SEARCHING FOR DESIGN METHODS

An Excursion to Design Methods and Analysis of the Change Process in EMO Organization

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Abstract

This final thesis called "Searching for Design Methods" is an excursion to the broad field of user-centred design methods and teamwork practices and an attempt to improve the present design process of EAS applications. The final thesis reports the results of a participatory action research where the purpose has been to study the change process of the work practices of a design team. My position in this process has been to explore, select and introduce new possible design methods, communication and collaborative tools for the team and to initiate and steer the change process together with the System Manager.

The final thesis aims at answering the main research question: "*How to improve the present design process?*". The research question has been divided into several items such as: the analysis of the present design process, evaluation of suitable design methodologies, analysis on how to integrate the users in the design process, analysis on evaluation criteria and evaluation of the ways to improve the collaboration and communication practices inside the design team.

The outcome of the process is a changed design process, the documentation and analysis. The experience of the action research is drawn into a set of design guidelines and a model of user-centred design process.

Keywords: User-centred design, design methods, design process, change process, collaboration and communication practices, teamwork, Participatory Design, Action research

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I also want to thank Katja Battarbee whose comments helped me structure the material to its final format.

And last but not least ...special thanks to my dear husband, who has been supportive and encouraging in my studies.

Espoo 22.9.2003

Tutta Kauppila

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1. Introduction

> *There may be "nothing so practical as a good theory", but coming up with an effective theory is often difficult. However, good theory should at least be understandable, produce similar conclusions for all who use it, and help to solve specific practical problems. (Ben Shneiderman, 1993)*

This final thesis called "Searching for Design Methods" is an excursion to the broad field of design methods and teamwork practices and an attempt to improve the present *design process*[1] of EAS applications. The document presents the results of a participatory action research where the purpose has been to study the change process of the work practices of EAS *design team*[2]. The preparation for the process has required research on the field of design methods and techniques. The theories of the methods and techniques are thoroughly presented in the final thesis due to the reason that this document will later on be used both as a documentary report of the change process and a training material in the future.

During this change process the design team has analysed the present design process of EAS applications and studied means to change it. They have learnt and practised new design techniques when outlining a new software version. The process for changing the present way of working has required implementing new methods and techniques and learning new ways to collaborate and communicate. This final thesis is largely a description of the change process, where some particular design methods are empirically practised and new collaborative working approaches are experimented, documented and analysed.

My role has been to initiate and support the change process together with the System Manager. I have studied this change process from a researcher's perspective but participated in it in my role as a System Responsible.

I started this thesis with the focus on exploring new design methods and analysing the present design practices but soon discovered that the complexity of the social processes involved in the design team's work, as well as requirements for cooperative and communication practices, played an important role and could therefore not be ignored.

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[1] The design process means the process of system development where certain disciplines and methods are used in order to deliver the specified software system.

[2] The design team originally consisted of the persons in the EMO-organization and the external programmers. Further on in the process the Product Managers and ebusiness developers were joined to the team.

In this thesis I have aspired to select such design methods and techniques as I believe are beneficial for the design team. The fundamental idea of the thesis has been the fact that the present design quality and practices can be improved by changing the present organization of the design team and by adopting new design practices, involving users in the design process and improving communication within the team and with the users. These aspects form the basis to the selection of the new design practices. I have searched for tools that can easily be taken into use by non-technical persons and I have seen the need to involve the users in the design process more tightly. Therefore most of the tools and techniques presented in this thesis are aim at better collaboration and communication between the users and the design team. These assumptions have guided me to the disciplines of user-centred design methods such as Participatory Design, Human Computer Interaction and Contextual Design, just to name some of the approaches that I have been influenced by. As being a novice in practicing these tools and techniques, selecting them is not based on personal experience, but more on research reports in this area and to an intuitive feeling of what would be suitable for this particular group of persons.

Part of the material presented in this final work has been utilized as training material during the process. I have approached and applied the design theories as a novice in system design methods, and the results and lessons should be understood againts that background. It has been an explorative expedition through the wide selection of design methodologies, where I have searched for new ideas and reinforcement to the earlier assumptions on how to proceed in the change process. I have had one guiding theme when selecting the design methodologies for the EAS design team i.e. the necessity of making compromises is inevitable in real life because the best possible methodologies are not always applicable due to time, cost, resource and skill restrictions (see e.g. Nielsen's Discount Usability Engineering or other similar approaches called as the "quick-and-dirty ethnographies").

1.1 Background

The idea for this final thesis originates from experience in the development work in the EMO-organization in AGA. In order to justify the chosen design method approaches, I will explain some of the factors and events that have influenced the way the change process has been initiated.

Background of the EMO Organization

EMO-organization (described in more detailed in chapter 2.1) is responsible for the development and maintenance of the Extranet Application Software (EAS) in AGA REN region. This EAS application consists of three different business concepts: ACCURA Cylinder Management, ACCURA Liquid Management and Web Order which are user task-centred services supporting the user's daily work of

monitoring gas cylinders, liquid tank information and placing gas orders.

The first version of ACCURA Cylinder Management was launched at the beginning of 2000. After the market launch the maintenance and development responsibility was transferred to the EMO -organization, consisting of System Owner and System Manager (both from the business side) and System Responsible and two internal developers (all three from the IT side).

The main tasks of EMO organization have been to take care of the daily operations and maintenance of the applications in four different countries, to support the on-going implementation of roll-out projects and to develop and launch new versions of the services in these countries.

Today the service concept consists of all the main functionalities to be included. Further development of the services consists of fine-tuning the existing functionality and improving of the integration between the service concepts and the user's work practices. The design tools and techniques have been selected to support the design process from this viewpoint.

Factors and Events

My interest in design approaches dates back to the years 1998-2000 when I was leading the ACCURA development project in Finland. At that time I became aware of the importance of exploring users´ work practices for delivering an optimal system solution. I felt uncertain of the methods used at that time, while they were mostly market-oriented pre-studies giving overall information on user's attitudes, but not really supporting the process of defining the system requirements in detail. It aroused my curiosity towards new possible approaches in the system design. During my maternity leave in 2001-2002 I focused my studies on examining different design methods in the University of Industrial Art and Design in Helsinki. After returning to work, I proposed a joint effort to explore the present design process critically and initiate a change process to reform the present work practices and the organization of the design team. The objectives of this joint enterprise were to, firstly, introduce new design methods (e.g. contextual inquiry and Participatory Design approaches) to the *design team*[1] consisting of the EMO members, Product Managers and eBusiness developers, and secondly, to experiment observing and interviewing methods during *field visits*[2] in connection with the next version planning.

The original idea was to arrange two workshops to introduce the theory of the contextual inquiry method for observing and interviewing users and gathering data from field visits to the design team. It was planned that the design team undertake experimental field visits to selected customers in three different countries.

[1] Further in this document the design team refers to a group of persons consisting of Product Managers and the EBusiness developers, people from the EMO-Organization and external programmers, 11 persons in total.
[2] The field visit is an observation and interviewing session taking place in the user's work environment.

The planned field visits consisted of visiting customers, interviewing them and monitoring the use of certain predefined areas of the system. Increasing understanding of the users´ working practices as well as the experiences from new design techniques were the main goals in the final thesis project.

This original idea was briefly introduced to the team at meeting in June 2002. The project was planned to start after the summer vacation but it was strongly resisted, mainly because of the lack of common understanding of the purpose of the enterprise. One reason for this reaction was that all persons involved were not aware of the problems in the present way of working. Also the unfamiliar terminology evoked strong reactions from the team who feared the project would be too technical and time consuming.

Workshops and case studies were not realized in the format originally planned. The reason was that the heterogeneity and maturity level of the team posed a number of challenges that could not be met with such an oversimplified approach. It was like trying to eat an elephant in one bite.

After the meeting, the scope of the final thesis was changed. It was realized that the idea of improving the design process had to be introduced to the team in a different way. The design process is an iterative process itself and part of that process was to change the scope of the project by cutting the big elephant into smaller bites.

1.2 Scope of the Final Thesis

After the meeting in June 2002 where the original idea of the final thesis was briefly introduced, it became obvious that the original plan had to be reconsidered and changed. The only way to initiate a change process and avoid strong resistance against the "design methods", was to create a new plan to reach mutual engagement for change and a joint goal for the team.

The goal was to set the scope to a reasonable level. *In practice this meant that the user-involvement in the process was limited to experimenting only some techniques and tools instead of making more extensive field studies with observing and interviewing sessions.* The purpose was to keep the design methods and everything related to them on a very practical level and to create common terminology familiar to all involved. Improving communication inside the design team and with the users was considered one of the most important issues in the new design process. (See more about the challenges in communication in chapters 5.1 and 6).

Focusing the Scope of the Final Thesis

Although the collaboration of the team and cultural aspects have played a significant role in the implementation of the new way of working in this final thesis, the *main focus has been on the creation and introduction of a design "tool box" for the design team to improve the design quality and collaboration inside the team.* My position in this process has been to explore, select and introduce new possible design methods, communication and collaborative tools for the team and to initiate and steer the change process together with the System

Manager. As being novice in the field of social sciences, I have not taken a deep insight into the social behaviour of the team. The notes during the process are based on my intuitive observations and interpretations of the social dynamics inside the team and the effects on the change process on the persons and organizations involved.

Changing the way of working does not happen overnight as the process requires mutual involvement from the team to cooperate and make decisions on the design process as well as learning new methods. *The first steps from analysing the requirements for the new EAS 3.0 version up to the design phase are described and analysed in this final thesis.*

Research Questions

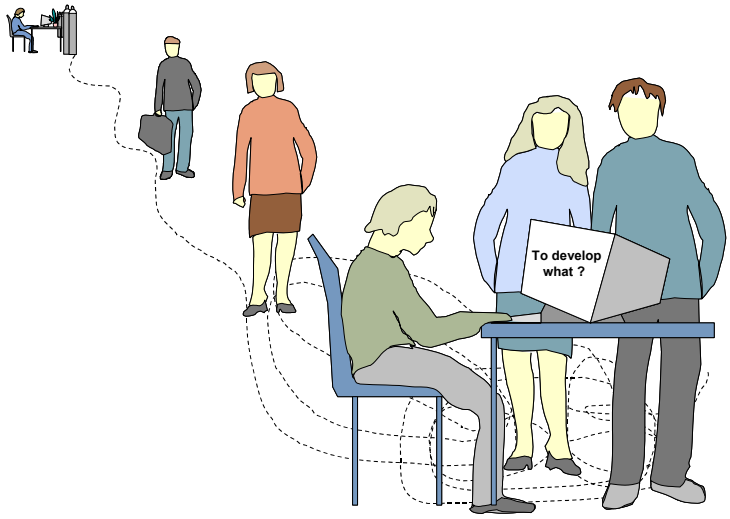
The main question of the final thesis "*How to improve the present design process?*" has been divided into several research items including the following research questions: The research questions in this work are:

- *What are the advantages and disadvantages of the present way of working and what things should be changed and why?*
- *What new design methodologies could be brought into the design process?*
- *How can user participation be increased during the design process?*
- *How can the new design methods be utilized in designing the next version EAS 3.0?*
- *How can the collaboration of the team be improved and how does the change of the design process affect the relations and roles of the persons and organization?*
- *What are the metrics to be used for evaluating the quality of the design process?*

In chapter 7 I analyse the advantages and disadvantages of the present way of working and try to answer the first research question. The second research question concerns the selection of suitable design methods for the team. In chapter 5 I present those tools and techniques I consider suitable for the EAS design team. How these new tools and techniques can be practised in our team and how to increase user participation is studied in chapters 8 and 9. The communicational and collaborative practises as well as the change of roles in the design team are studied in chapter 6. The evaluation metrics are presented in the form of design principles in chapter 8.2.1 and the realization is analysed in chapters 8 and 10.

1.3 Personal Motivation

In my role as regional System Responsible in the development of EAS application, I have felt a strong need to change the development process to one that is more user-centred and more efficient. This need arises from an awareness of the process of making system critical decisions that have direct impact on users´ work practices.



In the design team we have occasionally asked ourselves, what we are supposed to develop and why. To understand "why" and "what", the road goes back to the customer. The present design process has a thin path from the original user needs and goals to the place where the development takes place. The design team has become fragmented- having the Product Managers outside the core design team. The message from the user has been weak when reaching the design team.

In my studies in the Media laboratory at the University of Industrial Art and Design I have focused on learning more about user-centred system development methods, like Contextual Design, scenarios, story-based design, cooperative design and ethnographic research methods. My approach to design methods has been interdisciplinary. I have been curious about learning different design approaches and collaboration and communication tools. Instead of taking a critical approach to the theories I have greeted any practicable or sensible idea with satisfaction and curiosity.

1.4 Moment of Evaluation

The generation of the communication and design practices within the design team during the lifetime of the EAS applications are described in this chapter. The right moment of evaluation is justified by referring to the model expansive cycle of learning.

Background for the Present Communication and Work Practices

The present communication and work practices within the team originate from the early phases of the three-years´ lifecycle of EAS -services. Within the last two years several big releases of EAS applications have been launched in four different countries. People have been working hard on their new roles, facing new tasks and responsibilities. Working with a software product has been a new challenging experience for the team, since many of the persons have earlier been dealing with traditional product development and sales. System design has been entirely new for them.

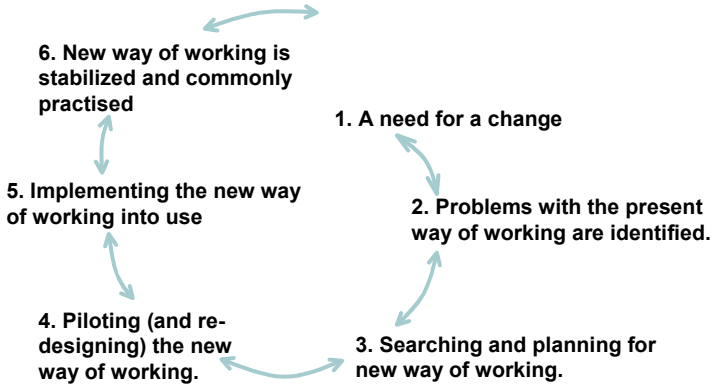
Communication and work practices have gradually been evolved. Soon after launching the services, a need was recognized to find a tool to share information within the team and to manage all the changes, like errors and change requests, in different countries. EMO database application- (EMO db) was created to meet the need of change management and collaborative dissemination. It became an efficient collaborative tool for the design team in some areas, but at the same time it set unnecessary frames on the communication. It suppressed to some degree the natural dialogue between people and knowledge-sharing within the team, while it gave the illusion that if something had been written in the EMO database, it had reached everyone's attention and been understood. During this change process we realized a need to improve our group work practices to support the collaborative teamwork and knowledge-sharing in a better way.

Time to Evaluate the Design Practices

The deficiency of the resources in the EMO-Organization as well as some sort of ineffectiveness in the design process aroused a demand to evaluate the design process and the present way the design is organised and practised. Although every team member was not aware of the problems, the need for the change had arisen.

One of the impetuses how to initiate and understand the change process was given by the picture found in the book of Muuntolaboratio (Virkkunen et.al.1999). This book deals with change processes in work communities and it presents the expansive circle of learning as a process for implementing a new way of working in a work community. This model shows the process of identifying the problem in the present way of working, proceeding to the stage where the new work practices are implemented and commonly practised. When starting to write this final thesis, the design team was somewhere between phases 1 and 2. When finalizing this work phase 4 is approached and new techniques and ways of working are being piloted.

Expansive circle of learning



Picture 1: Expansive circle of learning, Muuntolaboratorio

The principle of the model of expansive circle of learning is that employees themselves solve the problems existing in the present way of working by interpreting the meaning, scope, target and output of the work in a new way, with a wider perspective. It requires the development of new tools and rules, changing the roles and responsibilities of the persons and improving the quality of the operation. The period of progress includes breakages and crises, which have to be coped with by changing the way of working and operational principles. This is a multi-phased process including willingness and capability to plan for the new way of working. All parties must become conscious of the need for a change and see its possibilities. According to Muuntolaboratorio's model the development cycle may take several years before the new way of working is finally implemented (Virkkunen et.al, 1999)

2. Present Development and Maintenance Organization of the Application

Two of the world's leading industrial gas companies - Linde Technische Gase of Germany and AGA of Sweden - formed the international gas company Linde Gas, which operates in 50 countries. Linde Gas is the leading gas company in Europe and one of the most important suppliers of gases worldwide. AGA, a member of the Linde Gas Group, has developed and implemented various eBusiness systems in order to transact business and serve customers more efficiently. Development of some of the eBusiness applications like ACCURA Cylinder Management, ACCURA Liquid Management and Web Order services has taken place in AGA Region Europe North by the EMO organization.

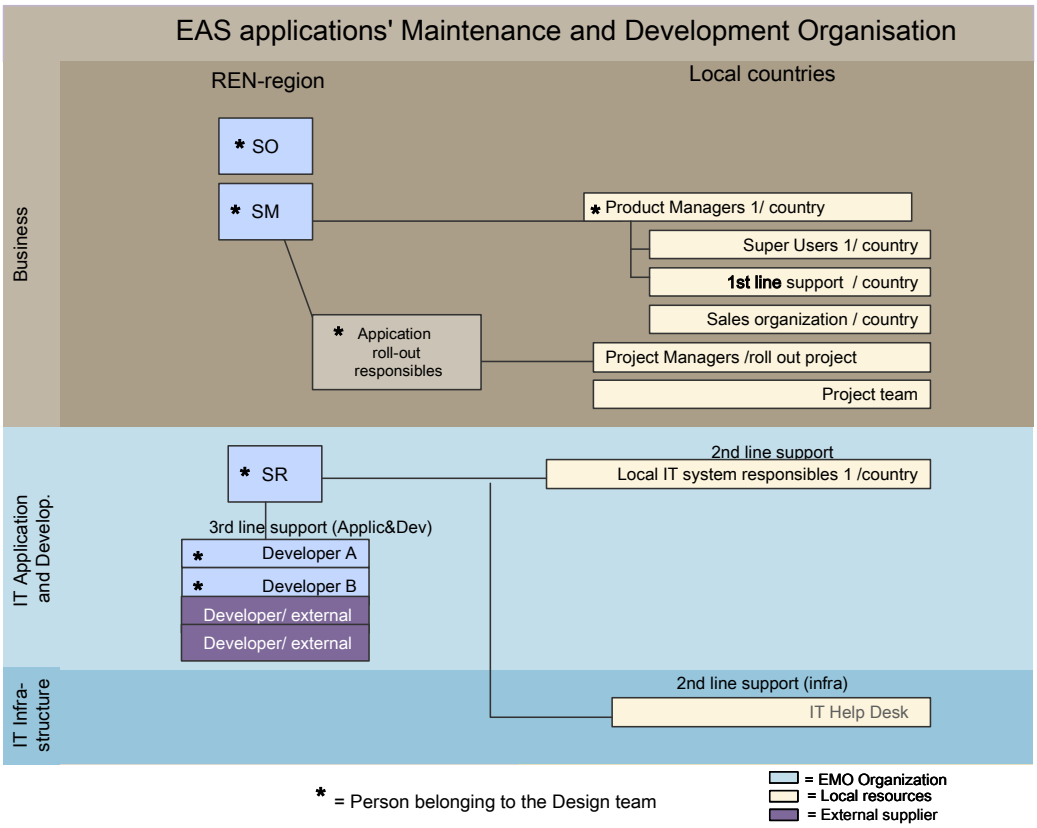
In the following chapters the factors, roles and responsibilities affecting the development and maintenance of the EAS applications are presented.

2.1 EMO Organization

The maintenance and development of the EAS is organized in a traditional way, where the roles of the persons and the organizational structure embody the traditional system administrative processes. The EAS application differs from most of the systems in AGA, being an in-house developed and maintained solution, rather than a standard software solution. The present organizational structure does not support the development process in the best possible way.

EMO (Extranet applications Maintenance and development Organization) is responsible for the maintenance and development of EAS applications in REN (Region Europe North) in AGA. This organization consists of System Owner, System Manager, System Responsible, Local System Responsible and Internal Developers. In this organization model the Product Managers, Super Users and Application Roll-out Responsibles are excluded from the core design team although they are the main links to customers. The coordination, cooperation and responsibility levels between EMO and the local marketing organizations (Product Managers and Super User) are not clearly defined.

EMO- members are physically located in different countries, which sets challenges for the daily operation of the system. Communication mainly takes place by telephone, e-mail or through the EMO db and occasionally through face-to-face meetings.



Picture 2: Roles involved in the development and maintenance of EAS applications

The present roles and responsibilities of the persons taking part in the maintenance and development of EAS applications are described below. These roles are described here as they are written in the job descriptions.

Regional System Owner (SO) and System Manager (SM)

The System Owner is a person who has the largest interest in the system and financial assets for developing the system.

