like I, you, here and there. It is impossible to define the meaning of these terms without falling into circularity. 'You' will mean different things according to whom you say the word. Garfinkel's (1967) point is that people avoid having to recognize indexicalities, though they deal with them all the time. However, despite our inability to define such terms "objectively" we are able to use them in everyday life.

[14] The term prototype in cognition refers to Elenor Rosch (1978:35-36). In terms of the principles of categorization cognitive economy dictates that categories tend to be viewed as being separate from each and as clear-cut as possible. One way to achieve this is by means of formal necessary and sufficient criteria for categorizing membership. The attempt to impose such criteria on categories marks virtually all definitions in the tradition of Western reason. Another way to achieve separateness and clarity of actually continuos categories is by conceiving of each category in terms of its clear case rather than its boundaries. Categories can be viewed in terms of their clear cases if the perceiver places emphasis on the correlational structure of perceived attributes such that the categories are represented by their most structured attributes. By prototypes of categories Rosch have generally meant the clearest cases of membership defined operationally by people's judgements of goodness of membership in categories. Out of the prototypical notion of a bird a class is generated. This space has the prototype as the centre. Roy D'Andreade (1995:178) describes a prototype as a typical example of a type of object capable of being held in the working memory, often with many properties "chunked" together to form a rich, specific image. A robin is a prototypic bird, but a penguin is not. A prototype is the instantiation of a schema, thus a robin is an instantiation of the Bird schema.

[15] Bricolage is an activity of a science that he calls prior instead of primitive. He argues that it is important not to make the mistake of thinking that bricoleur-engineer are two stages or phases in the evolution of knowledge. Both approaches are equally valid he argues (Levi-Strauss 1966:14-15): "...to work out techniques, often long and complex, which permit cultivation without soil or alternatively without water; to change toxic roots or seeds into foodstuffs or again to use their poison for hunting, war or ritual - there is no doubt that all these achievements required a genuinely scientific attitude, sustained and watchful interest and a desire for knowledge for its own sake... There is only one solution to the paradox, namely, that there are two distinct modes of scientific thought. These are certainly not a function of different stages of development of the human mind but rather of two strategic levels at which nature is accessible to scientific enquiry: one roughly adapted to that of perception and the imagination: the other at a remove from it. It is as if the necessary connections which are the object of all science, Neolithic or modern, could be arrived at by two different routes, one very close to, and the other more remote from, sensible intuition". Levi-Strauss argues that the sets that bricoleur-engineer use are at different distances from the poles on the axis of opposition between nature and culture. Concepts are believed to be more transparent with respect to reality (Levi-Strauss 1966:20: "...signs allow and even require the interposing and incorporation of a certain amount of human culture into reality. Signs, in Peirce's vigorous phrase 'address somebody'."

[16] Due to a number of modification projects and the building of water injection, gas production systems at Norne the low-level staffing of the installation has been postponed. In January 2001 the number of people working on Norne are on the same level as the original estimate of 1996-97.

[17] Several people on Norne have reported that the 75 % reduction in work orders has been accomplished. Still, it must be moderated. There is a tendency to increase the size of the work packages that require work orders so that one work package is disguised as consisting of many smaller jobs.

[18] Model power (Bråten 1973) can be described as a situation where two people (A and B) try to communicate, and one of them (A) has a much stronger and more developed model of the subject matter than the other person (B). The person holding the weaker model (B) will try to learn and adopt this model (because without a common point of reference communication is impossible). This means that the more successful B is in adopting A's model, which is developed on the basis of A's world view, the more B is being controlled by A.

[19] An installation like Norne may be considered as comprising a group of technical systems, seen together they become series of functional locations. Each system consists of a collection of physical plant items that together provide a discrete service, independent of the technology employed. A system number that is used as a basis for identifying tag numbers uniquely identifies each service. All major equipment requiring spare parts and/or separate maintenance programs have a tag number. Major equipment includes all mechanical, electrical, telecommunication and instrument equipment. The format is specified for each tag type.

[20] Thanks to Bente Evjemo and Jan Grav at Norwegian Telecom Research in Tromsø for letting me borrow their material.

[21] It should be noted that this amplification and reduction mechanism works more or less like a metaphor, some aspects are highlighted others are played down.

