KUNGL TEKNISKA HÖGSKOLAN
Royal Institute of Technology
Numerical Analysis and Computing Science

TRITA-NA-D9813 • CID-40, KTH, Stockholm, Sweden 1999

User Centered Design in Practice - Problems and Possibilities

Jan Gulliksen, Ann Lantz and Inger Boivie

CID
Centre for
User Oriented IT Design

Jan Gulliksen, Ann Lantz and Inger Boivie
User Centered Design in Practice – Problems and Possibilities
Report number: TRITA-NA-D9813, CID-40
ISSN number: ISSN 1403-073X
Publication date: January 1999
E-mail of author: Jan.Gulliksen@hci.uu.se
URL of author: http://www.nada.kth.se/cid/

Reports can be ordered from:
CID, Centre for User Oriented IT Design
Nada, Dept. Computing Science
KTH, Royal Institute of Technology
S-100 44 Stockhom, Sweden
telephone: + 46 8 790 91 00
fax: + 46 8 790 90 99
e-mail: cid@nada.kth.se
URL: http://www.nada.kth.se/cid/

Contents

Preface

Jan Gulliksen

This CID report is a summary of and a collection of the papers accepted to the workshop “User Centered Design – Problems and Possibilities” that was held in Seattle, the U.S., on November 14, 1998.

User Centered Design has more or less been widely accepted as a model for or approach to IT development in general. But what does user centered design mean? We decided to put together this workshop to discuss whether the problems we were facing in user centered design were real or imaginary problems. Whilst preparing and conducting the workshop we discovered that user centered design still is an issue containing a great number of unsolved problems and different approaches. UCD is not the "silver bullet" for designing for usability in cooperation with the users. Several examples were provided during the workshop and in the papers - some of which were success stories and some failures. We hope that this summary will give you an idea of the lively and interesting discussion that took place during the workshop. And that it may inspire you to pursue the quest for a solution to the problem of designing for usability in cooperation with users.

For more information see the web-site for the PDC’98 workshop
http://www.nada.kth.se/cid/pdc98/workshop/

The summary has been submitted for publication in the SIGCHI Bulletin. All position papers have been reproduced with permission from the authors.

User Centered Design – Problems and Possibilities

A summary of the 1998 PDC & CSCW workshop

Introduction

The approaches in User-Centered Design (UCD) vary from Participatory Design (PD) to model-based engineering. No matter the approach, UCD is not the simple, clear-cut way to successful systems development as is sometimes made out. To discuss these issues the authors arranged a one-day workshop at the Participatory Design Conference (PDC ’98) in Seattle on November 14, 1998 entitled “User Centered Design – Problems and Possibilities” [1]. The purpose of this workshop was to discuss the problems encountered in UCD in practice and possible solutions, focusing on case studies in real systems development projects. Ten position papers were accepted and the workshop gathered 16 participants from 7 different countries. The position papers are available on the workshop web site [1].

This paper is a summary of the work performed prior to and during the workshop. The main areas discussed are used as headings below. The initial discussion concerned the concepts UCD and PD. These matters were discussed on our workshop web site [1] before and after the workshop. The workshop participants were asked to read the position paper in advance. The workshop did not include any paper presentations but a discussion based on each contribution and the assembled experience. This article starts with the discussion about the definitions that was the basis for the workshop.

Definitions

One of our observations in preparing this workshop is the confusion in the definitions of common concepts. What does user centered design and participatory design mean? And what does user mean? Depending on which discipline you represent, whether you are an academic or practitioner, whether your user population is well defined or not, these concepts are interpreted differently.

In order to be able to discuss the practical consequences of user centered design we needed to define these concepts.

We all agreed to use the international standard ISO/DIS 13407 (Human Centered Design Process for Interactive Systems) as a basis for our discussion on user centered design [2]. By User Centered Design we mean an approach to software and hardware design that identifies four different basic principles [2];

1. an appropriate allocation of function between user and system,

2. active involvement of users,

3. iterations of design solutions and

4. multidisciplinary design teams.

In addition to this it is important for a truly user-centered design approach to ground the design process on observations of the users' practices in the real world.

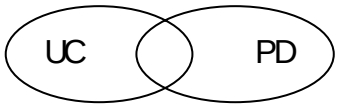
Similarly we regard Participatory Design as a specific mode of User Centered Design which implies the involvement of the users not only at the beginning and/or at the end of the process, but through all the design process. In a PD approach the users actually participate in and are in charge of the making of the design decisions.

One of the comments we received was that it is important to distinguish between bespoke (custom-built) and off-the-shelf products. PD suggests a bespoke product with the participants being the real users of the system being developed. UCD can apply to either kind of product - but in one case you might be working with the real users, while in others working with "representative" users.

What do we mean by "user"? For the purpose of the workshop and this report, we agreed that a user is a person who will use the system for performing tasks that are part of his/her job or leisure activities. People, who are only circumstantially affected by the system, are considered stakeholders, e.g. managers or support personnel.