The regional System Manager is responsible for managing the daily operations regarding the application and organising the system service like training, user support and operational routines. He/she initiates changes and development of the system and has an important role in coordinating and collecting the input of the user needs from local Product Managers. Both the System Owner and the System Manager are employed from the business side.

Product Managers (PM)

The local Product Manager works with both internal and external customers. He/she is responsible for achieving marketing goals and arranging the first line customer help in each country. Today their roles and responsibilities do not include being responsible for attending the system development activities in any form.

Super User

Super Users work in close cooperation with the local product manager and the local IT system responsible. They are responsible for establishing new customers as well as for the successful running of the service with established customers. They are also responsible for carrying out local acceptance testing during the system development phase. (Today there does not exist any Super Users in the organization and therefore the responsibilities of Super Users are distributed to several persons inside the team).

Regional System Responsible (SR), Local System Responsibles and Developers

The System Responsible, an IT person, is responsible for the technical functionality of the system including the programs and the IT technical support functions. She/he has also an important role in system development activities.

Developers, also from IT, support the System Responsible in designing a well-functioning system. "They are basically to concentrate on the technical solutions and will mostly be involved in new development. They strive to obtain competence within e-commerce technology." (As can be seen there is no mention of being active in making user visits to find out the real user need.)

External suppliers take part in the development and maintenance of EAS applications. The cases are ordered from the developers and the external supplier through the EMO db by the System Responsible.

eBusiness Developers

eBusiness Developer's role is to support the implementation of the roll-out projects. Their purpose is to support the business in organizing the operation and maintenance of the services in each country.

Design Team

The central actors in the design process of the EAS applications have been presented in this chapter. The need for changing the organization of the design team has been mentioned earlier as the key actors, like Product Managers, are currently not tightly integrated in the design process. The change of the organization is one of the goals of this final thesis. Further on in this document, the term design team or team stands for the group of persons consisting of the EMO organization, the Product Managers and eBusiness developers and external programmers, 11 persons in total.

2.2 EAS Application

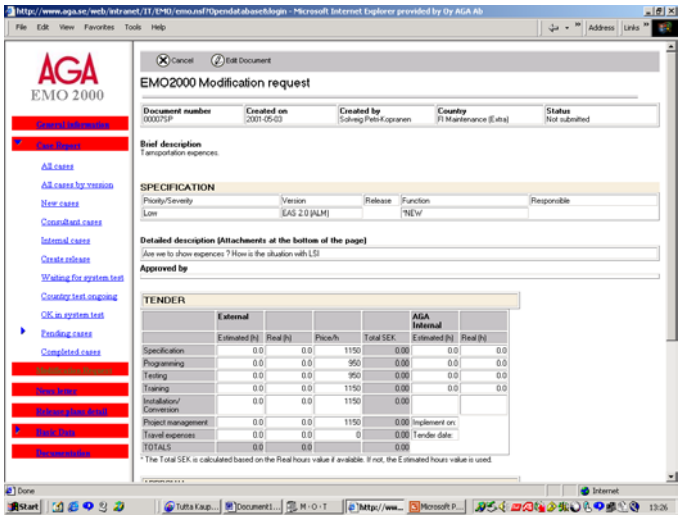
Extranet Application Software (EAS) is software consisting of three different integrated business concepts: ACCURA Cylinder Management, ACCURA Liquid Management and Web Order. This software solution is coded in Java language, which offers the advantage of being a technical platform independent solution. The content of EAS application service concepts is focused on the aspects closely related to the main function of the service, tracking, logistics of gas products and ordering. All other contents are designed to support and add value to these core functions.

The service concept consists of different functions, which can easily be packaged for different customer segments. The service concept has a modular structure, which makes it easy to integrate any of the three service concepts for the customers. Content and functionality is based on the results of the customer surveys carried out during the year of 1999.

2.3 EMO Database

EMO db was created by the need to have a tool to share information within the team and to handle the change management of the application. EMO db is a Lotus Notes based tailor-made application, which offers web access to all the parties involved in the development and maintenance. It has proved to be a very good collaborative and communicative tool for keeping the team up-to-date on change management issues.

The EMO db enables the administration and follow-up of each change request throughout its whole lifecycle. Each case has a status, which will be changed during the process. This tool supports development, planning and, cost control, as well as testing phases during the design process.



Picture 3: Screen shot of modification request template in EMO db

2.4 EAS Applications and Concurrent Activities

EAS applications are being implemented in four different countries at the moment. New "roll-out" projects are running in some new countries and new versions of the services are under development. This creates pressure for the EMO-organization, as there are concurrently several types of activities connected with the system maintenance, support and development. This has been one of the reasons for the need to change the present way of working.

3. Introduction to System Design

The purpose in the following chapters is to describe the essence of the system design and the factors that are taken into consideration in system design.

3.1 Definition of System Design

In this final thesis the system design is comprised as **a process of activities where the goal is to produce an optimal software solution for the intended users**. In order to attain the optimal solution the process has to consider the three domains of discourse: User's present work, technological options and the new system (see more in chapter 6.1).

The following chapter presents different viewpoints to understanding user's work practices and factors in good usability experience.

3.2 Functions of good usability experience

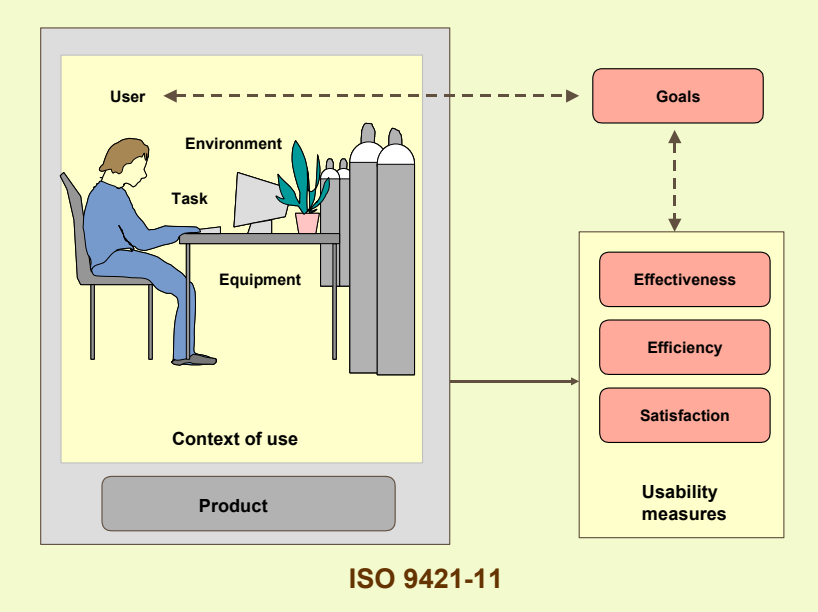
The understanding of the users´ working practices and the context of use should become the main goals in the system design. It is important to recognise and study the way the technologies are used and how they have become integrated into the user's work. The context of use is a compound of users, tasks, equipment and physical and social environment in which the system is used. In the user-centred design, the understanding of the context of use is the cornerstone of the design.

> *If usability is a function of user, task, and environment characteristics, and principles of good dialogue are also dependent on these same characteristics, it seems likely that techniques to support design should also consider these elements. (John Karat in Scenario-based design, 1995)*

The ISO standard 9421-11 defines the usability of the product in the following way:

> *Usability: the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.(ISO standard 9421-11)*

In the process of software development it is crucial to study and understand the context of use of the system.



Picture 4: The picture describing the elements of the user's work (picture 4) has inspired me and given an insight into understanding the functions of good usability experience. As the picture is descriptive and easy to interpret it has been used as one of the guiding principles throughout the whole change process in the EAS design team.

According to ISO standard, system usability comprises the learnability, effectiveness, efficiency and satisfaction with which specified users can achieve specified goals in a particular environment, where:

- **Learnability** measures the time taken to get accustomed to the system and its operation and how easy it is to remember operational details
- **Effectiveness** measures the accuracy and completeness of the goals achieved;
- **Efficiency** measures the accuracy and completeness of goals achieved relative to the resources (e.g. human time and effort) used to achieve the specified goals;
- **Satisfaction** measures the comfort and acceptability of the system to its users and other people affected by its use.

The left side in the picture describe the factors that are affecting the usability experience of the user.

- **Context of use**: The users, tasks, equipment (hardware, software and materials), and the physical and social environments in which a product is used.
- **Work system**: A system, consisting of users, equipment, tasks and a physical and social environment, for the purpose of achieving particular goals.
- **User**: The person who interacts with the product.
- **Goal**: The intended outcome.

- **Task**: The activities required to achieve a goal. These activities can be physical or cognitive. Job responsibilities can determine goals and tasks.
- **Product**: The part of the equipment (hardware, software and materials) for which usability is to be specified or evaluated.

4. Design Processes in System Design

The purpose of this chapter is to present alternative system design processes. First the reader's attention is drawn to the differences in the traditional waterfall model and user-centred system development process models. Later in the following chapters more focus is on describing the user-centredness and how to increase it in system design.

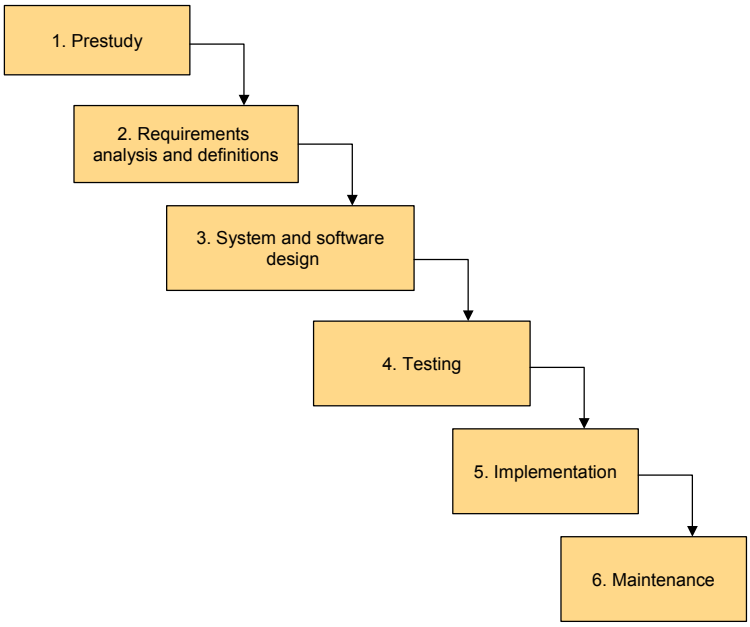
Although the system development projects can be managed in several ways they generally consist of similar main processes such as **requirements gathering, design and implementation**. These main phases can be recognized in all the approaches presented in the following chapters. The main differences in these approaches are the iterative nature of the design process and the focus on user involvement in the design process.

4.1 Traditional Waterfall Model

The traditional view of software engineering characterizes the development of software in a linear fashion. This type of software production is often called the waterfall model in which each stage passes on its results to the next, and once the pass-off has been made (once you are over the edge of the waterfall), there is no turning back. The problem with the waterfall model is that the design is really an iterative process and the waterfall model does not support the nature of design. Iterative design means rapid prototyping, working with the users, modifying and iteration of the design solution until it meets the user requirements. The traditional waterfall model does not support this iterative process of design (Norman, 1998)

Preece claims that it is impossible to completely understand and express user requirements with waterfall model until a fair amount of design has been undertaken (Preece, 1994). This process model is missing a user-centred approach and it does not integrate knowledge and expertise from the different disciplines as e.g. methods from ethnographic research.

One of the problems with the waterfall model is that the evaluation is often done at the end of the process. In the recently presented models the evaluation is in a central position throughout the design process.

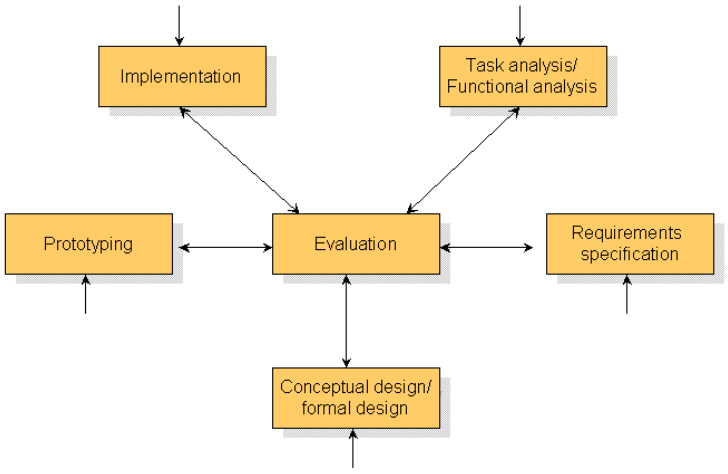


Picture 19: Waterfall model

4.2 Star Model

The star model, created by Hartson and Hix in 1989, emphasizes that an ordering of activities during the design process is inappropriate. According to Preece this model takes the idea of prototyping and evaluation much further than any other approach. Evaluation has a significant role in this model. All aspects of systems development are subject to constant evaluation by users and by experts. The process involves much more iteration than the traditional waterfall model.

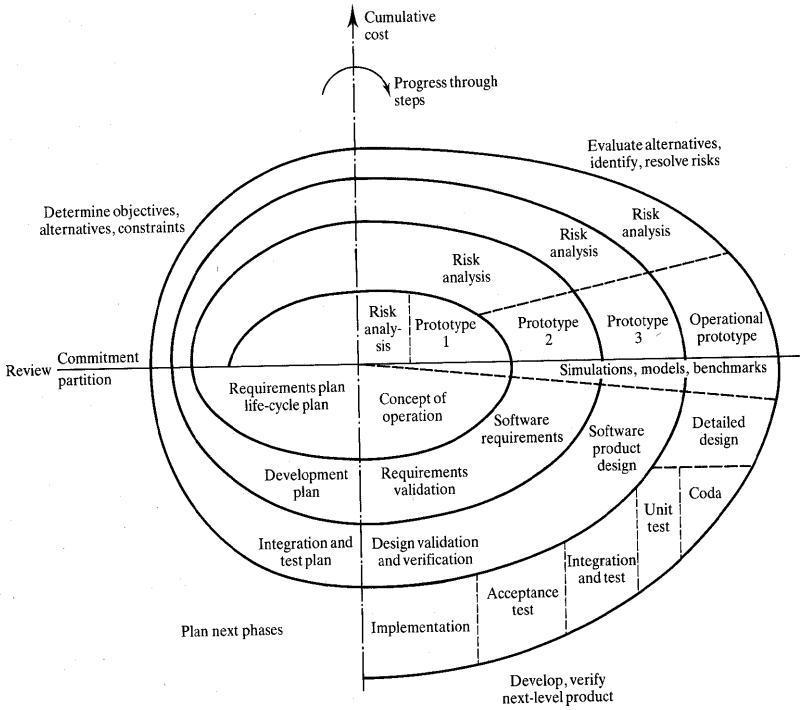
In the star model system development may begin at any stage (see the entry arrows) and may be followed by any of the other stages (see double headed arrows).



Picture 20: The star model by Hartson and Hix, 1989

4.3 The Spiral Model of the Software Process

In the spiral model the Barry Boehm has integrated the main processes of system development with the iterative processing of prototyping. The iterative prototyping can be seen as a sign of user involvement in the process, where the prototypes are evaluated together with the users or as a sign of increasing knowledge in the design team, where the final shape of the design is gradually developed from the various prototyping phases.



Picture 21: Spiral model of software process (Boehm, 1988)

This model presents the iterative character of the design process in a descriptive way but it is quite difficult to interpret your exact location in the process. Therefore its interpretation is much more complex than that of the waterfall model.

4.4 User-Centred System Design

This chapter presents user-centred approach including Participatory Design. Chapter 4.4.1 describes the traditions of Participatory Design approaches and chapter 4.4.2 shows how the ethnographic research methods are applied in system design. Some examples of the user-centred design processes are also given later.

4.4.1 User-Centred Traditions

The integration of traditional design methods with the methods adopted from the social sciences is relatively new. Design firms began experimenting methods used in social sciences in the early 1980s. A large variety of user-centred design methods were introduced in 90´s. The principle "know the user" is one of the oldest and widely accepted principles in the design of computer-based applications. Ethnographic techniques introduced to system design in the early 90´s provide a framework and methodology for helping designers gain this additional knowledge about users and their work. Most of the user-centred design methods like Contextual Design, Cooperative design, User and Task Analysis and other Participatory Design emphasize knowing the user and designing "for" and "with" the user.

Traditional system-centred designs have often been too technical (flowcharts, dataflow diagrams, programming languages etc.) for cross-functional design teams, where most of the team members have no technical background. *User-centred design approaches have introduced new useful and demystified tools for design teams to work and communicate with.* These tools facilitate the communication and collaboration within the design team and with the users. The comprehension of the design process has expanded to comprise the process as a social process (e.g. Carroll (ed), 1995, Erickson, 1995), where the users are involved and studied during the design process.

The participation of the users in the design process is emphasized in the Participatory Design (PD) approach, which is one of the research approaches among user-centred design. The traditions vary on how the users are involved in the system design. In some PD approaches the users attend the design projects as full team members and in other approaches the participation of the users is limited to providing the designers with information on the user's work, his behaviour, experience and skills. Because PD practitioners are diverse in their perspectives, backgrounds, and areas of concern, there can be no single definition of PD. It is rather a family of approaches where the user participation is emphasized.

In PD approaches the users are respected as experts of their own work. By participating in the design sessions, the users give valuable information to the design team and the team does not necessary have to make comprehensive field studies to find out the user requirements. This is an easy way to obtain relevant information on the user requirements on the required level. Of course, there are also risks of having only a few users to represent a larger number of users. Therefore, the selection of the users taking part in the design process should be carefully planned.

The PD approaches also emphasize the fact that the systems should be studied from a wider perspective, not just from the technological viewpoint. The system should be seen as "networks of people, practices, and technology embedded in particular organizational context" (http://www.cpsr.org/program/workplace /PD.html). Understanding the organizations and their work practices is one of the bases in the PD approaches.

Numerous tools and techniques have been developed in the PD area recently. They have been designed to promote the attempts to

understand the user's work and the factors affecting the work practices like technologies, materials and environments. Techniques e.g. Future workshops, mock-ups, scenarios and cooperative prototyping are typical PD techniques. More systematized design practices with an ensemble of tools and techniques (sometimes criticized as "cookbook" approach) are represented by the Contextual Design approach (Beyer & Holtzblatt,1998)

4.4.2 Ethnographic Approach to System Design

> *Where the technologies are designed at a distance from the situation of their use, as most are, there is an inevitable gap between scenarios of use and users´ actual circumstances (Suchman & Trigg, 1991).*

The principles of an ethnographic approach imply that users should be observed in the place where the work is actually done. According to the ethnographic conception a user's behaviour can only be understood in the everyday context in which it occurs. Observers should describe the actual behaviour of users and not how they ought to behave. The ethnographic approach therefore concerns understanding people's behaviour in the context in which it occurs and from the point- of view- of the people studied (Blomberg et.al.,1993). Understanding users requires a combination of observation, informal interviewing, and participation in the ongoing events of the community.

Challenges in Applying Ethnographic Approach

Observation of the user is not an easy task for the design team and it is necessary to train the design team to practise new ethnographic interviewing and observing skills. It has been discussed within the ethnographic and system design sciences whether it is possible to train the design team to learn ethnographic research skills or whether the field studies should be carried out by professional ethnographers. Helena Karasti points out in her doctoral thesis that "typically ethnographical field studies are conducted by professional ethnographers or field researchers as the fieldwork is hard work requiring training, particular skill and experience in considering a multitude of interrelated issues". On the other hand she agrees that even getting out to the "real world" and attempting to understand the context of use would increase sensitivity towards work practice in plenty of design projects, but maintains that an analytical mentality should also be aspired to (Karasti, 2001).

All in all it is important to achieve a profound knowledge of the user's work and this understanding requires an analytic approach to study the user's work practices and learning of new skills. In practice it may not be possible to employ a consultant to carry out the field visits and therefore the implementation of the new design methods with ethnographic approaches has to be carefully considered and proper training has to be arranged.

My starting point has been that any field visit where the users are observed and interviewed, regardless of whether it is conducted by professionals or non-professionals, is better than no field studies or user involvement at all. Integrating ethnographic approach in system design is certainly challenging and the quality of the field studies and the analysis of the findings might not be as extensive and correct as those conducted by professionals. *I am aware of the challenges in carrying out field visits but the few visits of the designers to real customers that we have experienced have proved to be incredibly motivating, giving a more comprehensive view of the work of the user and making the user's work and his needs more concrete*. It has been comforting to read from Karasti's conclusions that "Though system designers are probably not capable of producing analytic explications of work that would satisfy all demands of social scientists there is still possibility in the plurality. It is counterproductive to repress those attempts that try to break disciplinary boundaries and adopt something new as in them may be the seeds and sprouts of change."