[22] Don Ihde (1979) uses the electron microscope to present an even more distant micro feature. Here, he says the means have started to change, since one no longer looks through the instrument (vision is no longer directly embodied through the instrument). Instead a substitute eye is used through photography. It is in a more distinct discontinuity with bodily vision, but yet a representation of the thing itself, of a micro feature of the world. In the case of the electron microscope simultaneously a difference in the experienced use of the equipment and of the visible result begins to appear, both noema and noesis is transformed. It emerges from its normative, relatively transparent use into the foreground during some stages of the investigation. The person using it must enter into a specific relation with the instrument such that it becomes a positive feature of both his perceptual world and the telic aim (the attainment of a visible result). As the potential amplification increases, the instrument is increasingly being looked upon as the very condition of the possibility of gaining the knowledge sought. It is increasingly a positive element in the expansion of the visible world. When the use of the electron microscope is represented in a photo, it begins to produce a degree of enigma, says Ihde. The structure of transformation attains a higher degree of discontinuity. The photo loses more of what must be there (reduction) although it visualizes things never previously seen. This last example, the electron microscope brings to light what he calls the hermeneutically mediated position for instrumentally mediated knowledge. The electron microscope still belongs to the human-instrument-world form of relation, but the character of the mediational position of the instrument is changing (both its experienced use and the result)

[23] KOT made a technological adjustment. This means that in the setting that I am presenting there are several ongoing technological dramas where KOT is participating. In the process for Norne, KOT did much of the technological regularization. In the technological adjustment KOT (related to this footnote) access to LOTUS NOTES r 4 they adjusted to the actions of the obligatory passage point Statoil Data that had full control of the NOTES release 4 technological regularization process (another technological drama). As in this process these technological dramas overlap.

[24] Kathryn Henderson (1999:12) argues that visual representations powerfulness and strongness is related to their meta-indexical role. This role allows them to be something more than the sum of their parts:
"They serve as a holding ground where codified knowledge and un-codified knowledge can meet, drawing on each other's strengths to bring together various levels of tacit knowledge, including but not limited to visual knowledge, kinaesthetic knowledge, mathematical knowledge (verbal and non verbal), local and experimental knowledge, and multivisual competencies.... It is the chameleon meta-indexical, elastic quality of visual representations that demands mixed practices in the workplace and facilitates multivisual competency to enhance the creativity of individual and group design work".

[25] Another reference to a game of "cats cradle" is done by Ernst Gombrich (1987: 233-34) that discusses what artists make of tradition: "There is an element in all art- certainly in all Western art - which might for brevity's sake be called "the cats cradle" element. The young artist takes over the game from his predecessors and as he does so he introduces variations. In Western communities, at least, art has become a social game played among artists and the pattern that emerges with each move owes at least as much to the moves that have gone before as

it owes to the ingenious variations introduced by the present player". A game of cats cradle will according to both Haraway and Gombrich always be two-sided. To make progress after a number of moves the strings have to be handed over to another player. The drama of the Collaborative Workspace project in Norne needed at least two sides, that of KOT and the others (Norne, Statoil Data, divisional management and others) KOT could only be partly responsible for the ingenious variations that developed in the process.

[26] Andrzej Huczynski (1996) describes how the content of the new ideas and concepts must be relevant for the business. The content must be easy to communicate, employ magical terms, abbreviations and contain a short and concise message. Case studies are used as truth witnesses of the theory and a number of graphical descriptions support the theories. Huczynsky also argues how such ideas and theories have an individual focus (motivation, personality, communication) and less a collective focus. Its perspective of human beings is reductionistic, of a system actor that can be manipulated. It is optimistic, hardly problematizes and argues for win-win situations. Management must find it appealing, meaning; increase in status, legitimate their role, exemplify ways of managing organizations and groups. The ideas themselves must be multivocal meaning that managers themselves must feel that the ideas can be adjusted to local circumstances. At the same time they must make control possible and work against uncertainty and faint-heartedness. Consequently, the ideas and concepts can be summed up in checklists and overall principles. The dramatization of the ideas and concepts is of large importance. Since particular agents portray them, they are often a part of a narrative tradition, where the lecture is an important dramatic and embodied performance style. The speaker tries to portray himself/herself as an expert. He or she tries to establish a dichotomy between something that is not favourable or scary on the one hand and his or her own ideas on the other using advocates (often business cases). Then invite to create confidence by playing on feelings, getting people to laugh or cry in order to identify with his or her message. There are a number of such features also in KOT's concepts. However, it is evident that their concepts had to have properties from this genre, since this is the most meaningful genre for their audience in Statoil.