User Centered Versus Participatory

It may seem that User Centered Design (UCD) and Participatory Design (PD) are very similar, almost equivalent terms, with PD being a subset of UCD.



However, what came to light during the workshop was that these are two overlapping sets, with an uncertain amount of overlap. Some cases were presented in the workshop which were user-centered, but which had no true sense of user participation (in the design process), whilst other projects were discussed where the user participation was in no true sense user-centered.

For example, participation by management and trade union representatives in design reviews (or even in a larger design effort) does not ensure that the designers center their designs on the user and the users' needs.

It seemed to be generally agreed that reducing the size of the PD set that is not also user-centered was the most immediate challenge to UCD in practice.

PD, particularly in North America, is so much more than systems development. It is closely connected to the democratization process in the workplace, i.e. breaking down power structures and empowering the workers. UCD rarely involves such aspects. It is usually limited to ensuring the influence of specific users in a systems development

process. It would probably be more or less impossible for most systems development projects in practice to address democracy matters and issues of power structures.

In Scandinavia PD is no longer as tightly connected to democratization or the influence of the unions as it was in the 70ties [3, 4]. This might be due to the fact that in Sweden the work environment legislation facilitates user involvement. The Swedish Work Environment Law states, among other things, that “the worker should be given the possibility to participate in the design of his /her own working conditions and in development work that concerns his/her work” [5].

Problem Areas

The basis of the discussion was the identification of several different problems with UCD. These problems were illustrated by the different case studies described in each position paper [1], and also a set of possible ways of overcoming these obstacles. The position papers covered the following aspects, amongst others:

- Communication difficulties or lack of communication between e.g. system developers and users, between management and users, between individuals in a team.

- Conflicting goals - do the goals of the different groups involved in the process conflict?

- Competence - what skills and expertise are required in a UCD project in terms of e.g. social competence, technical skills or expertise on the work activities?

- Attitudes - does UCD require certain attitudes in the organization and in individuals in order to be successful - attitudes about users and usability as well as the role of the designer?

- Project organization - what is the role of management in a project, what authority is required for making the necessary decisions?

- Work organization - in what way does IT development influence the organizational requirements?

- Work activity - is a user centered design approach appropriate for every type of work activity?

- Methods, techniques and tools - are the current methods and techniques applicable and efficient, are they easily available on a non-commercial basis? Are the tools suitable for user participation in the prototyping process?

- Requirements engineering - do UCD and requirements engineering conflict, does the demand for frozen requirements allow for the iteration called for by UCD?

The following discussion focused mainly on four different problem areas:

- User participation,
- Project Management and Work,
- Organization,
- Communication.

User Participation

UCD should be integrated in all design processes but how this is done depends on the type of project and product.

Different approaches to UCD must be adopted if the user population is 1) known and accessible, 2) known and not accessible, or 3) unknown and therefore not accessible. Several methods exist for the first case but it is not obvious that the same methods can be used for the other two categories. Several of the questions in this session dealt with the matter of user participation when the users are not accessible or not known.

The following questions were raised:

- Where, when and how do we involve users and who should participate for the most efficient process?
- How do you work with users from the general public – who have non-professional interests in the project?
- How do we address user participation when we work in organizations with freelancers and independent contractors?
- How do you work with UCD when the users are not available?
- How mature must the technology be, i.e. to what extent must a prototype work faultlessly, for showing it to users in e.g. distributed groups, and carrying out usability evaluations?
- How do you integrate UCD if you work with innovative IT? That is, when you work with technology that is not yet known to the public, e.g. in research and development. How do you then do UCD?

Whatever your approach, it is always better to talk to one or two users than not talking to any users at all. We all agreed that UCD should be integrated in all work. The below sections discuss how UCD could be integrated in different situations.

With or Without Users

It is always important to find out who the users are. The discussion included examples where user-centered design was performed without users, as well as examples where the project team met the users at several occasions throughout the process.

Several examples were described where the users were known but not accessible. The reasons for this could be that management prohibited contacts with the users of security reasons, e.g. military applications. Or that management considered their knowledge of the users' ways of working as better and more precise than the users' own versions. In one example management also feared that user participation would preserve old routines based on the current system. Other arguments against letting the developers get in contact with the users included heavy workload or simply because of tactical reasons.

UCD must be possible even when we cannot work with the users, even though practical user participation always should be preferred. When working without users we can focus on the users, for instance by working with scenarios, based on observations (without directly involving the users), created by the design group and make use of the prevalent psychological expertise about people. This way of working may also be useful when the users are not known and therefore not accessible.

If the system is intended for the general public, focus groups, in which representatives of the general public participate, can be used in the development process.

If the total user population is so small that we could fit all of them into the project other methods can be used. The learning process, of the users and the systems developers, that takes place in such a development project is very useful for comprehending the resulting system.