This thesis does not describe and analyse the process of practising user and task analysis in the field studies, as it would have been too challenging a task for the team at this stage. It remains to be seen in what way the field studies are to be conducted in the future, how the customers work practices will be studied and to what extent the users are involved in the design process.

4.5 Examples of User-Centred Design Processes

The user-centred system design processes consist of the same main phases (requirements gathering, design and implementation) as the models presented earlier. The difference from the traditional system development is the increased weight of user involvement and the iterative nature of the design process.

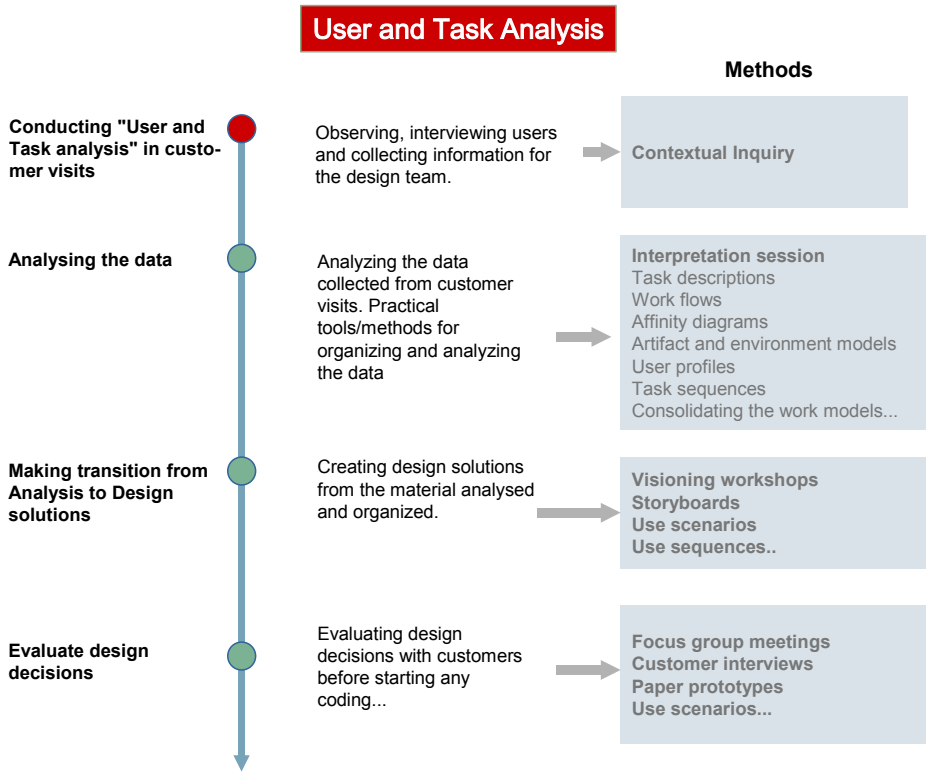
In this chapter the purpose is to present two different examples of the user-centred design process models. The first example is a typical user- and task- focused process, where field visits with observing and interviewing sessions are conducted.

The second model is an example of a participatory design process, where the users are part of the design team and they actively participate in system development. This process gives a more comprehensive picture of the whole design process and its interface to the company strategies and project management. It is not a typical example of a participatory design process, but it is presented in this chapter due to its interfaces to the practices in the companies

4.5.1 User and Task analysis Process

In an ideal situation the requirement analysis of the new design are based on thorough user and task analysis from the field visits to real customers. In this chapter a simplified picture of the phases encountered in the user and task analysis process is presented. The main phases comprise conducting the field visits, analyzing the data

from the field visits, the transition from analysis to design solutions and evaluation of the design decisions.



Picture 5: User and task analysis process (visualization by Tutta Kauppila)

The process of user and task analysis is briefly explained below. The tools and techniques practiced during the process are specified in more detail in chapter 5. The process is not as linear as it looks like. In practice several phases are activated in parallel and some of the methods, like paper prototypes, use scenarios, visioning workshop etc. can be used in earlier phases of the process. The nature of the user-centred design process is typically very iterative.

Preparing for Field Visits

Before conducting field visits, the team has to plan useful techniques for gathering data during the visit. It is important that all team members participating in the visits know how the data will be analyzed after the visits. Preparation for the visits includes making plans for observing and interviewing users, collecting artifacts, holding artifact walkthroughs and documenting the process.

Conducting Field Visits

Typically the field visits consist of observing and interviewing users while performing their tasks. The purpose of the field visits is to increase the knowledge of the user's and user's work practices within the design team. Various techniques for interviewing and observing during the field visits are presented in the chapter 5.2.3.

The purpose of the field visits is to understand:

1) what users´ goals are; what they are trying to achieve
2) what users actually do to achieve those goals
3) what personal, social and cultural characteristics the users bring to the tasks
4) how users are influenced by their physical environment
5) how users´ previous knowledge and experience influence what they think about their work and their workflow when performing their tasks
6) what users value most that will make a new interface a delight for them

Picture 6: What to find out during the field visits.

Analyzing the Data from the Field Visits (Interpretation Session)

The design team needs to have some concrete starting point for the analysis and evaluation of the work practices of the user and the design of the new solution. The material collected from the work place artifacts, photographs, tape-recorded interviews or video material stimulate a deeper analysis of the work practice and facilitate a wider understanding of the user needs within the design team (see also chapter 5.2.3). The data collected during the field visit is analysed in design workshops (e.g. in the Contextual Design method the workshop is called Interpretation session). The purpose of this workshop is to spread the knowledge of the users and their work practices to the whole design team and to analyse the material and experiences from the field visits.

Analysis of the field visits can take the shape of work models, environmental and social models, task flow charts, user profiles, task scenarios, affinity diagrams, artifact analysis etc. In this final thesis only some of these models (e.g. scenarios, artifact analysis) are explained in more detail.

Making Transition from Analyses to Design Solutions

The design solutions are based on the knowledge of the user's work practices and on the findings of analysed data. Sufficient information on the users, their environment, goals and tasks, facilitates finding the new design solution. Various tools and techniques promote to find optimal design solutions. These tools can be scenarios, prototypes, visioning workshops, storyboards etc.

Some of the above mentioned methods and additional techniques are introduced in more detail in chapter 5.

4.5.2 MUST process - an Interface to Company Practices

In this chapter the purpose is to present a process of one PD approach called MUST method. The reason for presenting this method as one of the examples of design process models is its family resemblance to the practices in handling the projects in the companies. *It is very seldom that the ethnographically approached user-centred methods give any practical guide for how to bridge the design process and the company guidelines, IT strategies and other activities.* In the principles of the MUST method the link between the design activities is emphasized, which is not typical in other user-centred approaches. MUST is originally designed for software development inside the organizations the system is to be used but most of the principles of the method are adoptable in EAS development too.

The MUST method is based on six principles:

1. Ensure the participation of the users in the process.
2. Link the design activities and project management.
3. Organize design as a communicative process.
4. Combine ethnographic techniques and interventions.
5. Co-develop IT, work organization, and users' qualifications.
6. Make design a first step in introducing sustainable IT.

Some of these principles have been the guiding themes in changing the way of working in the EAS design team (see the design principles defined in the chapter 8.2.1 and the new design process in the chapter 9.)

In the MUST method, presented by Bødker, Kensing and Simonsen, the design process is constituted by five main activities:

- project establishment
- strategic analysis
- in-depth analysis of selected work domains
- developing visions of the overall change
- anchoring

In the first activity the purpose of **project establishment** is to "clarify and negotiate the aim, level of ambition, scope, and conditions of the project." This is a general way to start projects in AGA, too.

The **strategic analysis** is carried out to clarify and delimit which work domains should be in focus in the design project. This analysis takes the strategic plans of the company, IT strategies, market surveys etc. into consideration.

The purpose of the **in-depth analysis** is to "reveal and develop an understanding of the rationale behind current work practices." This can be achieved by interviewing and observing the users, analysing the artifacts (e.g. documents) used in the work practice, asking the users to "think aloud" while observing the users, carrying out Future Workshops and conducting workshops making collages/wall graphs of current work practices. These in-depth analyse methods are more detailed presented in the chapter 5.

The purpose of developing visions is to **develop ideas and visions**, and form these into one or more coherent visions. The visions should not only deal with functionality of the suggested system, but also include organizational changes and alterations in the qualifications needed by users.

Anchoring the visions is a way to ensure that managers, users, and technical and organizational implementers understand the rationale behind the overall design.

This approach in the design process is more integrated with the company business- and IT strategies than most of the ethnographic design approaches in general.

5.0 Tools and Techniques in System Design

The user-centered design approaches with different tools and techniques, which have been considered beneficial for the design team are presented in the following chapters

In the first chapter I describe my approach to the design methods in order to explain the reasons for concentrating on certain kinds of tools and techniques in this final thesis (see also chapter 1.2). Next the reader's attention is drawn to understanding the user's, their work practices and the context of use in a deeper level. In chapter 5.2.3 I present observing and interviewing techniques for reflection of the work practices. Later in the following chapters I present various tools and techniques e.g. prototyping, scenarios, video records for facilitating the system design within the design team and with the users.

5.1 Approach to Design Methods

The selection of the design theories is based on the principles of an easy adoption process by the team and the facility of the communication and collaboration both inside the design team and with the users. The suitability of the techniques has been evaluated in respect of the team's reception and their ability to cope and practise the new methods. Most of the techniques presented in chapter 5 (e.g. prototypes, scenarios and visioning workshops) can easily be practised even with minimal introduction and training. Some of the techniques, such as observing and interviewing as well as analysing the material collected from the field visits, require more training and practicing and therefore their usage needs to be evaluated case-by-case.

A few methods are experimented during this change process in order to avoid overloading team members with new techniques and theories, and thereby try to maintain a positive attitude towards the change process. Therefore only some of the techniques have been experimented during the time of writing this final thesis.

The selection of the design methods has also been based on the need to increase the user involvement in the design process. The EAS applications are task-centred solutions and therefore it is of high importance to understand the user work practices and needs. The presented design methods have been chosen mainly from the user-centred system design disciplines.

The material introduced in this final thesis has been used in several ways during the process, among other things as training material in the workshops and instruction material in the functional specification template. Therefore the basic principles of the design methods have thoroughly been described in this document in enable their use as the training material, too.

Modifying the Approach to Design Methods for the Team

> *If the state of mutual respect and commitment can be achieved within the team, the design can succeed with this viable team having the variety of skills and a great variety of personalities. (Carroll , 1995)*

The heterogeneity of the team and the inexperience of the Product Managers in design perspective had to be considered at every turn; when planning the workshops, presenting the design theories, defining common terminology, improving the communication inside the team and planning the new design process etc. We recognized the challenge Liam J. Bannon writes about: "This necessary heterogeneity poses a number of problems which cannot be removed simply by ensuring good communication between the differing groups. The issue is more fundamental, arising out of the different practices of the groups and the essential incommensurability of their world views and language." (Bannon,1994).

It became evident that although the team members seem to have the same goal of offering good services to the customers, issues like organizational roles, responsibilities and organizational practices, technology, terminology, regional and local country aspect and even cultural differences appear to create unnecessary barriers between persons and issues. Therefore more focus had to be put on creating communicational and collaborative means for the team. This became a learning process, which takes time and cannot fully be implemented in this phase where the new design process ideas were practiced within this design team for the first time.

The heterogeneity was not just considered a limiting factor but a positive thing for the team, because it makes it possible to extend the diversity and skills of the team and strengthen the essential link between the users and the design team.

Pragmatic Approach Towards Design Techniques

> *Most traditional systems development methods are too abstract and detached from the work and life of most people. Traditional tools used in system design such as flowcharts, dataflow diagrams, and programming languages are useless when we try to cooperate with users (Brødker, Grönbæk, Kyng, 1993).*

In this final thesis the approach to different design techniques is pragmatic and "feet on the ground". User-centred design methodologies in Participatory Design (PD) area have been the main focus in this excursion. Some ideas have been adopted from human computer interaction (HCI) and activity theories. Traditional and less traditional system development theories have been evaluated.

The wide area of design methods has only slightly practiced in this final thesis. My approach is based on the reality of knowing the existing abilities and skills of the team and the limited time resources team members have for these activities beside their other

responsibilities. Therefore training the team to become experts in observing, analysing user behaviour and interviewing customers is impossible. Within this framework easily adoptable and practical tools are needed to improve the design quality.

5.2 Designing for Work Practice

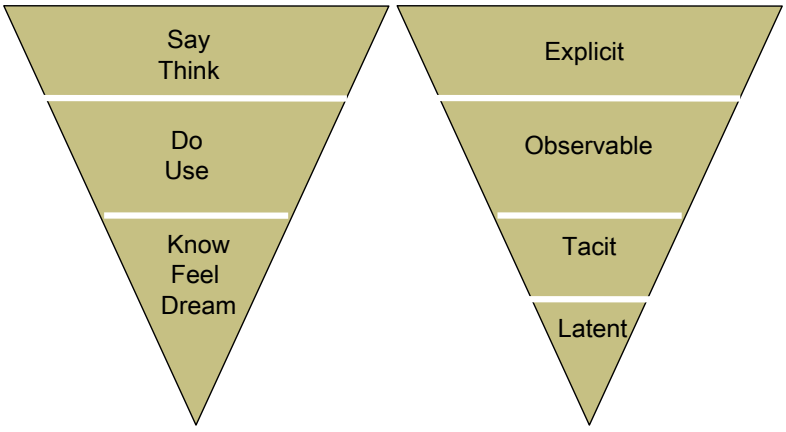
In this chapter our attention is drawn to the users and their work as well as to the functions of the context of use with a more profound approach to understanding their diversity.

5.2.1 Understanding Users

Discovering the needs and dreams of the users is vital to the design process and it should take place in the location of the system is used.

> *"Particular behaviours can only be understood in the everyday context in which they occur" (Blomberg, Ciacomi, Mosher, and Swenton-Wall,1995)*

We need to understand the levels of customer behaviour in order to be able to find out customer needs. Elizabeth B.-N. Sanders describes in the human behaviour and how the behaviour is visible to us in her article *Post design and Participatory Culture*.



Picture 7: Accessing experience. (Sanders, 1999)

Listening to people does not give explicit information on customer needs. The customer may select words according to the listener or may be unable to express himself. It is commonly experienced and written in various research papers that users themselves are not capable of articulating their needs or doings especially if they are very familiar with the tasks they perform. Users ignore activities in their normal routines. They report on their beliefs rather than on truths. Customer needs are often hidden and difficult to find using traditional market research (through focus teams, interviews, and questionnaires)

methods. The ability to not just know, but also to empathise with the user, comes only at the deepest levels of their expression (i.e. tacit and latent knowledge). Understanding human behaviour and accessing people's feelings, dreams and imagination, can really establish resonance with them. (Sanders, 1999)

Knowing the user is a simple idea, but often a difficult and undervalued goal. According to Ben Schneiderman the process of knowing the user is never ending because there is so much to know and the users keep changing. Every step in understanding the user is likely to be a step closer to a successful design. Knowing the user is not just important when designing a new system but also when new functionality is brought to the old concept (Schneiderman, 1992)

The profound understanding of the users and their work is based on selecting the right kind of users with whom to conduct field visits. The usage of the system differs depending on the tasks and responsibilities of the users. When selecting users for observation the design team has to carefully consider what type of users to interview and monitor in order to get an overall picture of their work practices. The users should be representative of the majority.

The limitations of the users are understandable as the users have thorough knowledge of their own work practice but they do not necessarily know the work activities of the others. Helena Karasti claims that the users views are necessarily partial; the workers see and know the work practice from within their situated positions and according to their occupational points of view (Karasti, 2001). By interviewing and monitoring different types of users the design team can obtain more accurate information.

Users may differ considerably from each other, some being novice and others expert users. When planning a field visit it is preferable to monitor both novice and expert users in fluent work activity situations as well as in conflict situations. Paying attention to everyday routines is as important as learning from problem situations.

5.2.2 Understanding Work Practice

> *Armed with knowledge of user work practices gained through direct observation of users at work, designers are in a much better position to accurately, and more fully, incorporate users´ perspectives in the design, with the potential of improving existing products as well as identifying opportunities for new products! (Blomberg, Giacomi, Mosher and Swenton-Wall,1993)*

The work is often mediated by the technology. In order to design a system that intensifies and extends the work practices of the user, the design team has to have a profound understanding of the users working practices. It is important to study the "intimate relation" between work and technology to understand the way the technologies are used and how they have become integrated into the work (the term "intimate relation" is introduced by Karasti, p.32). Participatory Design methods aim for understanding the nature of the user's work. These

techniques elicit the structure of the work, revealing the tasks and actions the user takes in order to accomplish the goal. To understand the context of use and the user's work, it is important to make field visits to the users´ premises.

The Field Visits Revealing the Structure of the Work

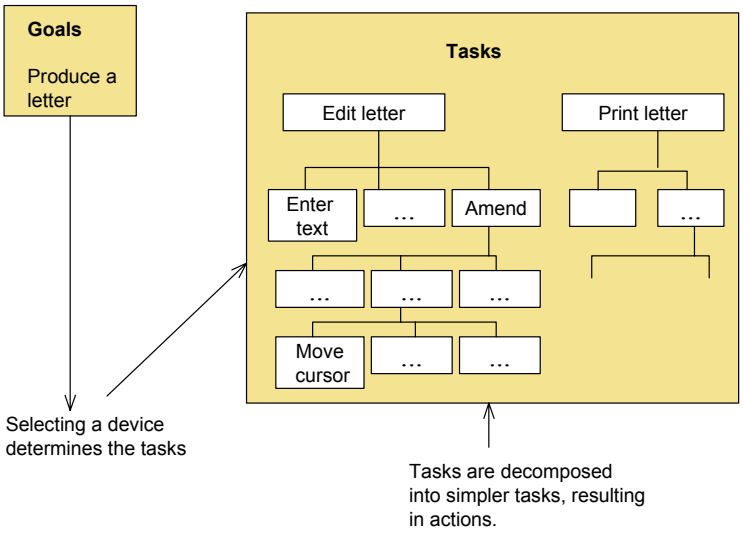
The field visit techniques, as a basis for the system design, have been extensively studied in recent years. New ethnographic techniques (e.g. Contextual interviews, User and task analysis, work practice analysis with videos etc) have been applied to system design to help to reveal the structure of the routine way of working and also give valuable information on how the user deals with exceptional circumstances or emergencies. The typical system design approach is to emphasize the problems and disturbances of the work instead of paying attention to the current work practice. Karasti argues for the importance of understanding "the analysis of work as unfolding practice, i.e. including both the routine ways of working and the problematic instances encountered and handled as part and parcel of everyday work. ...the problems encountered in work may seem more easily detectable, but through users [Karasti used the word practitioner] participation in analysis also the routine ways can be identified which contributes to broadening the narrow problem-solution oriented interest of system design". (Karasti, 2001)

One interesting issue to study in the field visit is the "workarounds" the users create in their work, if the system is not supporting the work in a wished way. These "workarounds" may have become the routine way of working and the user does not pay much attention nor does he consider them as problems. These workarounds, though, give the designers new ideas for further development of the system (Nielsen,1993).

Structure of the Work Practice

In order to understand the work practices of a user, the structure of his work must be familiar. The picture below describes the structure of a task and its relation to the user's goals. The designer should not only monitor the user's working, but he should also aim at understanding the user's goals.

A goal is a state the person wishes to achieve.
Tasks are what the human has to do (or what he/she thinks needs to be done) in order to accomplish a goal.
A task is a structured set of activities in which actions are undertaken in some sequence. An action is defined as a task that involves no problem solving (Preece, 1994).



Picture 8: High-level task actions can be decomposed into multiple middle-level task actions that can be further refined into atomic actions that the user executes with a single command. A general model for task analysis (Preece,1994.)

5.2.3 Variety of Observing and Interviewing Techniques

In this chapter the purpose is to describe various observation and interviewing techniques that can be applied during the field visits to customers.

Observation

One of the commonly known field visit techniques is Contextual inquiry (Beyer & Holtzblat, 1998), which is basically a structured field interviewing and observing method. It is a method for learning about ordinary users by observing them in action. It concerns visiting customers, observing and interviewing them when performing their tasks and sharing the knowledge of the customer with the team.

Contextual inquiry is based on three core principles: understanding the *context* in which a product is used (the work being performed), the user as a *partner* in the design process, and the design process, including assessment methods like contextual inquiry and usability testing, must have a *focus*. During the contextual inquiry the cross-functional design team conducts field interviews with customers in their workplace to discover what is significant in the work. Team members observe people as they work and try to understand their motivations and strategy. The interviewer and customer, through discussion, develop a shared interpretation of the work.