[27] The pragmatic tests of VISOK were rather obvious. VISOK did not lead to substantial changes in the work practices in the early phase and EDN in particular. However, some small changes could be observed. Simpler access to licence administrative data (LISA and PROSA) was an improvement. Better ways of producing maps had been developed and access to strategies and plans had improved. The visibility of poorly updated data in LISA and PROSA had led to more focus on in the maintenance routines of corporate information. Increasing collaboration and prioritization of resources between EDN's regions was in reach, i.e. rig management. A more active use of desktop conferencing systems was indicated. The process support to peer assist, peer review and recommendations for Exploration forum, had put more effort on team-based collaboration in the early phase. Finally, there had been a development of considerable skills in GIS software and middleware development, competence that could be used in future projects.

[28] It must be noted here that the problems described here were not new, and that they have been addressed afterwards by the SCORE project. It addressed many of the weaknesses that the VISOK project struggled with in the implementation of an integrated application package for the earth sciences. Judy and Constance continued in the SCORE project after the closure of VISOK to articulate a concept for multidisciplinary collaboration in the earth scientist community.

[29] Why did I develop this front page for EDN N? I definitely intruded in the project's ambitions; some felt that it was a 'stab in the back' for VISOK. In the autumn of 1997 I spent most of my working hours both as a facilitator and a systems developer in building a new organization and enterprise model for Statoil R&D. I had the skills to implement the EDN N front page. When conducting fieldwork in Harstad for the VISOK project I saw that NOTES could cover their immediate needs but that NOTES had become invisible in the design discourse. I also noticed the blindness the VISOK project had towards NOTES as a consequence of their "Web look and feel" decision. NOTES was regarded as old fashioned, a future dead-end road. However, most people used NOTES and ESOP was under implementation. This installed base indicated the use of NOTES for a number of years to come (and still is in 2001). This fact that did not seem to bother the VISOK project. To move the collaboration between the VISOK team and the Harstad organization a step in the right direction, I proposed this solution. It would solve EDN's most immediate needs and it would give the VISOK team more time to run a thorough process with the Harstad organization. This intervention can be defended in relation to action research. It creates ruptures in the organization and let new aspects of social phenomena become visible. However, it is only a viable path if reflection processes follow the rupture and enable people to work with their situation.

[30] This analysis is very much founded in KOT's 1999 VISOK experience report that was developed as follows. It was initiated at one meeting where an overall plan was set up for the work and some major themes for the report were defined. During group discussions these themes were further broken down into key areas of lessons learnt and future action. Each VISOK participant was given responsibility for one or several key areas, wrote a description of the area: lessons learnt and future improvements. In this part of the project I had the role of devil's advocate, commenting on written descriptions and pointing to inconsistencies and paradoxes. Descriptions were made available in a NOTES-database bulletin board for further comments and discussions. Discussions on the content were undertaken both digitally and through summit plenary meetings. Harald wrapped up the descriptions and published it as an Intranet on-line report and took the final descriptions of the areas further. The content was spread to those that participated from EDN and their collaborators. A close out workshop was supposed to be undertaken with EDN participants and EDN collaborators in 1999 to discuss the lessons from the VISOK project. It was postponed, for several reasons, after the problematic financial situation that developed and was not held before the remaining KOT- group collapsed. My analysis uses many of KOT's statements in the language of ANT and drama and it is also based on the participants reflecting and discussing incidents and activities in VISOK that appeared when I held an ANT presentation colloquium with VISOK examples in the spring of 1999 to start a dialogue on the use of ANT in the analysis of the lessons learnt from the VISOK project.

[31] The problems maintaining data sets in LISA and PROSA are similar to the updating of clinical records and rules of reporting conduct that Harold Garfinkel (1967:196-205) reports about the differences between rules, like data maintenance routines and practices in the community of professionals: "Such differences are not understandable let alone remediable by attempting to allocate blame between reporters and investigators. Consider, for example, the case where a staff member may seek to report in compliance with what the investigator's forms provide, and precisely because he attempts to take the reporting form seriously, finds it difficult to reconcile what he knows about what the form is asking with what the form provides as a rule for deciding the relevance of what he knows. For example, consider a question which provides the staff member with fixed alternative answers, e.g., "Yes" or "No," yet from what he knows of the case he is convinced that a "Yes" or "No" answer will distort the question of defeat the inquirer's aim in asking it... these documents have overwhelmingly the characteristic that their sense cannot be decided by a reader without his necessarily knowing or assuming something about a typical biography and typical purposes of the user of the expressions, about typical circumstances under which such remarks are written... Thus the *folder contains much less than revealing an order of interaction, presuppose and understanding of that order for a correct reading.* The understanding of this order is not one, however, that strives for theoretical clarity, but is one that is appropriate to a reader's pragmatic interest in the order... Most important, the competent reader is aware that it is not only that which the folder contains that stands in a relationship of mutually qualifying and determining reference, but parts that are not in it belong to this too. These ineffable parts come to view in the light of known episodes, but then, in turn, the known episodes themselves are also, reciprocally, interpreted in the light of what one must reasonably assume to have gone on while the case progressed without having been made a matter of record".