It is commonly known that people's sayings and doings do not always correspond. For that reason, observing people in their own

environment is essential. The observer often takes a role of "a fly on the wall" or he can actively participate in the users´ work and learn the work from a different perspective (insider).

One of the interviewing techniques is the "think aloud" protocol. This technique involves having one test user at a time and the observer. The user is asked to "think out loud." By verbalizing their thoughts, users allow an observer to determine not just *what* they are doing with the system, but also *why* they are doing it. This gives the observer additional insight into the user's thought process.

The focus of the observation has to be decided beforehand and the observational methods and strategies have to be established before the field visit. Observation can be focused on some event (event focus), or a particular individual in their daily routine (person focus), or the working environment (place focus) or equipments or artefacts that are linked to the work (object focus). When have you observed enough? The general principle is that "when you're no longer surprised by what you're observing, you've probably seen enough" (Blomberg et.al, 1993).

Interviewing

The purpose of interviews is to obtain information from the user by asking questions and listening to users. There are various interviewing techniques that can be combined in a typical field visit. The book User and Task analysis by Hackos and Redish specifies the techniques as follows:

Interviewing techniques:

- probe for information while the user is performing the task **(concurrent contextual interviews)**
- record what the user does and talk about it immediately after the user completes the task **(immediate recall interview)**
- record what the user does and talk about it sometime later, perhaps while you and the user watch parts of the videotape **(cued recall interview)**
- interview users individually or in groups to understand an entire process or work flow **(process interview)**
- interview one user first (as a key informant) and then later interview others and conduct observations with discussions during the observation **(ethnographic interviews)**
- collect artifacts from the user and construct and interview around the artifacts, particularly about differences in the way the user dealt with seemingly similar artifacts (cued recall interview or discourse-based interview; **artifact walkthrough**)
- interview users about specific situations when you cannot observe them **(critical incident interview)**
- interview users individually or in groups about attitudes, desires, preferences, experience etc. **(group interview or focus group)**
- interview users away from their work sites with examples of their work as stimuli for the discussion **(usability roundtables)**
- work with a group of users over time with interviews as one of the techniques **(customer partnering)**

Observing and Interviewing with the Help of Videos and Cameras

A useful extension to "think aloud" protocol is to record the session with a video and review the session together with the user (Ford & Wood, 1996). An opportunity to use a camera or a video would help the documentation task during the field visits. The statement "A picture is worth of thousand words " may hold true in this case, too.

I became interested in video-assisted field visits after reading an article on ethnographic field methods by Blomberg J, Ciacomi J, Mosher A, and Swenton-Wall P and Helena Karasti´s doctoral thesis (Karasti, 2001). As the EAS applications are implemented in different countries, the profound understanding of the users´ local differences concerning work practices, organization and culture is important. We have experienced difficulty in explaining how the users perform their routine tasks, not to mention the unexpected problem situations the users frequently encounter. The use of a video camera could be one solution for facilitating the communication within the design team.

The use of video cameras in ethnographic research and system design has been increasing. Video has been used as a medium for the reflection of the work practice and design. It has been used during field studies for recording work practices and interviewing purposes, and in various ways in workshops (e.g. WPSED workshop introduced by Karasti) during the system design phase (Blomberg et.al., 1993, Karasti , 2001, Suchman & Trigg, 1991). Video recording can be used to complement and extend conventional methods for data gathering. Human activities unfold so fast that it is impossible to capture by observation alone. Field notes have their limitations, as it is difficult to explain in words the complexity of the user activities and work practice. The video camera captures these actions and they are available for viewing and analysis.

Another advantage of the video, according to Karasti, is that the recorded field visits can be reviewed for the design team. The tape can be viewed and analysed by a wide range of people. It is a more easily shareable and understandable medium for collaborative activities than e.g. graphical or written descriptions of work (Karasti, 2001 p. 87). Video can be used as one medium for presenting and explaining the work of the user's during the Interpretation sessions.

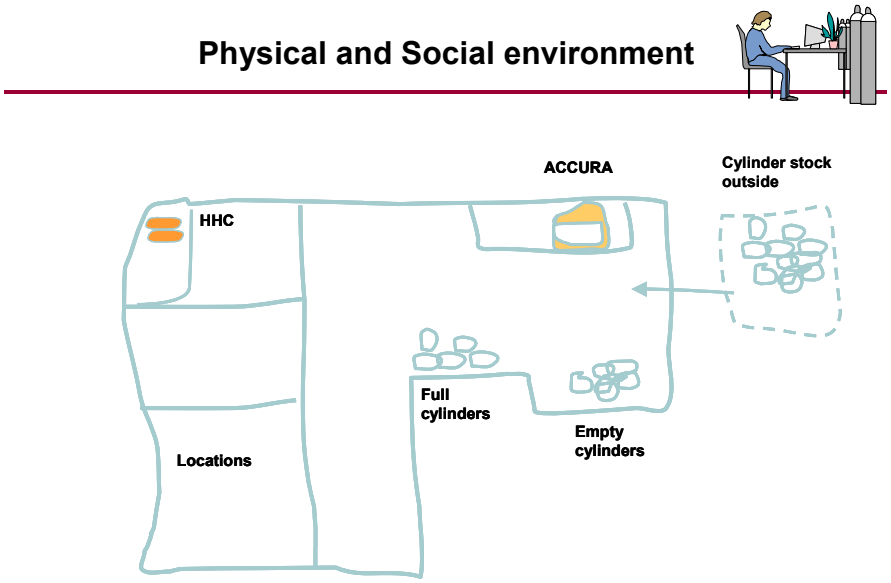
Karasti presents an idea of video collages, which offer the participants a chance to observe work practise almost *in situ*, as the work was actually performed in the workplace. Video could be one of the tools to integrate users into the design process in a convenient way. The video- taped material from the field observation sessions could be viewed together with the users and material could evoke discussions of the work practice.

Photographing, as a replacement for the video camera is another option for recording the user environment, equipment, artifacts and factors affecting the work practice. As in some cases the users are reluctant to let the field visitors watch them work (Butler M.B, 1996) they might be even more reluctant with field visitors using videos. In these cases a camera might be a less intrusive medium for recording.

I believe that *any material that makes the everyday work practice of the user visually more concrete and understandable, whether it is photographs, work model or video-taped material, and that becomes a shared object of the design team, facilitates the design process in the right direction*. I do not believe in thorough written descriptions of the work, because no one ever has time to read them. A picture, a collection of pictures or a model of the work can evoke the recollection of the work practice in an effective way. Such material can become the shared object of the design team as it is easily referred to as everyone has the picture of it "in his/her mind".

5.2.4 Equipment and Environments

Work is not performed in isolation. People are influenced by the activity around them, the physical characteristics of the workplace, the type of equipment they are using, and the work relationships they have with other people. When designing a system the physical, social, and cultural environments in which the users work should also be taken into consideration.



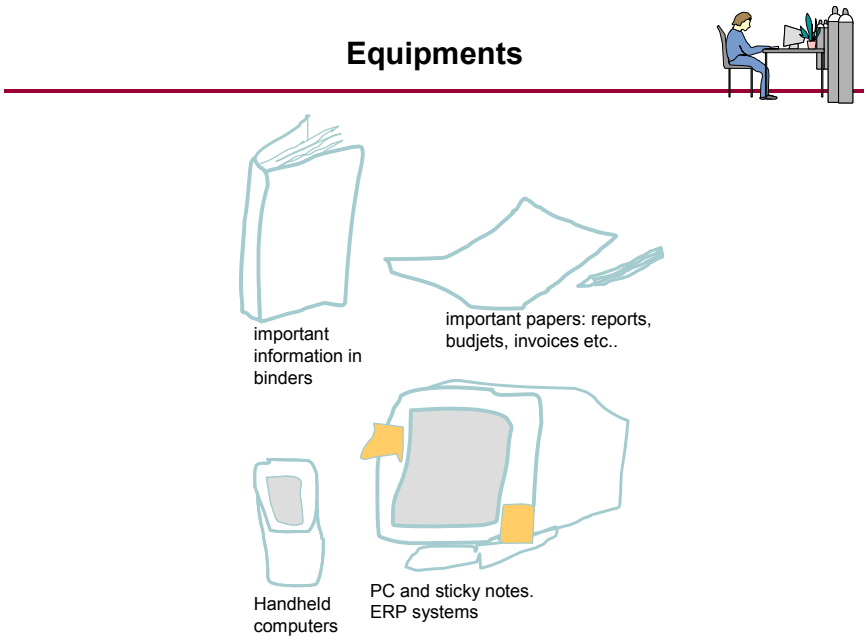
Picture 9: An imaginary drawing showing how the gas cylinders are located in the users premises.

From the EAS point of view, it is important to understand the physical distances and environments where the gas cylinders are handled and where the PC and handheld computers are placed. Knowing the physical and social environment where the system is used facilitates the understanding the problems encountered by the user.

5.2.5 Artifacts Exposing User's Work

> *" The quick phone conversations, office mail, sticky notes, etc, circulated by users of a specialized database system in a small company can be useful clues about important information tracking that the database should be revised to support" (Ford & Wood, 1996)*

Users often need additional equipment and material or information, like reports, notes, folders etc. to accomplish their tasks. The usage of these artifacts cannot be seen in the system logs and seldom do the users remember to mention these in the interviews. These small, but very important, issues can be easily missed, if not paying attention enough to what the user is doing and asking questions why the user is doing things in such way. The artifacts give the designers information on the workarounds that are normally not visible. They can lead us to new ideas and visions of future functionality.



Picture 10: Some examples of users' artifacts

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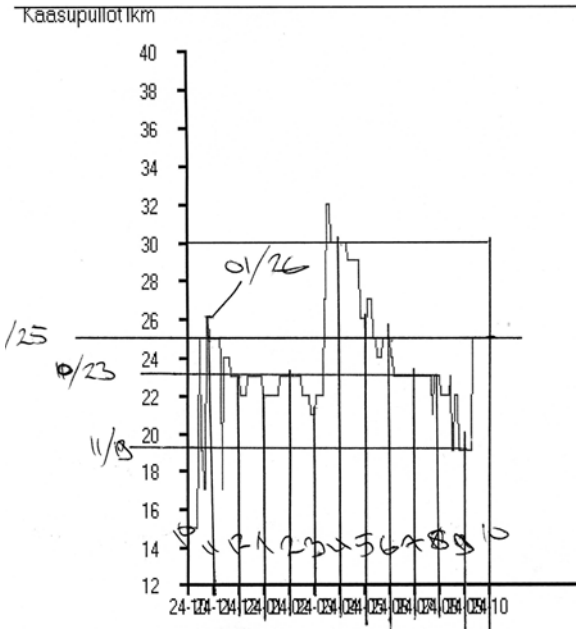
Bonnie Nardi describes the importance of the artifacts in relation to understanding human activities. According to activity theory all human experience is shaped by the tools and sign systems we use. In the activity theory, artifacts are mediators of human thought. The activity cannot be understood without understanding the role of artifacts in everyday existence, especially the way artifacts are integrated into social practice. Artifacts have been created and transformed during the development of the activity itself (Nardi, 1997).

Below I present one example of an interesting artifact that was created by one of our customers. This artifact, with other similar findings during the customer visits, has convinced me about the importance of paying attention to the artifacts.

The customer was preparing himself for a yearly meeting with an AGA salesperson. His goal was to find out how to optimise the amount of rent agreements for his gas cylinders. During the meeting the user tried to explain what information he needed to have on the system in order to accomplish his intention. EAS application did not support his goal in the right way. He had to make "workarounds" of the subject in order to get the right information off the diagram.

In the figure below is the user's artifact of one of the diagrams the system generates today.



Picture 11: The user has drawn lines and figures in order to find out the exact number of gas cylinders per month

The user wanted to know his average cylinder balance during the selected time period. In order to get the average saldo he had to take a printed copy of the report, draw lines to find out what the figures were on each month and then finally make a table of the figures and calculate the average cylinder balance for this selected time period. The user was also interested in identifying the highest and the lowest cylinder balance within the selected time period not given automatically by the system.

Picture 12: The user has calculated the average cylinder balance for the selected time period

This was a fairly simple example of user "workarounds" and artifacts but it gives us a good picture of the actions the user has to do in order to accomplish his goal. This information is never visible in the system logs and it might not easily come up in the normal customer visits.

Nielsen writes successfully in his book *Usability Engineering*:

> *See out and observe especially effective users and user strategies and "workarounds" as hints of what a new system could support! One should also identify the weaknesses of the current situation: points where users fail to achieve goals, spend excessive time, or are made uncomfortable. These weaknesses present opportunities for improvements in the new product (Nielsen, 1993).*

5.3 Visioning Future Needs

In creating a successful design the designer must also consider the future needs of the user. The most commonly known methods for generating visions, such as future workshops, brainstorming techniques and the six thinking hats, are examples of innovative ways to identify new solutions for future needs.

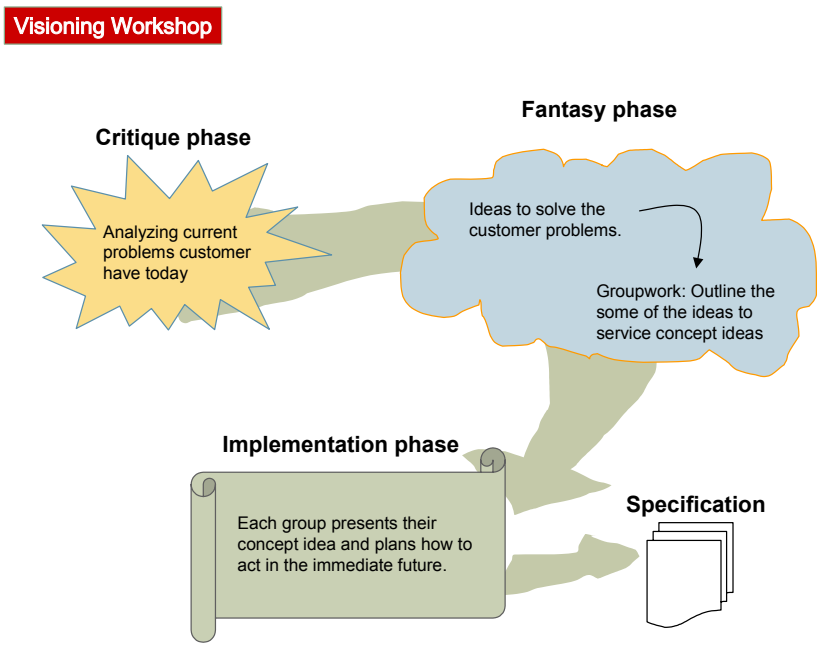
System design is often focused on the present problems of the work practices but as the users will not stay the same and their tasks tend to change, the readiness to make a flexible design is required to give a better chance of supporting users and new tasks. Visioning workshops are a good way to get the team into thinking of new functionality and further development of the system.

The following chapter is presents a visioning workshop technique called Future Workshop as originally introduced by Jungk & Müllert. There exist different variations of the technique where e.g. Kensing

and Madsen have included the metaphorical design approach to the technique. According to them, playing with metaphors in the critique and in the fantasy phase makes it easy for the users to express their relevant likes and dislikes and the use of metaphors is helpful if the participants get stuck or develop their critique or visions in too narrow a way. (Kensing & Madsen, 1991)

Future Workshop

The principles for the Future workshop technique are presented below. The workshop is held in three phases called: Critique, Fantasy, and Implementation.



Picture 13: Visioning Workshop by Jungk & Müllert (visualization by Tutta Kauppila)

In the critique phase specific issues are taken up regarding the current problems with the user's work practices. Basically, this phase is a structured brainstorming focusing on bringing up current problems that customer users have with accomplishing their work. Each participant is given a certain length of speaking time to make it possible for all the participants to speak. After the session statements from the critique phase are grouped under critique-headings / themes.

In the fantasy phase the group has the freedom to imagine "what if" the work practices could be different. In the first part of the fantasy phase critique themes from the critique phase are inverted to positive guiding themes in the line of "What if we could have instead?" Any idea in this phase is welcome! No idea is a stupid idea!

Statements (ideas) from the first part of the fantasy phase are grouped under a number of fantasy headings/ themes. In the second part of the fantasy phase some of the statements from the first phase are selected and group work is arranged round these themes.

5.4 Scenarios - Narrative Stories of the Usage

Scenarios are efficient design tools to increase the user-centredness and use-oriented perspective in system design. They are most often used in the early stages i.e. requirement analysis and design phase to describe the functionality of the system in an understandable way. They are narrative stories of what users do and experience as they try to make use of the system. The scenarios describe the actions of the user as well as the reasons for taking the actions. The purpose is to explain the user's motivations and expectations of taking the actions.

Scenarios should provide the designers with:

- sufficient information of the user's tasks and the structure of the task
- a description of the typical users
- a description of the work environment and communication structures therein
- adequate information on the user's motivations and expectations

Scenarios need not be in the form of textual narrative as in picture 14 presented below. They can also be storyboards of annotated cartoon panels, scripted prototypes, video mock-ups etc. They also can be "couched at many different levels of description and many grains of detail " (Carroll, 1995). (See chapter 8.5 where our experiences in using scripted prototypes is described).

Scenarios should be written in colloquial language and they should be as accessible and comprehensible as possible for all members in the design team as well as for the users. In this way the *scenarios facilitate communicating new design ideas* within the design team and to the users in an understandable way. They can, unlike most of the detailed specifications, be written and understood by people who have no technical background.

Scenarios are often used during design to ensure that all the participants understand and accept the design and to specify what interactions and work tasks must be supported by the system.

Use scenarios

Example of an use scenario:

Use scenario:
12.12.2002

Customer using automatic ordering functionality

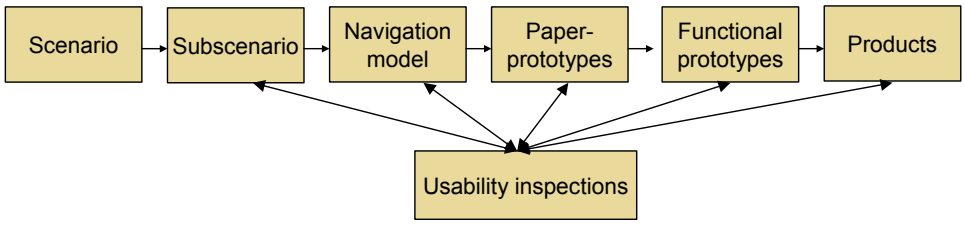
Peter has set up alarm levels for certain critical gases. One of his tasks is to make sure that company is not running out of gas. He gets an alarm to his mobilephone and mailbox when the system identifies that the number of gas cylinders go below alarm limit. This alarm is a notification for him, but if he wants to make an order for the gas, he can easily accept the textmessage or e-mail order proposal by .... and system will automaticly..

Picture 14: Example of Use Scenario. Telling stories is a natural way for a human to remember and pass on information to others. Therefore scenarios are useful from the design perspective.

Beyer and Holtzblatt claim that scenarios can help answer the question, "What does this new functionality matter to the customer?" but not "How should the system be structured for them?" One of the reasons for this is that the scenarios are often ill defined or incomplete from a system design perspective (SAP Design Guild).

One is unlikely to get a scenario "right" first time (Preece, 1994). The scenarios are often first written in an abstract way and refined iteratively to a more complete level (SAP Design Guild). Usually a scenario tells little or nothing about how objects are presented on the user interface. This is one reason why prototypes complement scenarios in a good way. The prototypes are tools to explore design issues (i.e. layout and interaction between different functions) and they bring new insights to the scenarios. When the requirements are on a very abstract level, scenarios are good tools to communicate ideas. Gradually when the focus shifts to a more detailed level the prototypes are in a central role (Erickson, 1995).

This intermingled process of prototyping and writing scenarios is descriptively presented in the product lifecycle model by Sinkkonen et. al. In this model the design process is described as an iterative process from scenarios through prototyping to the final design.



Picture 15: The product lifecycle during the development phase (Sinkkonen et.al.,2002)

Experiences in using scenarios and prototypes in designing the EAS 3.0 are described in chapter 8.

5.5 Prototypes - Making the Design Visible

> *Design should be validated through prototypes, that can provide a finer understanding of users. Iterative design methods that allow early testing of prototypes, revisions based on feedback from users, and incremental refinements suggested by test administrators are necessary to arrive at a successful system (Schneiderman, 1993).*

Prototypes are simple models of the proposed system and they simulate design ideas for the design team and the users in an easy and inexpensive way. They can be used at any stage of the design process but they are most valuable if used in the early phases of the process.

Prototypes can be done in many ways. They can be simple sketches of the system on paper or more advanced prototypes including inbuilt functionality. They can be created with paper and pencil, word processors, business slide-show presentation software (like Microsoft Power-Point), or specialized prototyping tools. The simplest prototypes are those made on paper. Their advantage is the fact that they are inexpensive to create, easy to change and they can be produced by anyone in the team. The disadvantage of them is the functionality of the proposed system cannot be experimented in real type of situations.

Prototypes Facilitating Design Ideas

Prototypes are efficient tools in facilitating ideas inside the design team and with the users, as they are something concrete and visible for the design team to discuss. Using prototypes can reveal hidden misunderstandings among the design team (Lewis C and Rieman J, 1993) and they are efficient tools in integrating the users in the design process (Bødker & Grønbæk, 1991).

The purpose of the prototypes is to simulate the design idea for the user and design team in the early phases of the design process. The design process can be seen as an iterative process where specifications and prototypes are gradually shaped into their final form. Bødker and Grønbæk recognised several learning situations, such as future work simulations, idea exploration and studying the current work, in which prototypes play a central role in facilitating the design ideas (Bødker & Grønbæk, 1991).

Prototypes, mock-ups, computer-based simulations or storyboard prototypes can also be used as communication tools to enable the design team to discuss the design solutions amongst themselves and with the users.

In our design team we have produced "low tech" prototypes with Power Point program. They have been as simple as a series of paper sketches showing the interface of how the user progresses through one task. The use of prototypes as a medium for facilitating collaboration and understanding of the design solutions within the EAS design team is described in more detail in chapter 8.5.

Cooperating with Prototypes

In the cooperative design philosophy users and designers have knowledge and skills that are central to the design of useful computer applications; therefore, design needs to be organized as a cooperative activity between the users and the designers (Bødker, Greenbaum & Kyng, 1991). According to them the customers should to be involved in the process at an early stage, long before any coding has started. Presenting and discussing the prototypes with the customers generate useful information and direct feedback of the design solution.

In cooperative prototyping both users and designers are participating actively and creatively in making the prototype of the system. In a cooperative prototyping session the users give comments on the prototypes and designers make prompt changes to them and get valuable feedback on the design. (Bødker & Grønbæk, 1991).

In the Ferronova- project in AGA prototypes were used successfully during the design phase. Design proposals were validated in reference customer meetings, where the customers gave direct feedback on the design to the designers.

Limitations in Using Prototypes

Using prototypes in facilitating design ideas is not only design conducive but they also direct the thinking of the design team, narrowing the range of design possibilities. The prototype, as the "shared object of the design team, is bound to comprise the ideas and assumptions of the designer who has created it." (Karasti, 2001) The prototypes can direct the expectations of both designers and users in a way that creates a blindness toward other and maybe better ways of dealing with the issues being considered (Bødker & Grønbæk, 1991).

Beyer and Holtzblatt write about the challenges in evoking the work practices with prototypes. It is difficult for the customer to give implicit response to the prototype of the design after a few hours' introduction. Bødker, Grønbæk and Kyng claim that to fully experience the prototype, the users need to be in control of its use for some period of time, to experiment in work-like situations. According to John M. Ford and Larry E. Wood users' reactions might also be influenced more by the form of the prototype than by their natural work context.

There are certain restrictions with the prototypes as mentioned above. Our experience of using prototypes has shown that there are difficulties in obtaining valuable information on them. The response from the user has been insufficient from a design perspective. *One reason for this has been the inexperience of the users as well as the*

designers in interpreting prototype sessions. Therefore it is again important to select the customers to participate in the design process successfully, as their participation also requires commitment to the design practises and certain abilities to reflect on the design proposals.

5.6 Prompted Reflections - Insight into User's Work

This chapter presents the Prompted Reflections technique as one possible approach to learn about the user's and their work without conducting in depth observing and interviewing sessions during the field visits. This approach is sometimes called as a "quick-and-dirty ethnographic approach" (Kensing,1998).

The Prompted Reflections technique may be used as part of any design method but Kensing presents this technique as one part of MUST method.

Prompted Reflections is composed of four main activities:

1. preparation
2. workshop
3. analysis
4. discussion of results

In the preparation phase a certain area or aspect of the work is chosen as the target of survey. A group of users are selected to participate in the workshops. The participants are asked to make a "freehand drawing on a large sheet of paper of how they see the chosen topic, tools used in various processes, and their own relationships to others in getting the job done" (Kensing, 1998). After all persons have produced their own freehand drawings of their work, they will explain their drawings to each other one at a time.

The purpose is to take advantage of the participants' reflections prompted by their drawings. The participants develop their own understanding of the work and achieve an improved understanding of the others' point of view.

The designers are looking for interesting themes, phenomenon breakdowns and possibilities for improvement from the material produced in the workshops.

The suitability of this technique for EAS development is not axiomatic. As the customers using EAS applications are from various areas of business, the amount of participants to attend the workshop is quite high. This kind of material may facilitate the understanding of the work practices at least to some degree, but interpreting the drawings might be difficult. *One of the advantages in this is the possibility to establish a meaningful dialogue among users and with the designers and a chance to understand the user's view of the work rather than making one's own conjectures of the user's need.*

5.7 Focus Groups in System Design

The focus groups originally have their roots in market research. The idea of a focus group is to gather together a group of individuals from different customer segments to evaluate products and product concepts in a discussion group format. Normally these meetings are organized to obtain information on user's attitudes and feelings and product and market opportunities.

The focus groups have also been used also in system development but their usage as a source of useful or valid design data has been highly controversial (Rosenbaum et.al., 2002). Those who do not believe in using focus groups in system design mainly base their arguments on the following limitations of the method:

- Users´ behavior is difficult to survey in focus groups. What users report on their work in these meetings may differ from their real thoughts and needs.
- Another reasons why focus groups are problematic in system design is lack of detailed information received on the work practices in the meetings. The analytic approach to the work practice is difficult to attain when the persons are removed from the actual work place into separate meeting rooms without having much stimulus to evoke thinking of the work practices.
- Focus groups might also have a "social problem" if the meetings are dominated by a few strong individuals. Some people are more outspoken than others and are likely to influence the direction and conclusions of the group.
- Developers have rarely been invited to the focus group meetings, which have mainly been market focused. From the system development point of view it is beneficial to involve the designers in the focus groups or at least offer them summarized information on the significant issues discussed during the focus group meeting.

In the following chapters I present some approaches where the traditional focus groups method is transformed into HCI method. In some cases these approaches are used to replace the need for conducting extensive user and task analyses and they embody such a "quick-and-dirty" ethnographic approach to system design, which is used by many design companies due to the lack of resources and time.

Usability roundtable, presented in the next chapter, is a method in which the users bring material related to their work to the workshop session. In the prompted reflection method, presented in chapter 5.6, the tool for reflecting the work practice is the freehand drawings of the users. Different techniques have been used in the focus group meetings to facilitate the discussions on a deeper level. Most of these methods could be easily adopted in system development of EAS applications.

5.7.1 Usability Roundtables with Users

One transformation of the focus groups is the Usability Roundtable method, which was created by the Lotus Development group (Butler M,1996). This group sought an efficient method to capture realistic information on user's and their work without conducting time- and resource -consuming field visits. Their experiences of the contextual Inquiry i.e. making field visits had turned out to be too laborious in relation to the amount of information gained.

When preparing for the session the design team carefully select the participants for the meeting and specify the characteristics of the work to be studied. The idea in the usability roundtable is to invite users to a session and ask them to bring samples (e.g. sample data, application files or printouts that are important in their work) to the session. During the session the users explain to the designers the major issues they face in their jobs and how the technology aids or obstructs them in their work. The samples brought to the session facilitate the discussions and help the designers to understand the user's work practices.

Experience of usability roundtables has been encouraging at Lotus. The sessions have been very efficient. The users have been willing to attend the sessions and the design team members have been able to meet users and share their view of the work in an easy way.

5.7.2 Techniques to Evoke Work Practice in the Focus Groups

One of the challenges in obtaining important information in the focus groups in system development point of view is the difficulty to stimulate the thinking of the work practices on the required level. The focus group meetings are often arranged in separate meeting rooms away from the work in situ. Other techniques that have been used with users to evoke the analysis of the work practice in the focus group meetings are presented below.

The storyboards, scenarios, mock-ups, prototypes and videotapes have been used in the focus groups to elicit more information on the user's work. The experience has shown that these techniques are useful tools in stimulating the thinking process and helping the users to place themselves in a work type of situation.

Video has been used for capturing details of the work during the field visits. The recorded material can be used to prompt the thinking process in focus group type of sessions. Karasti presents the video collages method for stimulating the thinking of the work practises. According to her experience this video collage method "provides an opportunity for an analytic distance as a mirror of the actual work practice in an accessible form". However, this methods is not used by Karasti in focus groups but in design type of sessions where the users can confront the actual work practice outside their everyday settings to be able to concentrate on analysing and reflecting the work (Karasti H, 2001). Although Karasti has not used this method in focus group type

of sessions, I regard this video collage method as one possible tool to reflect the work practices in focus group sessions.

One of the transformations of the focus group techniques is the Focus Troupe theatre technique presented by Sato and Salvador (Sato & Salvador, 1999). This method is mainly used for new product development and therefore it is not presented here in detail.

6. Communication and Cooperative practices

Evolving the communication and collaboration within the design team and between the design team and the users has been considered one of the key factors in improving the EAS design process. Therefore in this chapter another viewpoint is taken to selecting tools and techniques in system design. The approach to communication and cooperation practices is kept closely connected with the tools and techniques as the aim in this final thesis is not to make profound investigations into the social sciences.

Several types of design tools and techniques have already been dealt with in previous chapters. In this chapter we take another angle to the design tools and techniques and present a model to evaluate how the selected tools and techniques facilitate the communication within the team and with the users. This model is called user-developer communication model by Kensing and Munk-Madsen .

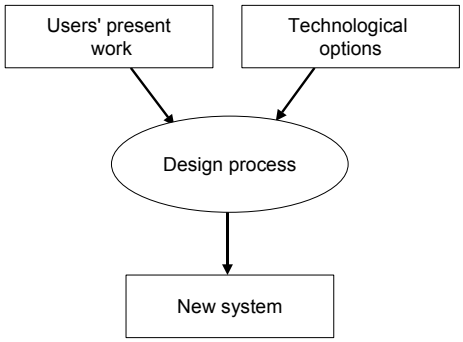
6.1 A Model of User-Developer Communication

The idea of the communication model (Kensing F & Munk-Madsen A, 1993) is based on the experience that far too often the system development projects fail in communication even thought they use the most promising techniques (e.g. the tools and techniques presented in chapter 5). For one reason or another the techniques sometimes yield to fruitful communication, while in other situations the same approaches turn out to be obstacles. As Kensing and Munk-Madsen state that these tools and techniques do not alone generate communication, since "the communication is created by people who interact" (Kensing & Munk-Madsen, 1993). Therefore the design team should case-by-case carefully analyse and validate the ability and inability of the techniques in facilitating interaction and communication between people. The main purpose of this communication model is to guide the design team in selecting the suitable tools and techniques.

The communication model presents three domains of discourse (areas of knowledge) in the design process (see picture 16). These domains are:

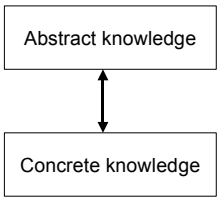
- users' present work
- technological options
- new system

In order to be successful in the design process the design team has to develop and integrate the knowledge of these domains. The design team has to carefully select the tools and techniques used during the design process in order to facilitate the communication in these areas of knowledge.



Picture 16: Three domains of discourse in the design process.

Another dimension in the communication model is the level of knowledge. We need abstract knowledge in order to obtain an overview of a domain of discourse and concrete experience to be able to understand the abstract knowledge.



Picture 17: Two levels of knowledge

Combining the two different distinctions into one model creates six areas of knowledge in communication (see picture 18). **The abilities of each tools and techniques in facilitating the knowledge development should be evaluated in each project case-by-case**. This communication model gives us ideas on what kind of techniques should be used to cover the needed knowledge areas as well as possible. The examples of techniques facilitating the specified knowledge area are listed in brackets (list generated by Kauppila).

	User's present work	New system	Technological options
Abstract knowledge	(2) Relevant structures on user's present work. (Interviewing users, prompted reflections, usability roundtable etc.)	(5) Visions and design proposal (Future workshop, metaphorical design, analysis of the critical incidents etc)	(4) Overview of technological options (Benchmarking other systems, literature study)
Concrete knowledge	(1) Concrete experience with users' present work. (Observing users, video recording, think aloud experiments, prompted reflections, usability roundtable etc.)	(6) Concrete experience with the new system (Prototypes, mock-ups, usability tests)	(3) Concrete experience with technological options (Prototypes, usage of other systems)

Picture 18: Six areas of knowledge in user-developer communication with a list of tools and techniques for knowledge development.

6.2 Communication in the Distributed Teams

The system design is today more often carried out in distributed development teams. Due to the reason that the developers are based in different countries, the communication between the developers is partly mediated by e-mails and different groupware systems (computer conferencing tools) or by telephone meetings. The face-to-face meetings are reduced to a minimum due to the costs of travelling. This imposes challenges in communication during the design process. The face-to-face meetings have to be carefully planned beforehand and the need for coordination increases.

Of the main observations in the group communication is that the involvement of several participants increases the amount of coordination required. Group meetings should follow the formal meetings protocols. One example of such meeting protocols used in the system requirement workshops is the JAD (Joint Application Development) originated in IBM in the late 1970´s. It is primarily designed for face-to-face meetings, but the protocol is also applicable in the Workshops where the participants join the meeting in technologically mediated environment (e.g. in group ware systems like Microsoft NetMeeting, Same Time etc.)

The extent to understanding and communicating with people varies considerably depending on the presence and type of media that is used (Preece, 1994). In face-to-face meetings people can see each other and "read" the signs of non-verbal communication. This aspect does not exist in all technologically mediated communication e.g. in computer conferencing, multi-party telephone meetings etc.
If the face-to-face meetings are not possible, the groupware types of systems are used during the design phase. Only a few surveys have been carried out to study how to run requirement sessions in groupware systems environments. (Numerous studies have been conducted in the CSCW area though).

Daniela Damian and Armin Eberlein have conducted a study called *"An empirical study of groupware support for requirements negotiations in distributed software development".* According to them the reduced richness of social behaviours in groupware systems was not as obvious as generally believed. The group performance and decision quality was at the same level as in face-to-face meetings. Knowing each other was discovered to be of importance as well as trusting relationships among the participants. Therefore the initial face-to-face contact before the computer-mediated meeting was considered significant (Damian & Eberlein, 2001)

To sum up: People knowing each other and having trustful relationships are prerequisites for successful collaboration and communication during the design process. Face-to-face meetings are required at least in the start-up phase. Utilization of the meeting protocol provides a frame for the meetings and makes it easier to attain the set goals.

6. 3 Change of Roles in User-Centred Design

Role of the Designer in the User-Centred Design

The designers should take different roles in system centred and user-centred design phases of the design process. This is to say that designers should understand how to behave in the roles of a designer during the design process. The first phases in the system design process are considered more user-centred than the rest of the phases. The user involvement is increased often during the requirements gathering phase, which set up different demands, roles and tasks for the design team.

A good example is the programmer who in the system centred phase takes on role of software engineer, but in the user-centred phase his role as a designer is much wider, involving a lot more cooperation with the interest groups (Sarkkinen). This cooperation with the interest groups consists of activities with the users or within the design team to facilitate the design important knowledge. This all means that the designer's role is changing from a system developer to more of a facilitator's role. The designers should be actively involved in gathering system requirements instead of expecting system requirements to be "given" to them, as often is the case in system -centred design processes where someone else (e.g. business making prestudies) is responsible for carrying out the requirements-gathering.

The designer's role is important in communicating the alternative design possibilities for the interest groups and the users. The designer should be able to explain the design in a different way depending on the target person. Participatory Design techniques offer various means (e.g. prototypes and scenarios) for communicating design ideas for the interest groups.

The Designer in the Role of an Observer

The designers are often considered the experts of the system. They are asked how the system functions and how it should be used. However in real life the systems are seldom used exactly in the way they were designed. The designer's connection to real users and use situations is often very thin. They seldom meet the users and their knowledge of the real work practices is often based on second hand information given by the market people. To facilitate the knowledge of the users' needs, the designers should also attend the customer visits and observe real users in real usage situations.

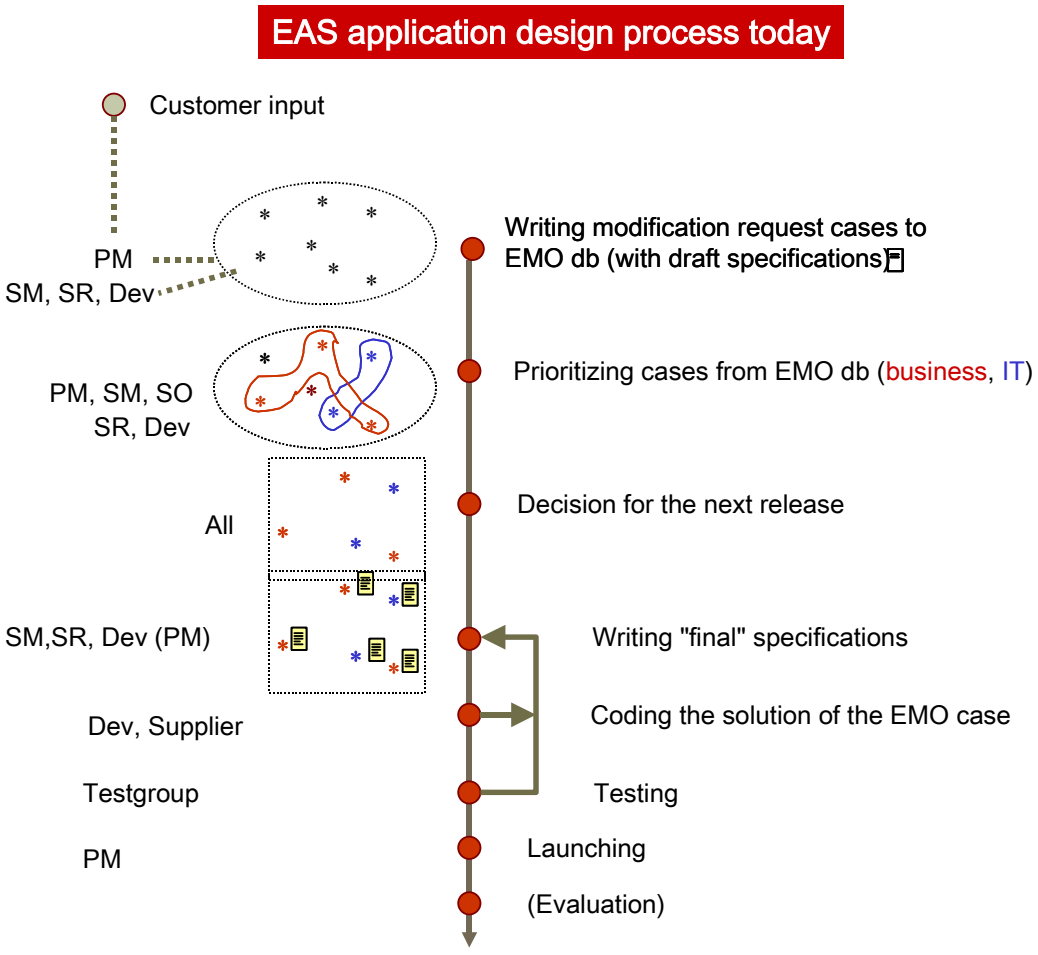
The role of an observer is often very opposite to what designers are used to. Becoming an observer requires a humble open mind with novice approach to the system and users work. The users should be considered experts of their own work (e.g. Karasti, 2001). In the user-centred design the designers should respect the users´ knowledge of their own work practices and the abilities of the users to understand, give comments and even build technical solutions (Sarkkinen). Observation can be quite informal process, but some observation techniques help to record the observations during the visit. Designers should also practice these skills.

7. Analysing the Present Way of Working

The purpose in this chapter is to describe and analyse the design process of the EAS applications before the process of changing the way of working started.

The figure below shows a simplified model of the former design process for EAS applications. It characterized the traditional waterfall model of the software development process, where the development of software consists of a number of phases in an essentially linear fashion. Little iteration happened at the beginning of the process, but more appeared excessively in the later phases of the process in the form of prolonged testing time and rewriting of specifications.

The left side of the picture shows the persons involved in each phase of the process and the right side indicates the design process phases in principle. The problems identified in different phases of the design process are presented in the following chapters.



Picture 22: EAS application design process before the change process started

7.1 Writing Modification Request Cases in EMO db:

Collecting and Sharing Customer Data

The Product Managers have been the main and the only link between the design team and the users. They have conducted follow-up meetings with the customers in order to collect users' attitudes towards and experience of the system. The behaviour of the users has not been investigated in the form of contextual inquiry.