[32] Here Harald is here using the argumentation of Lucy Suchman(1995) Suchman argued that work has a tendency to disappear at a distance such that the further we are removed from the work of other, the more simplified often stereotyped our view of their work becomes.

[33] Some popular notions of knowledge management from Statoil are: "knowing what you know and then profit from it or obsoleting what you know before others do the same and profit by creating the challenges and possibilities others haven't even thought about". In this world knowledge management technologies deliver the right information to the right person at the right time. Further, that information technologies can store and distribute human intelligence and experience. Finally, knowledge is conceived as a 'thing' or commodity that can be managed and developed according to strict corporate agendas. A more sophisticated version is found in the work of Ikujiro Nonaka (1994). His perspective bears little similarity with the above popular notion.

[34] 'Due process' is a principle protecting individuals from state power. It demands that no one is deprived of life liberty and property except by established practices of law, like the 14th Amendment in the American Constitution. A 'due process' is an obligation to go through with a just, proper and adequate process.

[35] Edgar Whitley (1999) shows that the basis for such a theory is twofold (drawing on Habermas (1984) *Theory of Communicative Action*). It has an ideal of fairness that can be aligned with my praxhos' political and ethical

aspects, and it tries to provide guidelines that would characterize ideal situations where distortions can be avoided, meaning giving some examples of mechanisms where due process can take place.

[36] Some ideas about future work can be connected to this issue. I do not see my future research agenda going deeper into the translation approach, to developing more descriptions of the role of translation in Technoscience. This is a trail on which AST and STS will continue. I see my role as one of applying these insights inside organizations. If I should touch upon some important areas of future research I return to a research agenda more connected to theories of action. This will take me back to the praxhos insider perspective I defined in the methodology chapter and try to use these AST-STS insights in processes of organizational and technological change within organizations. Embedded in 'due process' is a spark that can lead to something more fundamental in handling change processes in organizations. I sum up a future research agenda in two main areas: *1. Work methodologies in anthropology.* Can 'due process' give input to a more general theory of praxhos in anthropology, one that also can give valuable insights to those anthropologists not working as insiders in business organizations? What will happen when praxhos insider anthropology is conducted according to 'due process' principles? Is the nature of doing anthropology, from preparation, via fieldwork and writing texts consisting of the same four elements: perplexity, consultation, hierarchy and institution? Just to trigger the imagination: how do we as anthropologists deal with perplexity and how it is resolved? How are our consultation processes undertaken, how can we help make human and non-human claims known to the collective through our ethnography? How do we handle amplification and reduction mechanisms to become reflexive about what becomes visible or invisible in our work? What is critical participation in relation to a 'due process'? How can we through fieldwork and writing let voices speak, and find the hidden voices that punctualization and black boxing processes have rendered invisible? How do we establish the hierarchy of elements in the collective we are mobilizing and what are the methods for facilitating this discourse on values? Finally, how do we institutionalize our work? What happens when we take shortcuts from perplexity to institutionalization? Do we act as judges, solicitors, witnesses, as part of the jury, the court case expert or as Latour (1999) claims himself to be in the science wars, the defendant? *2. Due process as a theory of action.* A 'due process' can be combined with various theories like action research that work with groups wanting to improve their situation. Since 'due process' because of STS insights have incorporated non-humans into the setting, this perspective has shown the active role of technologies in situated settings. Action research has traditionally been ill equipped to understand the role and claims of non-human stakeholders in change processes. If one combines AR with elements of a "due process", this can become a methodology used in reflection and change processes within organizations. Some questions of importance here are: How do we operationalize a 'due process' into day-to-day work in change processes? What arenas do we use? How are claims made known to the collective? What are elements in a proper consultation process? How uncover main values and develop new values to be followed in the course of action? Who should speak on behalf of the non-humans, like IT? What sanction mechanisms must be used in developing hierarchies of people and things and how are claims rejected?

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