The biggest challenge in this type of process model is to solve how to collect the right kind of data from the field visits and share it efficiently with the design team in order to result in the right specifications of requirements. The communication practises have not sufficiently supported the knowledge sharing within the design team, as the Product Managers have been "beside" the design team and not "in" the team. Interpretation session type of workshops where the knowledge of the users' work practices would be emphasized, has not taken place after the first launch of the application. The role of the Product Manager has been incompatible with the need of being more involved with the system design.

"Too technical"

The EMO organization has, in most cases, drawn the specifications based on the information received from the Product Managers. The reason why the Product Managers have not participated in writing the specifications, has probably been that they feel they are too technical. There has been resistance and fear of becoming too involved in and unable to cope with technical issues. Taking this into account, the scenario-based approach to writing the functional specifications might reduce the technical approach.

Missing User Participation During the Design Process

The user participation in the design process has been minor. The product manager and the sales persons have made follow-up meeting to the customers and obtained comments from the users. The low user involvement during the design process has certainly been a deficiency. One of the challenges in the new way of working is to define how to use the different design tools and techniques for increasing the user involvement in the design process.

Conceptual approach

EMO database is generally an eclectic collection of independent cases. This is both a challenge and a problem when planning a new version, while being a mixture of independent cases recorded, a certain firm conceptual approach is missing. New versions must have preset scopes and objectives, a clear vision of what will be achieved with the new release.

7.2 Selecting Cases for Next Release and Drawing Specifications

In this phase of the design process cases are selected and prioritised in respect of necessity, severity and cost effects. Decisions have been made on what to be included in the new release and what to exclude. Prioritising has mainly been done by voting.

Based on our current experience, drawing good detailed specifications and creating prototypes must be emphasized more. One must reserve more time and resources in the requirements gathering phase and more effort has to be put into drawing the specifications.

The specifications have been too unspecific and they have left too many open questions to be solved by the programmers whose knowledge of the users work practices has been almost non-existent. The opportunity to involve the users during the design process must be considered. Specifications and prototypes can been validated with the customers during the process.

7.3 Coding the Application

In the past, coding of the application was performed by a few external suppliers who sat next to each other. Today the developer group consists of both internal and external developers who are situated in different places. The challenges in the communication between these distributed teams have increased remarkably. The number of development environments has also increased which has also set up new needs for the administration of the maintenance and development activities.

The main problems encountered in this phase of the process have mainly been dealing with the great deal of responsibility given to the developers and open questions left to be solved. This has caused problems in the form of redefining the specifications in the later phases of the design process and problems encountered during the test phase.

7.4 Testing

Testing has been organized separately in each country. The lack of test resources has been one of the bottlenecks in the design process. It has been difficult to get persons who know the backbone systems and the EAS applications in the test groups well. These persons are often the most sought-after key persons in the company.

The test phase has often been prolonged due to insufficient specifications.

7.5 Evaluation

Evaluation is traditionally transferred into the last phase of product development in the design models. In some of the design models (like in the star model which is explained in chapter 4.2) the evaluation is in a central position in the design process.

Evaluation is relevant at all stages in the life cycle. The design process itself as well as the outcome of the process must be evaluated. This final thesis is part of the evaluation process in the EMO organization.

When analysing the present way of working the team realized a need to set up evaluation metrics for measuring the effectiveness and efficiency of the design process and customer satisfaction level.

8. Implementing a New Design Process

The following chapters describe the change process of moving towards the new way of working.

The first chapter describes the backgrounds for directing the change process. The following chapters present the events i.e. workshops and other activities carried out during the design process. These events are presented in detail level in order to document the design process, the findings and the central learnings of each phase faithfully.

In each chapter I have presented the process for carrying the workshops and the experiences encountered.

The workshops are described in a chronological order in the chapters below.

8.1 Directing the Change Process

The theories of design methods and process models (presented in the chapters 3-5) gave us[1] ideas in what direction the present design process should be steered. On the other hand we also realized the challenges in the teamwork. A coherent and cooperative team was considered as a prerequisite for the change process and therefore, the importance of getting a good start for the team was strongly emphasized in the beginning. One of the leading themes for directing the change process came from the book "Communities of Practice" written by Etienne Wenger. The picture below presents the different dimensions of practice as the property of a community. Although in Wenger's model the community is not a synonym for the team it gave us ideas about things we should focus on before better collaboration within the team can be reached.

As already stated in the beginning of the final thesis I have not done much of research in the area of social sciences and therefore the model of Wenger's is just presented as one single inspiration that has steered my thinking during the process.

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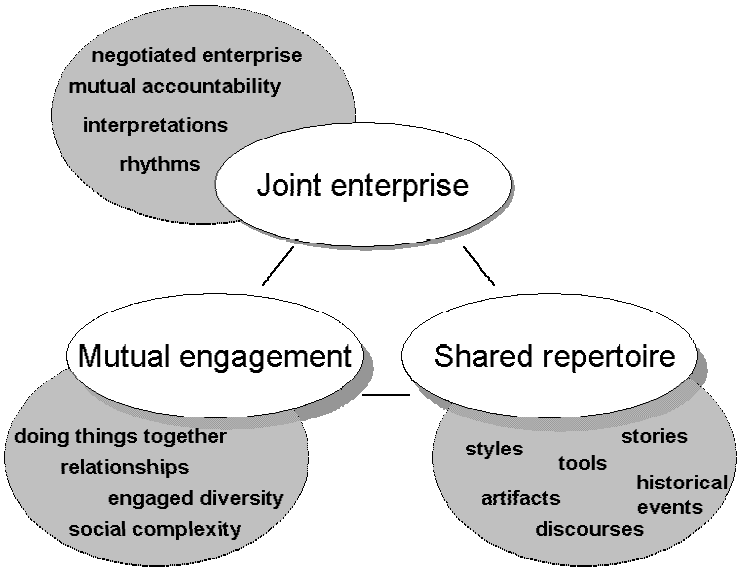
[1] *Here I refer to System Manager and myself*

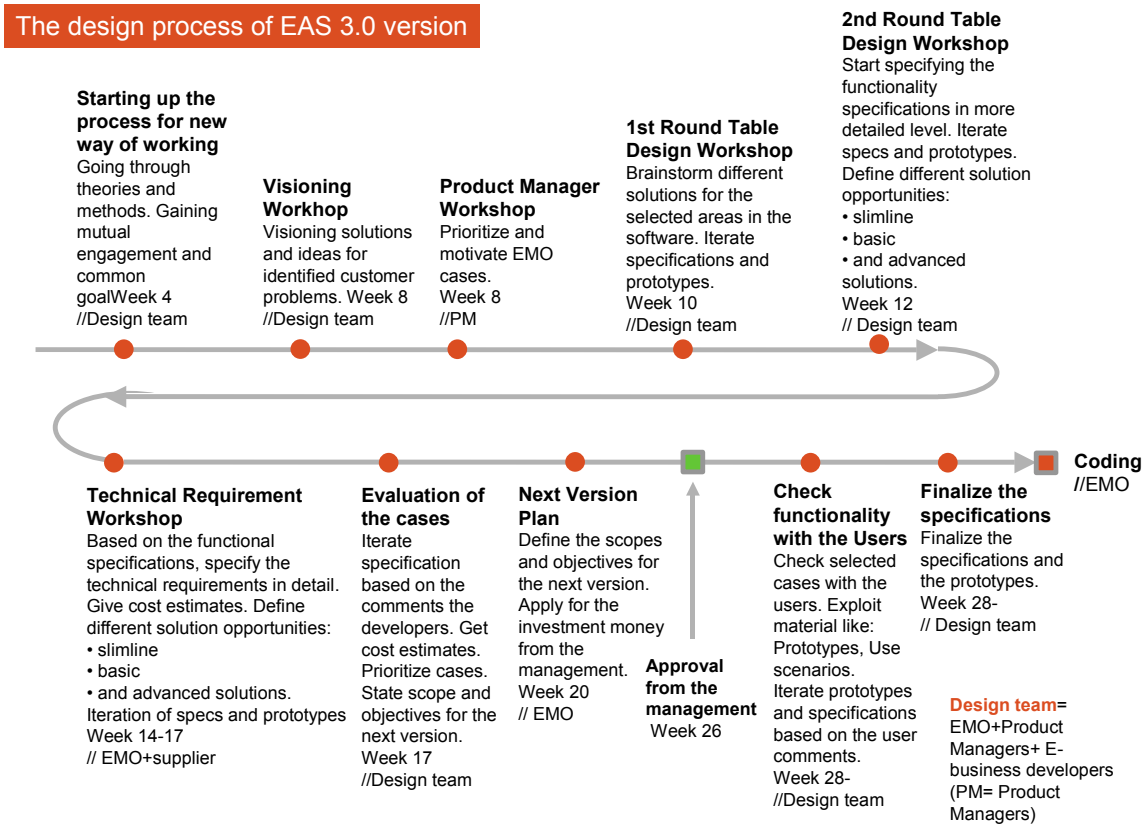


Picture 23:Dimensions of practice as property of a community

During the workshops we discussed a lot of the reasons for changing the present way of working as some of us were not aware of the difficulties in the present way of working. The aim was to achieve a joint enterprise for the team. During the process we could see that mutual engagement had gradually grown from "doing things together" although at the end of the process we occasionally still had to discuss and give arguments why, for example to involve the users in the process, why to emphasize gathering the requirements in the early phases of the process etc. The tools practiced during the process as well as the material produced in the workshops became a shared repertoire of the team.

The process for designing the EAS 3.0 version and the experience obtained are described in the following chapters. It started with series of workshop sessions during spring 2003. The first workshop focused on engaging the team in the change process and defining mutual objectives for the team. The present design process was analysed and some new design tools and techniques were briefly presented. The visioning workshop was organized soon after the first workshop to attain a wide perspective of possible solutions and visions. In the round table workshops, more commonly known as "requirement session" or "design session", the planning of the functionality of the EAS 3.0 version was started.

The picture below shows the activities that took place during the process. Each phase and the main activities and responsible persons are shown in the picture



Picture 24: The design process of EAS 3.0 described to the phase where the coding starts

8.2 Starting up the Process for New Way of Working

The implementing process of the new way of working started with a workshop in January 2003. The objective of the workshop was to gather the team members for two-day session to discuss how to proceed with the next version (EAS 3.0) and to examine possibilities for new way of working. During the workshop days we evaluated the present design process and discussed how to improve the present working routines. We talked about the role of the design team and who should be part of the team. We introduced some new design process ideas, and finally, made a preliminary plan how to continue with the process of planning the next version (EAS 3.0). The purpose was to obtain mutual consensus on how to proceed in the process and to create an action plan to follow.

Common Theory and Terminology Base

One of the scopes discovered during the first meeting in June 2002 was to create *a common theory and terminology base for the new way of working - a common language for the team.* In order to achieve this, t*he terminology was simplified* into colloquial language. We spoke about "Workshops and Meetings" instead of "Interpretation Sessions"

or "Design session", "changing the way of working" instead of emphasizing the "design methods and design practices", " User and Task analysis" instead of "contextual Inquiry" etc. In other words, unfamiliar terminology was avoided.

We started the theory part by discussing the usability factors of the context of use (see chapter 3.2) like user, tasks, equipment and physical and social environment with the different aspects. The second day was spent discussing the design method possibilities in the new process. User and task analysis, visioning workshops, focus groups and other techniques were generally presented for the team.

Analysing the Present Way of Working and Building the Bridge to the New Design Process

The present design process (see chapter 7) was first discussed with the whole team and then the team was split into three groups. These groups were asked to study each phase of the present design process (they had the present design process picture in front of them with some helpful questions) and consider what is good and what requires improvement. These preset questions were to stimulate the thinking process and facilitate a critical approach to the present way of working. The outcome of the group work was turned into a set of **new design principles** during the workshop days (see more detailed description of the design principles in chapter 8.2.1).

Design principles

We will make an effort to:

1. improve our way of working as a team
2. learn more about the user, his tasks, working environments and equipment
3. share the information of the user with the whole team
4. look into new visions and future needs of the user
5. write better specifications
6. improve next version planning. Define scope and objectives for next releases
7. check specifications/prototypes with reference users when needed
8. make better plans for testing
9. evaluate the design process and its outcome

Picture 25: The design principles as agreed on the first start-up workshop

The team's acceptance of and commitment to these design principles was considered the most important issue in the workshop as the following steps in the change process were based on these statements. The aim was to obtain a joint goal for the team and therefore the design principles were discussed with the design team several times during the process.

These principles are considered to cover the most fundamental areas of the design process. Even small progress in these areas can improve the design process, though the change process and implementation of new design techniques and collaborative practices will take time. This is a learning process for all the team members.

A Plan to Proceed with the Next Version

The other important issue (in addition to getting commitment to the design principles) was to create an activity plan for the version EAS 3.0. A preliminary activity plan was introduced and accepted by the team with some minor changes.

The picture 24 shows the activity plan as agreed after the first workshop meeting. Small changes were made during the process mainly concerning the timetable.

8.2.1 The Design Principles to Improved Way of Working

Drawing up the design principles of the improved way of working was based on the group works analysing the existing problem areas in the present way of working. The principles are considered as statements of the ways the design team planned to improve the design process.

The principles and our plans for achieving the set of goals is described in more detail in the following chapters.

Principle 1: Improving our way of working as a team

This principle states the importance of seeking for new ways to collaborate during the design phase. Therefore, in order to facilitate the teamwork, we agreed that new forms of design tools and techniques would be practiced, the experience of which is described in chapters 8.3-8.6.

In order to work as a coherent design team, we agreed that the team has to consist of members both from IT and business sector. The experiences from the present way of working had indicated that the invisible borders between IT and business have to be broken down, as software development requires horizontal interaction between organizations and countries. In the new way of working the Product Managers have an important role and it was strongly stated that they *have to take a more active role in the design process*. Participation in software development should be a natural part of their tasks in addition to selling and marketing services. How this participation was realized is described in chapters 8.3-8.6.

The change of the roles and tasks does not only concern the Product Managers, but also the whole design team. The design team must have occasionally contacts with real users in their everyday work settings. The team agreed that the link between the users and the design team has to be strengthened. (The change of the designer's role has been described in more detail in chapter 6.3).

Principle 2: Learn more about the user, his tasks, work environment and equipment

The goal of this principle is to increase user-centredness in the design process and it states the importance of integrating users more tightly in the design process. According to this principle the team will seek for ways to involve users during the design process. How the users were involved during the design process of version 3.0 of EAS applications see chapter 8.8.

Principle 3: Share the information on the user with the whole team

The importance of sharing the knowledge of the user, his work structure and needs etc. with the team is emphasized in this design principle. It states the importance of arranging meetings and workshops more often in connection with the next version planning, in order to disseminate the experiences and knowledge within the team more efficiently. This means arranging interpretation sessions or just ordinary face-to-face meetings where the experiences and ideas are shared within the team.

The experiences of the workshops and meetings arranged are described in chapters 8.3-8.6.

Principle 4: Look into new possibilities and future needs of the user. Create visions and ideas

This principle states that when planning new versions of EAS applications, new possibilities and future needs are actively investigated from a wider perspective. Customers´ work processes and needs will change in the long run and these requirements must be met. In the chapter 8.3 is described the experiences in running a Visioning workshop.

Principle 5: Write better specifications

The need to focus on writing more comprehensive specifications is one of the main scopes in developing the design process. All people should be involved in drawing up the specifications (both functional and technical specification) and they should have a good understanding of the users´ needs, work structure, and anything connected to the users´ work processes. A common understanding of the users´ needs and restrictions facilitates working.

The need for a new approach in writing the functional and technical specification was recognized. The new way of specifying and documenting the requirements is described in chapter 8.5.

Principle 6: Improve next version planning. Define scope and objectives for the next releases

New versions of EAS must be based on explicit, trustworthy understanding of the customers, their needs and work processes. The visioning workshops give wider perspective to the scope.

This principle states the importance of defining clear scope and objectives for each version. It is a tool for the team to evaluate subsequently how well the scopes and objectives of each version have been achieved. This is one way to create metrics to measure the quality of the design process as well.

Principle 7: Check specifications with reference users when needed

This principle emphasizes the importance of working in closer contact with the customers during the design process. Specifications and prototypes will be more actively worked on and design ideas continuously checked with the customers during the design-planning phase. The experiences in co-operating with specifications and prototypes are described in chapter 8.5.

Principle 8: Make better plans for testing

Testing has often been prolonged due to insufficient specifications. All the other Design principles will help us to conduct the test phase more successfully. Automated testing possibilities are also to be investigated to make some of the testing procedures easier.

Principle 9: Evaluate the design process and its outcome

Evaluation is an essential part of the design process through the whole life cycle of the design process. It should be done at intervals during the process and not only at the end. It must be a central activity throughout the whole design process. The outcome of the evaluation phase will be our guide towards later versions.

The metrics must be defined to enable measuring the outcome of the process.

The metrics and the definition of the scope and objectives for the next version are described in chapter 8.7.

8.3 Conducting a Visioning Workshop

The visioning workshop was held in February 2003. The reason for arranging a visioning workshop was to attain a wider and more innovative perspective to the customer's needs and to avoid getting tangled in the individual cases in the EMO database. The purpose was to discuss the customer problem situations within the design team and brainstorm new solutions and visions for solving them. Sharing ideas and visions with the team in a creative and noncritical atmosphere was considered a good way to start the process.

The following chapters describe how the Visioning Workshop was organized and what experience was gained. The model for carrying out the visioning workshop was taken from the Jungk & Müller and it is described more detailed in chapter 5.3.

Running the Visioning Workshop

The team members were asked to prepare themselves for the critique phase of the Future Workshop by thinking of customer problem situations they are aware of. In the beginning of the workshop the participants were asked to specify different problem situations the customers encounter with the managing gases and administrating costs. These problem areas were written on sticky notes and put on the whiteboard.

Picture 26: Here we have customer problems written in yellow sticky notes.

After having written the customer problem cases on the separate notes, they were grouped under the critique headings. Then all notes were discussed with the whole team and each problem situation was explained in more detail.

Picture 27: Yellow (and red) stickers are grouped under critique headings (blue notes).

After all of the cases were presented to the team, an opportunity to prioritise the cases was granted. Each person had 7 pieces of PRIOR 1, 7 pieces of PRIOR 2 and 7 pieces of PRIOR 3 voting points to give. By prioritising the cases we were able to identify the critical problem areas in the system to be solved. 12 important areas were identified for improvement (see the picture below).

Picture 28: The problem areas were prioritised. 12 important areas for improvement with high priority were identified.

In the last phase of the workshop the team was split into three different groups. Each group was given four problem areas to fantasize solutions for (fantasy phase). The ideas were presented to the whole team at the end of the visioning workshop and a priority list of

improvement areas was forwarded as candidate cases for the next version.

8.3.1 Experience of the Visioning Workshop

The clear advantage of the visioning workshop was the possibility to look at the solutions of customer problems from a different standpoint - from a wider perspective. *During the visioning process we realized that the solutions merged and new solutions grew from the interference of others. Individual cases were interconnected to new "Umbrella cases" which made it possible to loosen the single problems to identify the real problems behind.* We identified parts of the system that were more important and critical for the users than others and this forced us to prioritise the large number of cases. We were able to take a wider perspective on the system when allowed to fantasize solutions without thinking of restrictive issues like money, time, resources, local requirements or certain customer demands etc. The outlining and grouping of the problem areas gave structure for the further design work in the design process and it facilitated the work in the Round table workshops.

In this kind of a "customer problem" -approach, which the Jungk & Müller model represents, the throughout knowledge of customer work practices and the understanding of the reasons for customer problems are important. In our case the Product Managers were regarded as representatives of the users, but in practice their knowledge of the user's tasks and goals appeared to be on quite a general level. The customer problem situations had not been analysed sufficiently to support the system design purposes. *Therefore the developers should participate the customer visits to the user's work environment more frequently. It should also be carefully studied what possibilities there are to involve the users in the visioning process.*

Five hours turned out to be too short a time for running the visioning workshop. The grouping of the problem notes and discussions around them took longer than expected. "Visioning" did not reach the expected level. Similar kind of practical time-pressure problems in applying the Future Workshop model have been reported by Kensing and Madsen (Kensing & Madsen, 1991) and therefore more time has to be reserved in the future.

The process during the visioning workshop was documented by a digital camera, which proved to be a good way to utilize the material further in the process. The good quality photos facilitated reporting the process and made it more efficient.

8.4 Product Manager Workshop

The Product Manager workshop was arranged a day after the visioning workshop. The purpose was to discuss and prioritise the cases (such as ideas of new functionality or modifications of present functionality) collected in the EMO database, based on the business experience and

market response received from three different countries. The workshop was arranged mainly due to the reason that it had been earlier agreed and the day had been settled. The clear advantage of the workshop was the experience gathered from Tupla-Tiimi method.

The process for arranging the Product Manager workshop and the experience obtained are described below.

Arranging the Product Manager Workshop

The Tupla-Tiimi (two pair team) method for prioritising the candidate cases for the next version was used in the workshop. The method has been developed by Kari Helin, the psychiatrist, in the Helsinki University. Advantages in this method are that the persons attending the session can enter the cases intensively and creatively, but at the same time in a democratic and comfortable way without mutual competition with the others. It seemed to be a good tool in identifying the common interest areas among the Product Managers, and it was an efficient and fair way to prioritize and select cases in situations where there was a high risk of conflict of interests.

The workshop consisted of four phases. In the first phase the participants were asked to select 10 cases from the EMO database, which they considered important and wished to be included in the next version. In the next phase the participants were asked to write down some motivation on each case. They were to consider what it is with this case that makes it easier to sell this service to the customers and what is the value for the customer.

Picture 29: Here Juho and Rune are motivating their favorite cases to each other.

In the third phase the participants were split into two pair teams. They were to present their lists of cases and motivate them to each other. The rule was to listen, but not to criticize the ideas presented. The pairs discussed the cases and expressed their views based on their experience from the local market. At the end of the discussion, the two pair team had selected 10 cases out of their total 20 cases and forwarded that list to the next phase in the process.

In the fourth phase all participants were given 8 voting points to select from the 16 cases (resulting from the two teams having four cases common in their lists). As result of the process 10 cases were brought further in the process as candidate cases for the next version.

Experience of the Product Manager Workshop

The workshop was arranged as a face-to-face meeting but as one of the Product Managers was unable to attend the meeting, part of the meeting was conducted by telephone. Voting and prioritizing took place by e-mail. Even with this mixture of mediative tools and techniques, the Tupla-Tiimi method seemed to work quite well.

One of the benefits of the Tupla-Tiimi method was the possibility to separate the clear local country demands from the generic demands. The generic demands were considered to go over the local requirements. One reason for this is the experience that something working perfectly for one country can generate problems to others. Therefore the cases had to be analyzed from the generic requirement perspective. However the Product Managers had the possibility to sell their ideas to each other and in this way to motivate others to vote for the cases.

In the future it is important to integrate the Visioning Workshop more tightly with the requirement sessions and the whole team should attend this kind of prioritizing session.

8.5 Round Table Workshops for Designing the Solutions

The team members were invited to the two days' round table workshop, where the objective was to brainstorm the draft ideas (candidate cases) from the previous workshops further into concrete proposals of solutions. The previous workshops had generated a priorisation and grouping of identified problem areas and ideas for solving the problems. In the round table workshop the ideas were iterated into more detailed proposals for solutions.

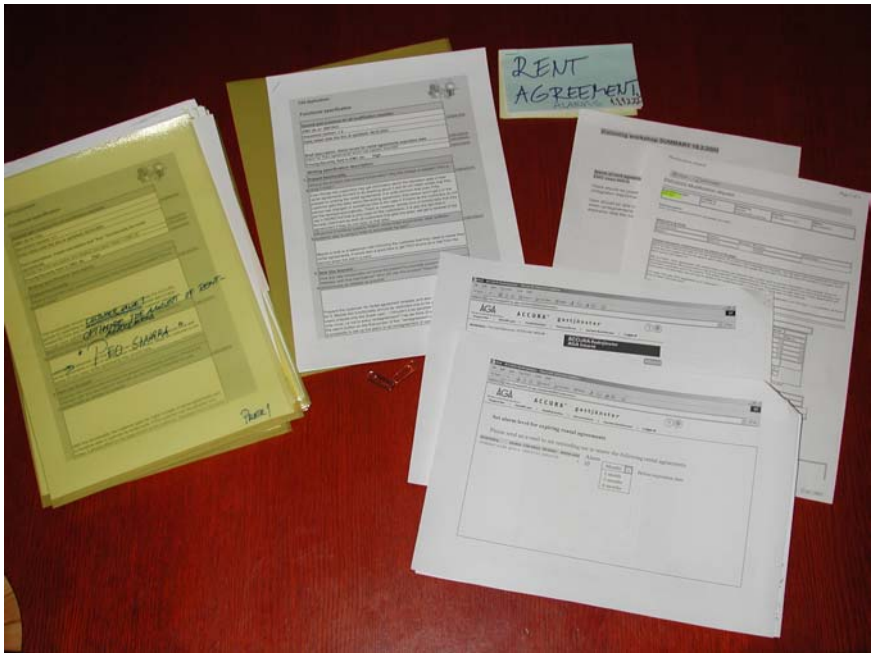
The process for drawing and rotating the specifications and the experience of the methods used are explained below.

1st Round Table Workshop and Rotation of the Specifications

The functional specification template was presented to the team before the team was split into three working groups. The purpose was to use the template as a framework for writing the functional specifications

Picture 30: Here is the round table meeting just about to start.

Each group received six candidate cases to start with and a folder with the material gathered from the EMO database, visioning workshop and the Product Manager workshop (see picture 31). The groups used the folder as an "idea bank" to create design ideas for the new design solution.



Picture 31: The "idea bank" folder with material copied from EMO db, notes from the visioning workshops, specification template and prototypes designed during the round table workshop

The purpose was to *brainstorm the design ideas between the groups*. When a group had given its contribution to the case, it was rotated to the next group. The functional specifications and simple prototypes were electronically rotated between the groups. The original pre-printed material followed the case physically. The goal was that all

working groups would survey all the cases at least once. The process was monitored and all the rotated cases passed on to each group electronically.

In the last phase of this workshop the cases were presented to the whole team with the comments from different groups. In this way everybody had a chance to discuss the different proposals. If the discussion had been conducted within the whole group, it would have probably taken a lot more time and the results has been less comprehensive.

The idea for rotating the specifications and the structure of the workshop was generated by the System Manager and I. Later I found a similar kind of brainstorming technique called Method 635, where six participants each write three rough ideas for solutions. The ideas are passed on to the next participant, who revises, extends and modifies them. The Method 635 is created by Pahl and Beitz.

The 1st round table workshop lasted for two days. During these days the iteration process of defining the functional specifications for the candidate cases started.

Getting into Details - 2nd Round Table Workshop

The 2nd Round Table Workshop was organized two weeks after the first one. In the second requirement workshop the team was split into three groups. Each group was given approx. five cases to work on. The purpose was to elaborate a more specific definition of the functionality and to draw the prototypes into more detail. The groups were asked to focus on writing the scenarios in common and understandable language from user perspective, but detailed enough for the developers to be able to start with writing the technical specifications. They were also asked to go through the prototypes and consider their logicality, consistency, navigation, layout etc.

As we had identified several functional and technical ways to design the required functionality, the groups were asked to define different solutions (slimline, basic and advanced solutions) of each candidate case. The idea was that the groups should evaluate the necessity of the functionality of each case in order to point out what is prioritised as most important functionality and what is considered an additional features ("icing on the cake"). The team should clarify what is most essential in the functionality. These slimline, basic and advanced solution proposals gave us in the EMO organization a tool to evaluate and prioritise the cases for the version EAS 3.0. The idea was to prepare for making an optimal selection of functions to be included in the next version in respect of customer need, cost, time and resources (coding, testing).

Once again, the prototypes appeared to be the most efficient tool for communicating and visualizing the design ideas in an understandable way. It had already become clear during the workshop sessions that we needed to involve the real users somehow in the process in order to evaluate the design proposals with the users. The purpose in this workshop was also to make a customer visit plan and define what

customers and what material (scenarios and prototypes) should be presented to the users.

The Outcome of the Round Table Meetings

During these round table sessions the specifications and prototypes did not reach the level that could be considered "ready". After the workshop sessions the EMO-organization continued with the functional specifications and prototypes to a more detailed level based on the documented ideas. The cases were sent back to the Product Managers for review and comments. After the functional specifications and prototypes had been described in greater detail, we arranged technical meeting with the developers and started the process of defining the technical specifications for each case.

8.5.1 Experience of the Round Table Workshops

Rotation of the cases during the 1st round table workshop proved to be a feasible way to start the process of brainstorming ideas for new functionality. First one group brainstormed new ideas concerning the case and then the case was forwarded to other groups. Of course one can say that the first group steered the next group's thinking, but on the other hand, as the groups were separated, they were able to take a critical approach to the earlier ideas, change, extend and modify them. Within one big group the ideas can be dominated by few ideas and persons and it is not so easy from a social perspective to impugn the ideas, if you want to proceed with the process and keep a positive spirit during the process. The benefits of rotating the cases in small groups were the possibility to emphasize a certain amount of cases at a time and to share different ideas and viewpoints within the groups without ending up in a debate. Going through the cases with the whole group would probably have taken more time and the cases would have been saturated with too much information and discussion. Rotation sessions could be compared to brainstorming. The level of specifications reached during the workshop was by no means sufficient*. I consider it more like efficient idea processing and a good start for proceeding with the requirements gathering sessions*.

The five-hour work on thirteen candidate cases resulted in a collection of ideas for new functionality and improvements to the present functionality. The cases selected in the Product Manager's workshop where mainly focused on the present customer problems whereas the cases from the visioning workshop were aiming for new functionality.

Soon it was noticed that most of the cases were elaborately connected to each other, which had to be considered in order to keep consistency in the system. This connection was also a benefit, as some of the cases could be built on the same technical framework. So started the intermingled process of creating scenarios and prototypes from general ideas to more detailed, and the specifications gradually emerged from the increased knowledge and understanding of the team. *Writing specifications proved to be a deep thinking process and people's ability to concentrate is rather limited at a time.*

In the 2nd round table workshop the candidate cases were discussed in groups of 2-3 persons. The purpose was for each group to concentrate on certain specifications and work them into more detail. A lot of brainstorming took place and new insights were brought to the cases during this workshop too. *One of the findings from this workshop was the need to have a developer in each working groups*. One of the groups was only consisting "marketing" people and they worked for hours with some cases. Finally they checked one of their ideas with the developers, and quickly found out the impossibility of their idea.

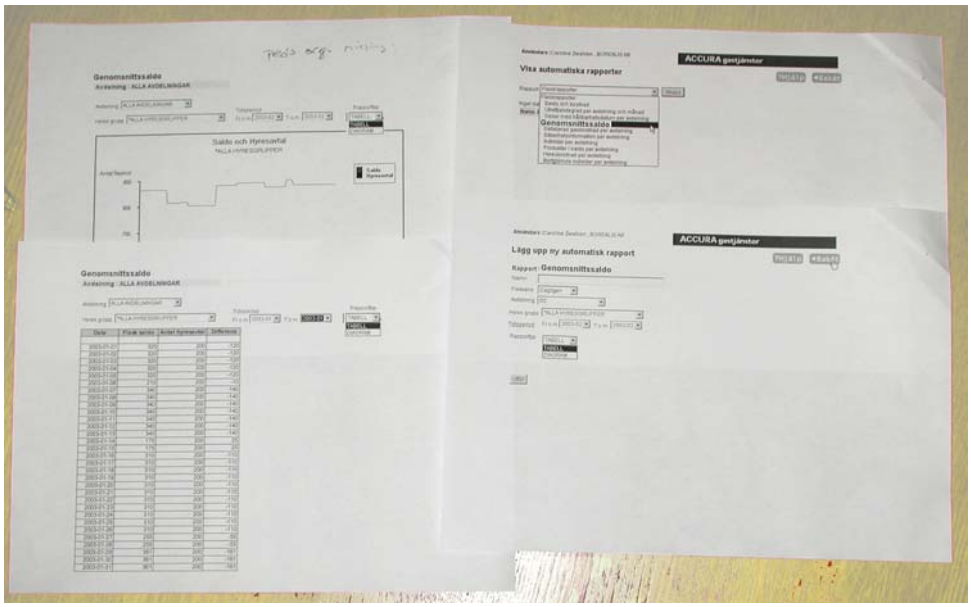
The functional specification template seemed to be well suited. The instructions and help questions forced the writer to explain the subject in more detail than the team members have normally done. *The narrative approach to writing use scenarios helped all the team members understand the nature of the design solution.* The scenarios and especially the prototypes facilitated the communication inside the groups. *These design artifacts (scenarios, stories, prototypes etc) became shared resources and a "repertoire" of the team.*

Visual prototypes were produced for almost all cases. The prototypes clarified the idea of the new functionality in an efficient way. If the solution was not obvious, the prototype helped the communication of the idea to the heterogonous team. It was surprising to see how the team had changed their attitude towards making prototypes. The prototypes were unquestionably very efficient tools in explaining the functionality within the design team. *Making the prototypes forced the team to consider the working process and structure in a more profound way than just writing the use scenarios.* Most of the prototypes included scripted descriptions (text boxes beside the user interface) of how the system would work. This was to make it clearer for the design team in the beginning of the process how the system would work. (Later in the process, when the prototypes were presented to the users, the written descriptions were taken away). The prototypes were good tools for *immediate transfer of information.*

The quality of the prototypes varied remarkably. The prototypes were rough sketches of the functionality in this phase of the process and more as discussion tools to explain the ideas inside the teams rather than material to be presented to the users. Careful consideration is needed before submitting a prototype for user review. If the prototype is low quality, messy and hard to understand, it might be meaningless and misleading to present it to the users.

Snag it, Power Point and Excel programs were used for making the prototypes during the workshop. All of these programs have limited technological possibilities in making prototypes, which was a benefit from a design evolution perspective, *as the prototyping process was more focused on the user's work flow and usability issues than playing with "technical gimmicks".*

When analysing the results from the round table workshops, I faced numerous issues that require careful consideration. E.g. What constitutes a good scenario and a prototype? How do we know that the scenario is sufficiently described? The scenarios changed during the rotation. Should we save all the iteration versions of the scenarios with all comments from the groups?



Picture 32: Example of a paper prototype produced during the rotation sessions.

The groups were cross- functional, which was one of the strengths in this way of working. Having Product Managers, IT persons and locally and regionally responsible persons in the same group brings different perspectives to the conversation and to the solutions. Product Managers had a good "keep it simple" approach to the design solutions and they also have a good understanding of the abilities of a typical user. One good sign of the change process being in action, was the comments from the Product Managers on the need to check and discuss the new design solutions with the customers before coding. Finally, when the solution possibilities for the new functionality were mapped on a quite detailed level, the groups were asked to define the slimline, basic and advanced versions of the solutions for each case. This was not unequivocal as different solutions for the functionality could be identified either from the user viewpoint or from the technical viewpoint. We decided to take the user viewpoint and asked the groups to define the functionality defined during the workshops from the WYSIWYG ("what you see is what you get") perspective instead of emphasizing the different technical possibilities and solutions. This was in some cases a difficult approach as the proposed solution was not always the most optimal from a technical point of view. On the other hand when focusing on the functionality rather than technicality, we did not become too overwhelmed by the technical possibilities.

Generally one could summarize that one of the factors differentiating the slimline, basic and advanced solutions from each other was the increased usability of the system when turning to more advanced versions. The slimline solution was a cheap solution built into the existing functionality not in the most user-friendly way. Basic functionality was a compromise having some new functionality integrated with other functions. Advanced version was most often considered as the best solution from a usability point of view. The functionality was integrated to other function in a consistent way but the solution certainly was also the most expensive.

The process of round table sessions would have been improved considerably if the persons involved had more information on the user's work practices. A lot of open questions were placed and left without answers, as we did not know the user needs in enough detail. Again the importance of understanding the user's work practices and the user involvement during the design process was proved. In principle, this type of design session works as long as the users' needs are recorded *but the possibilities to involve the users in the requirement sessions should also be evaluated.*

To increase efficiency, the workshops should last longer at a time (e.g. 3-5 days) and they should be arranged at shorter intervals. In this way the team has an opportunity to concentrate on the detailed issues and they do not forget things between the workshop sessions.

8.6 Technical Requirements Workshop

In the technical requirement workshop the purpose was to go through the candidate cases from a technical point of view together with the external and internal developers and validate the completion of the functional specifications and prototypes. The next step was to start with the technical specifications if the functional specifications were considered comprehensive enough. As a conclusion of the meeting we discovered several open questions regarding the cases for which we did not have answers. Some of functional specifications and the prototypes needed to be "iterated" in more detail and some changes were required due to technical requirements or limitations.

After the functional specification and prototypes had been completed, the process for defining the technical specifications started. The group of developers, System Manager and I mostly did remote work and we communicated using various technologies e.g. Same Time computer conference with telephone connections, e-mails, chat and remote connections between the computers etc. These systems have advantages, which allow communication and collaboration in situations where face-to-face meetings are impossible.

We first tested the Microsoft Net Meeting computer conferencing tool with video and audio connection, mainly with poor results. We encountered technical problems with the audio part and also the requirement for band width seemed to cause problems. We also had a chance to test the Same Time conferencing tool for a while with an audio connection, but later it was also turned off due to the band width problems. Finally we ended up using the Same Time with telephone conferencing connection, which worked well enough.

Our experience in using the computer conferencing tool in mediating information between the developers was promising. We used Same Time in situations where we needed to discuss or check some details from the group or when we needed to present some new ideas to get a quick response from the others. Based on these experiences we will continue to use the Same Time and try to make it accessible for all team members in the design team.

8.7 Next Version Plan

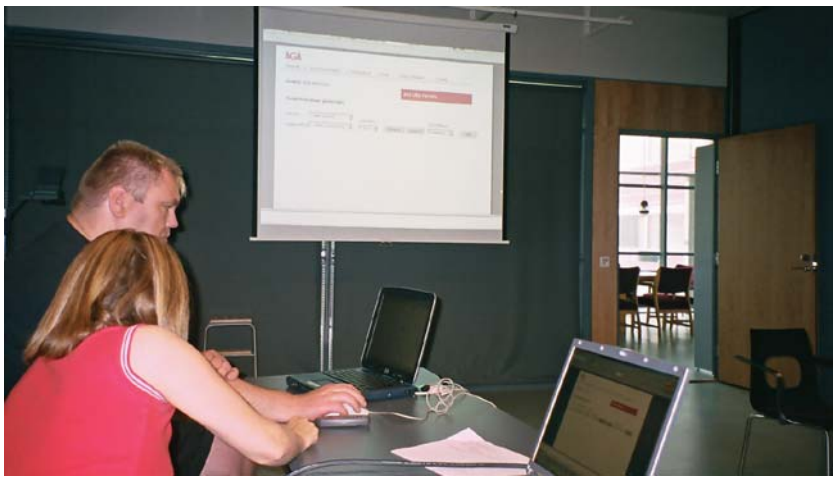
After the functional specifications and the technical specifications were ready the next version plan was finalized. The purpose and added value for the users were stated case by case. The next version with the defined scope and objectives was presented to the management. After the approval from the management the money for the development was released and the coding started.

The plan describes also the metrics to evaluate how the scopes and objectives for the next version were achieved.

8.8 Evaluating the Next Version Plan together with the Users

The customer visits were arranged after the financing of the new version had been approved by the management. The Product Managers stated in the very early phases of the process that in order to avoid unrealistic expectations, no new functionality should be presented to the reference users before the acceptance by the management. One reason for this kind of fear is that our company lacks such focus group or reference customer practices as would make the new ideas of functionality a natural subject for discussions. *Therefore it should be considered if such customer relationships could be established and new practices for focus group type of meeting could be implemented.*

The purpose of the customer visits was to evaluate the ideas of the new version with selected customers. Two different kinds of customers in each country (in Finland, Sweden and Norway) were visited to find out their reactions towards our ideas.



Picture 33: Visiting one customer in Finland.

The users were informed of the nature of the meeting to ensure that we would obtain as realistic and critic response as possible to our

ideas presented in a form of Power Point prototypes. We had produced 5-7 customer demos and discussed them in detail with the users. After all cases had been covered, we asked the user to set the cases in priority.

8.8.1 Experiences from the Customer Visits

As the users were involved in the design process in a late phase, their knowledge of the new functionality was based on the presented material. The most central notion from the visits was that in order to attain valuable response, the design ideas had to be presented on the concrete level. The visual layout and the elements, such as dropdown menus, button, images etc. were designed in the prototypes to correspond the real system as much as possible. From this perspective the prototypes were easily interpreted by the users who were familiar with the existing system. The prototypes themselves included no functionality and the user had to imagine how the system would work in real life. This caused problems to some users as they felt a need to try out the system for some time period before they could come up with a good analysis of the functionality proposed.

With some of the customers we entered into a very productive co-operative prototyping situations, where the existing prototype was changed according to the user's comments. This way we recognized some usability problems in our own plans and obtained concrete ideas from the users to work on. It was also very important to hear how the users interpret the prototypes. Therefore the "think aloud" method was mainly used when each prototype was entered.

Picture 34: Customer user (right) and I making changes into the prototype. Place: user's own work environment.

The users' ability to give comments or to argument their needs, varied from user to user. It was also obvious that their motivation and interest in the particular functionality was comparable to the level of input. In general, the users seemed to have reached good and practical solutions intuitively.

In one customer visit the user had his own ERP system open in front of him and he showed us by turns how he used both the systems to find the required information. This opened a deeper understanding of his requirements for usability and system guidance, which seemed to be descended from the ERP system. *The tight connection between the EAS system and the user's other systems was obvious and gave us some idea of the complexity of the user's daily tasks and their relation to the factors in the context of use of the product.*

All in all, the experience in discussing the design proposals with the users widened our understanding of the users' needs. We identified some problems in the existing plans, mainly concerning missing information on certain screens or usability issues (e.g. weak-eyed persons needed to see the edges of the table rows in order to select a right row etc.) and we obtained direct feedback to our design ideas. We became more aware of the reasons "WHY " the user needed such functionality and "HOW" and "WHAT" should be produced.

As a conclusion from the customer visits, we claim that due to the reason we lack of focus group/ reference user practices today, the user involvement this time came in a right phase of the design process. We had iterated our ideas into concrete level, which made it easier to involve the users. As the users are inexperienced in evaluating prototypes, the first sketches of the new functionality would not have facilitated the discussions into a sufficient level. When the users become more familiar in participating the design process, these practices become a more routine way of working and the users can be engaged to the design process in earlier phases. Based on these experiences the reference user practices have to be carefully planned and implemented.

8.9 Next Steps

The purpose in the final thesis was to follow and steer the "first steps from analysing the requirements for the new EAS 3.0 version up to the design phase" the final analysis of the change process and its effects on the design quality will take place after the completion of this thesis. The process will continue with coding, testing and implementation phases, where the specified functionalities are first created and then finally introduced to the users. The design quality and the outcome of the process will then be evaluated against the evaluation metrics stated in the next version plan (see chapter 9.2.5)

9. New Design Process Model

9.1 Introduction

> *To gain the benefits of cross-functional perspectives, the team needs a clear process that allows them to do real design together: gathering detailed customer data effectively, supporting design conversations and making them concrete, and supporting team design. Without a clear process, the team spends its time working out the process instead of working out the design* (Beyer & Holzblatt, 1998)

The design process model presented in picture 35 is my attempt to bridge the user- and system-centred approaches in system design and the company strategies closer to each other. The process starts with more user-centred focus in the analysis phase and changes to more system centred when proceeding with the coding phase. The process is described in a linear fashion and it does not visualize the iterative nature of the design process well, but I believe that for this particular team this kind of model is easier to interpret compared to models like the star model and the spiral model (described in chapter 4).

The process has numerous cooperative and iterative forms. It requires people with different backgrounds and skills and it changes the traditional company organizational lines by involving marketing, sales and IT people tightly in the design process. In this process the initial stages take longer but the overall result should be faster, less expensive, and superior.

9.2 Structure of the New Design Process

In this model most of the design problems are addressed at the analysis phase of the process, when modifications are still inexpensive. Changing a design is easy when still in prototype form, but expensive after it has been taken into production.

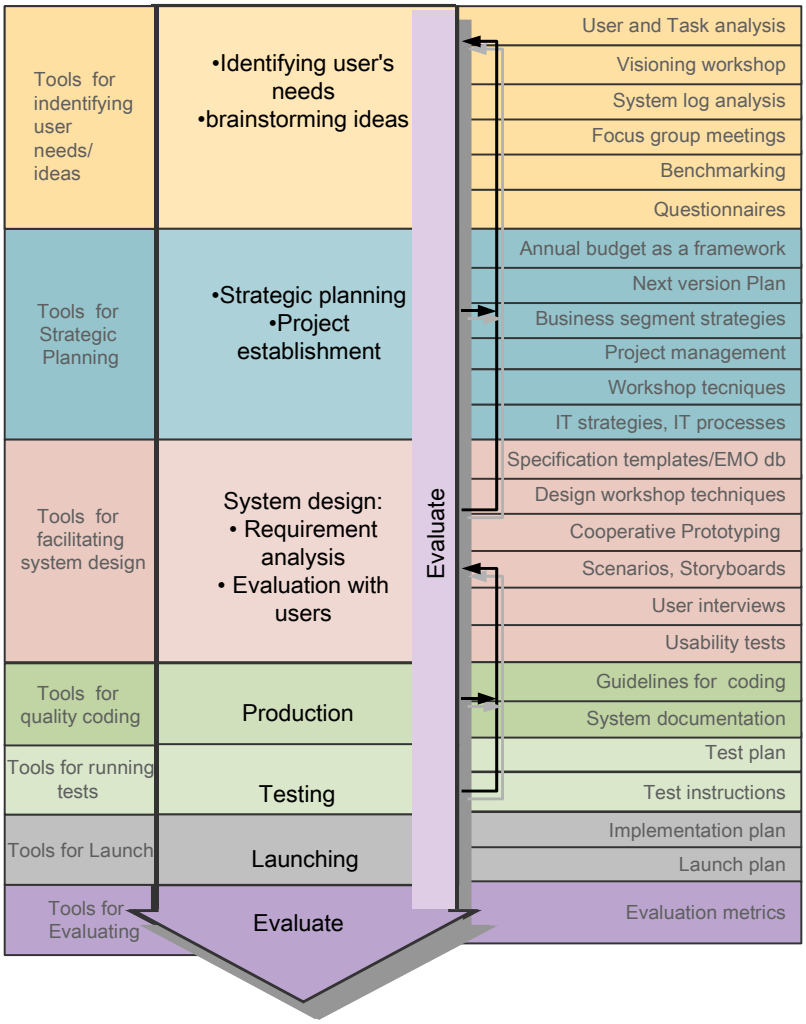
A new design model of course will not solve anything without true commitment by the design team. The design process must be based on the design principles, which, as *general rules, guide the design.* (The design principles are presented in the chapter 8.2.1).

Toolbox of Design Supporting Methods and Techniques

This model is based on the ideas derived from design theories and the experience gathered when experimenting new design techniques. *The toolbox is not only intended for the designers but also to help the* ***users*** *to take part in the design process.*

The right side of the process model shows some examples of design tools and techniques that can be chosen during the design process case-by-case. If there appears a need to use other techniques, the user-developer communication model presented in chapter 6.1 can be used as a guiding tool to select appropriate techniques for particular purposes.

The methods and techniques are grouped according to the main phases of the design process, but they can be used in various phases during the process. The process is iterative and the more you use the tools on the right side the better you ensure the design quality.



Picture 35: The new design process model

Some of the tools presented in the design model above are presented in chapter 5 and some are described also below.

9.2.1 Tools for Identifying User Needs and Developing Ideas

The aim for understanding user's work practices and needs should be one of the leading themes during the whole lifecycle of the software. User and task analysis help the team to experience the user's present work, understand the structure of the work and get to know the users.

In reality the possibilities in conducting an ideal development process with profound field visits are limited and therefore the need to make compromises might appear. Here below I give some practical solutions how to increase the knowledge of the user's work practices inside the team:

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- The design team should make customer visits once in a while to keep contact with real users. Make this a routine way of working.
- Conduct user and task analysis on a reasonable scale. Focus the observation and interviewing on some predefined areas of the work. Pay attention to important user artifacts (e.g. conduct artifact walkthrough).
- Report the visits to the whole design team. Use tools like video and camera to record your findings from the visit.
- Involve users in the design sessions if possible. Select reference users who can participate the design sessions or arrange focus group meetings in parallel with design sessions in order to discuss design solutions with the users.
- Evaluate the design proposals with the real users as often as possible (e.g. cooperative prototyping, focus groups etc.).
- Consider what other user-centred methods could be implemented (e.g. prompted reflections, usability roundtable, diaries etc.)

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For visioning new innovations and ideas, the team can use techniques like future workshop, early prototypes to get quick responses from users to the ideas, observe the critical incidents in a user's work to get new ideas, benchmark other software etc. Analysing the present usage of the system from the system logs also produces good information for design purposes.

9.2.2 Tools for Strategic Planning and Prioritising

In this sector the tools for strategic planning of the system development is presented. Annual budget as well as the company strategies and visions set up a framework for the software development. IT strategies, IT processes and project management guidelines also steer the direction of the development.

Create a version plan with clear scope and objectives for the next release and define the metric to evaluate the proceeding of the design process and the outcome of the process.

9.2.3 Tools for Facilitating System Design

In this phase of the process the design team has gathered knowledge of user needs and ideas for further development. As we could see in the EAS 3.0 design process, the ideas were gradually evolving to more concrete design proposals. The prototypes played an important role and therefore I recommend using them throughout the design process to facilitate the understanding of the proposed design inside the design team and with the users. The tools like scenarios, mock-ups, storyboards, specification templates etc. are also useful tools for making the understanding of the design solutions easier.

How to select appropriate tools and techniques? The User-Developer communication model presented in chapter 5.1 gives us an idea of what kind of information can be captured by using these particular techniques.

Below I list some practical issues that can help the communication and collaboration during the system design:

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- Plan the design workshops carefully. Involve the required persons and look after that necessary equipments (e.g. projectors, programs to be used when making prototypes, connections to network etc) and material (e.g. sticky notes, whiteboards etc.) are available.
- Consider the goal of the workshop and select the most appropriate techniques for running the workshop (visioning workshop, round table workshop or technical workshop etc.). The workshop techniques give a good structure to the design sessions. The round table workshop with the rotation of the cases and the Tupla-Tiimi techniques are some of the usable approaches at the sessions. Other possible approaches are e.g. the Interpretation session introduced in the Contextual Design or prompted reflections, usability roundtable etc.

- Utilize different design tools and techniques to facilitate the communication and collaboration within the team and with the users:

    - Use prototypes
    - Use scenarios, photos, storyboards, video materials
    - Benchmark other systems
    - Conduct interviews if needed
    - Arrange prompted reflections or usability roundtable sessions
    - Utilize pictures and the prototypes beside the text in the design specifications to give a sufficient amount of information to the developers.

- Iterate the design solutions and try to take different viewpoints to the solutions. Do not get stuck into few ideas, seek for alternative solutions as well. Utilize various brainstorming techniques to find different solutions. Do not make the prototypes "too ready" in the beginning because in this way you mayt get stuck to your original ideas.

- Carry out usability tests to ensure the design quality

- Involve both IT and business people from AGA to the design process and seek ways make users cooperate as well. User involvement during the system design phase is significant and it can be realized in the form of users participating in the design sessions, focus groups validating the design decisions, cooperative prototyping, metaphorical design etc.

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9.2.4 Tools for Quality Coding

One preconditions for quality coding is that the developers have good knowledge of the users' needs, their work practices and the level of their computer skills.

The guidelines for coding, well-defined development processes, change management, up-to-date system documentation etc. facilitate the coding phase of the process. The usage of groupware systems e.g. Same Time, Net meeting improve the communication in distributed development teams.

9.2.5 Tools for Evaluating

The evaluation is an integral part of the design process and done throughout the whole process. Without doing some form of evaluation during the design process, it is impossible to know whether or not the design or system fulfils the needs of the users and how well it fits the physical, social and organizational context in which it will be used (Preece, 1994).

Different kinds of evaluations are carried out at different stages of the design process and for different reasons, but the role of the evaluation is always to facilitate the design and to improve it at all stages.
In order to evaluate the outcome of the process, the design team has to define evaluation metrics for each project. Here below I describe some evaluation metrics that can be used throughout the design process:

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- Define the scope and objectives for each version and set evaluation criteria for the new version of the EAS application. (e.g. less time spent on supporting the users, increased efficiency in moving cylinders etc..)
- Follow up how the design principles (see chapter 8.2) are achieved.

- Investigate how well the new version respond to the needs of internal and external users. Use e.g. interviewing techniques, questionnaires and benchmarking.
- Analyse system logs.
- Evaluate the design quality in each phase of the process and take necessary steps to raise the level of the quality.
- Evaluate in each phase of the process what design tools and techniques would benefit the design most.

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10. Discussion

10.1. Experiences in Conducting Participatory Action Research

The final thesis documents the experiences and results of a participatory action research where the design work of a small design team was to be changed.

I had two roles in the change process. Firstly I studied the change process as a researcher in the action research process, secondly, I participated in the change process in my role as the System Responsible. My role as a researcher was kept hidden from the team as I felt it might have set my motivation to the change process in a wrong light inside the team. Therefore I officially acted in my role as System Responsible but at the same time maintained the researcher approach to the process.

As being involved in the change process and acting in two different roles I had more insight into the history of the group and work practices than a researcher normally has. I was able to reflect on the changes in the group and the work as I knew the persons and the work practices quite well. But on the other hand as being an operative part of the team and being involved in the work community made it difficult to take an "outsider" role and fully objective approach to the change process.

Steering the Change Process

During the change process we tried to listen and study the pulse of the design team and react to it. After each step in the process, we evaluated the way the change process should be directed. If we noticed a need to return to the subjects discussed earlier, we aimed at democratic dialogue within the team and tried to avoid the "expert" role. In the beginning we had to steer the process more as only part of us were aware of the problems in the present way of working and the change process had to be specified for them. Later on we tried to decrease the amount of steering and leave space for the participants to take more active roles in the process.

We adapted the material in such a form as we believed to be the most convenient for the team. We also searched for tools to increase communication and understanding inside the team. *The change process was contributed by providing the team with a possibility to learn new ways of working by making them try new things (empirical learning) rather than just explaining things to them.* This empirical learning proved to be one of the best ways to promote the change process.

Personal Challenges in Action Research Approach

The major challenge for me has been to evaluate to what extent the change process should be directed and how much space should be given to the group to act n the basis of their own reflections. In the action research the purpose is to help the participants become active and conscious actors in the process. On the other hand the change process has pre-determined timeframes, which pose challenges for the amount of guidance. I have my background in the project-oriented way of working and the role of a Project Manager differs from the role of participatory action researcher. The new role of a less guiding participative researcher has been challenging for me. Sometimes I have found myself "consulting" the group and "speeding up" the process, which seemed natural way of acting for me. The acceptance to face certain uncertainty in the process and to leave more space to the group to play around has been one of the most important lessons for me.

I have also realized that sometimes the participants need some steering or things that stimulate them to be active. Fairly often the companies have such a "meeting culture" where the participants come unprepared to the meetings and they passively wait for the chairperson to tell them what to do. This passivity is also recognized in the Kuula's research. The principle of the action research states that the participants become "active and responsible subjects" in the process, when the democratic dialogue, communication and interaction between the participants come true. In reality the researchers find the participants often too passive and this active role difficult to obtain (Kuula, 2001).

When critically evaluating my way of working during the process and writing this document I can see the signs of excessive optimism, positivism and steering. I have been too optimistic in evaluating timetables and estimating the amount of information one can absorb in such a short time. Being a part of the design team it has been difficult to take an objective viewpoint to the process and it has also imposed some restrictions on the way the process has been documented. My notes may be slanted with positivism although I have tried to keep the critical approach in writing this thesis. The process was not always smooth. Issues like why to involve users in the process have been discussed several times during the process. *Due to the tight timetables we had to take quite a firm control of the change process from time to time and this may have been one of the reasons why we sometimes found ourselves discussing some issues all over again.* We should have spent more time on discussing the reasons and cconsequences as well as objectives to obtain the mutual engagement in the change process. We proceeded too fast to the change of the design process. These discussions were decreased in the final phase of the design process.

Another challenge, especially at the beginning of the process was that I, as a person from IT side, should not be too active towards the business side e.g. product managers. The reason for this generates from the practices where the ideas of new products and applications are created in the business side and IT's role is to "deliver" what the business has ordered. To avoid such a conflict and integrate the

business smoothly in the change process, it was natural to work in a tight cooperation with the System Manager.

I have documented such observable and discoverable changes as can be identified during the process. As the time period in which this change process has been conducted is relatively short, it is difficult to evaluate how profound it has been. I do not claim that the new design practices would be "deep-rooted" in the design team's way of working, but I believe that we learnt much during the process and our experience will benefit us when designing new versions of EAS applications in the future.

The most outstanding evidence for myself of going into the right directing in the change process has been the opportunity to witness the process of creating ideas and innovations within the group of people interacting and communicating together. As one of the purposes in the process was to unite multiple skilled people into one design team and in this way to obtain better design quality, I consider the outcome successful.

11. Conclusions

The change process was forced to start in many respects but d*uring this process the team realized new possibilities in the new way of working*. The willingness and readiness to change the "old" practices increased during the process when people gradually realized the benefits of the new way of working. *The problems of the old practices did not take form until the benefits of the new way of working were concretized.* This same phenomenon has been identified in the change laboratory process (Virkkunen et.al., 1999).

In the early phases of the process we became aware of the nature of the design process as being more than just exploring design solutions with systematic tools and techniques. It is a social activity where the design involves the coordination of a number of individuals with differing backgrounds, skills, social identities etc. W*e realized that in order to enable a right kind of simulative atmosphere, creative and innovative spirit we had to first search for the joint goal for the team and then look into different kind of tools e.g. workshop methods and design artifacts (scenarios, prototypes) to facilitate the design process.* We also realized that the process for obtaining a joint enterprise, mutual engagement and shared repertoire could take time. We could see that "doing things together" and collaborative design tools facilitated the cooperation of the team.

During the process persons in the team posed new roles and tasks, which required them to collaborate to a fuller extent. Product Managers were participating in the requirement gathering sessions and their role was to represent the users. *The knowledge of the Product Managers was considered very important from a design perspective and their involvement in system development as designers is fundamental while they are the natural link between the users and the designers.* The developers were forced to use new means to communicate the design ideas to the team and their role was considered diverse in different phases of the process. The participation of developers in customer visits was emphasized and some customer visits were conducted during the process with good results.

One cannot argue that the user-centredness remarkably rose during the design process. Users were not observed and interviewed during the process and they were not much involved in the design process. User involvement was carried out in the form of evaluating the prototypes with the customers, which is quite a traditional way in system centred design processes. *The most significant improvement of this process was the increased consciousness of the importance of understanding the user's work practices and sharing the knowledge of the user with the design team*. The experience in discussing the design proposals with the user by using the prototypes showed us that users are able to contribute to the design process and their involvement in the design process is of high importance.

During the process the resistance against new design tools and techniques diminished. Numerous prototypes were created during the process. *The prototypes proved to be the "glue" to applying the experience and knowledge of the Product Managers to the design process.* The Product Managers were more active in designing the

solutions and they were directly able to give comments, criticize and change the design proposals. The linguistic artifacts, such as use scenarios and functional specifications, did not facilitate the design ideas in an efficient way as expected, but the prototypes seem to be good tools to understand the design proposals. As Ehn & Kyng have reported, the prototypes and mock-ups have *family resemblance* to the present functionality, which makes it easier to understand the design (Ehn & Kyng, 1991). The same phenomenon was identified in our case. Users understand the new solution as they understand the present logic and functionality of the system.

The functional and technical specification templates gave the missing structure to the writing process of the specifications. The scenario approach was easy to take into the practice but to still some rules for writing the specifications must be defined as the same specification is used as an order to both external and internal developers. We also found out that more time must be reserved for the visioning and round table workshops. The workshops should also be carried in shorter time period in order to keep the consistency in the design process.

The design process model presented in chapter 9 is a guiding tool in the development of the EAS application. The idea of having one fixed model for all development is misleading because the development projects are of different scale and type and in each case the relationship with customers has to be considered case-by-case. Therefore the model should be used as a guiding principle for steering the design process.

Only the first steps of the change process are reported in this final thesis and therefore it remains to be seen how well the design team succeeded in the EAS 3.0 design. In this phase of the process the design quality can be evaluated against the design principles defined by the team.

Below short summary is drawn of the application of the design principles during the change process:

- We sought for new ways to collaborate and communicate within the design team and with the users by experimenting various collaboration and communication tools and techniques.
- We realized how complicated the user's work practices can be and how detailed information is needed in order to find the optimal solution for the users. Some proof of the change process in action was also perceptible in the comments of the developers and Product Managers saying " this must be checked with the users" and "...we must involve the users in the process much earlier phases".
- The Product Managers took a new role in the design process, which increased the knowledge of user requirements inside the team.
- We arranged different visioning and brainstorming sessions to look into new possibilities and future needs. The approach proved to be right as we saw how the separate cases merged into "umbrella cases" with a clearer concept approach to solving the customer problems.
- We focused on obtaining better specifications and created a new specification template to support the work of the developers and the persons responsible for carrying out tests.

- We defined the scope and objectives and the evaluation criteria for the design process and the new version.
- We involved the users in the design process to evaluate the design decisions.

As one of the fundamental ideas of this change process was to improve the design quality and develop the design process, I consider the outcome of this phase of the process successful.

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If I had followed the advice: "when you're no longer surprised by what you're seen, you've probably seen enough" this final thesis would never have been ready.

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