User Representatives

You can choose to work with representatives for the user group. A user representative represents a group of users or a specific category of users, e.g. disabled users, for a specific reason. One should always try to maximize the difference between the people you involve, i.e. try to cover as many different categories of users as possible. When developing for a specific organization all different types of work activities that a system is to support should be covered by the skills of the user representatives. Management and unions are not to be viewed as representatives for a user group, although they are important for the justification of a project.

Some of the representatives should be involved throughout the whole project so that they get to know the project and get committed to its purpose. However, it is well known that users after having participated in a project no longer are representatives of the typical users, e.g. in evaluations. They learn over time and get a lot more involved in the technology that is being developed. Therefore, you should involve other representatives for shorter periods for analysis and evaluations, just to overcome the risk of having the user representatives influence the project in a way that is not suitable for other users.

User Selection

Different strategies can be adopted when selecting user representatives. Selecting users on a random basis, of course, may provide you with some information on how the average

user would behave. Often projects need to be able to arrive at consensus about specific solutions and in this situation it may be preferable to work with randomly selected users.

In other cases, however, you need to focus especially on the conflicting goals of the users. Your concern is not to develop systems for average users but to develop systems that support all user categories. Therefore you should cover the differences in user types. Try to maximize the differences by selecting users of, for instance different age, with different skills, various disabilities, and different computer experience.

Commitment

Having users that are committed to the development project is of course central. User commitment can be enhanced by means of, for instance, the users' participation within their normal work tasks, which give them the possibility of seeing directly how a new system could influence their work conditions. Voluntary participation of course increases the degree of commitment, as it is something the participants wish to do. Whether the users are being rewarded for their participation or not, in terms of increased salaries or benefits, travels, better positions, etc. is of course also central for user commitment.

When the users act on a non-profitable basis difficulties can occur. During the project it is important that the users really feel that they contribute to the project. For this to happen it is necessary to clearly show the participating users that all their suggestions and comments are addressed.

Working with Groups or Individuals

An example of working with representatives for a group of workers was given in which a homogenous group of about four representatives was formed in order to make them strong enough to work directly with researchers, designers and UCD facilitators.
If possible, you should work with both individual users and groups but at different occasions and with different activities in the process. Working with groups of people tends to be more conducive to creativity – people are less creative on their own. Having a group of users solving a particular problem is much more efficient than asking single users. Group work could also shift the balance of power from the development team to the user group.
Regardless of whether you work with individual users or user groups, users must be treated as equals regarding power and expertise. The goal should be to have at least be as many users as other participants in a project.

Humbleness and Respect

It is important to think about how to co-operate with users and that we have to take care of this contact. The keywords for success are humbleness and respect. The ways in which we interact with the users controls the result. Unfortunately attitudes both from the developer side and user side can be obstacles in this process.

It is what people think, say, feel and do that is important and what the context is.

When do We Meet?

In reality the users are often invited in the beginning and at the end of the development phase only. Sometimes, they are only involved in the scenario process and evaluations of a full-scale prototype. This is very unfortunate. In the phases where there is no user

participation several decisions are made that affect the usability of the resulting system, that would not have been made if the users had been consulted. It is important to have user participation continuously throughout the process to preserve the usability aspects in the final product.

Working on the Field.

Do we meet on neutral ground or do we let the users enter the design ground? Where do we meet?

It is important that not only the UCD facilitators but also the designers and developers should go out into the field and have direct contact with the users. Field observations might give the designers some impressions and ideas that they would not have been able to obtain otherwise. After all, users are clients that the designers and developers are supposed to deliver products to.

The designers must get to know their users but it is equally important that the users get a notion of the technological possibilities and limitations. Therefore, you should also invite the users to the designers' office: "Let the users leave their trace in the design office". This can be done, for instance, by means of modifications to a prototype or a mock-up, or by means of sketches of the system. This will be described in more detail in the section on Mutual Shared Understandings below.

Video Documentation

Video is a very useful medium for analysis and for visualizing current and future scenarios. Video is also a very efficient medium for showing developers how users actually use the products that they have designed. When a developer has seen a user perform the same error a couple of times there is no need for further convincing that the design must be changed.

In order to facilitate fruitful and informative interviews and to learn about the hierarchies of the workplace in advance, spending time at the workplace with a video camera could be very useful. The following example was described at the workshop:

"NN went down with a video camera and talked with some people that I previously had interviewed. I could tell from the video that these people that I had interviewed were the seniors and not typical user representatives. In this situation the participation had begun before we were involved, video taped the way people worked. "

In this example the video film that was shot in advance, on the floor could help the designers understand the power structures in the organization. Video can also be used for showing designers what is happening on the field with the developed systems or during the performance of work tasks, a shortcut to real observations on the field.

Finally, video can easily be used to visualize a future scenario or a prototype of a future system in its imagined environment.

Project Management and Work

The following questions were raised during this session:

- What is the role of the UCD facilitator in the process?

- How do you know when to stop your iterations?
- How do you involve the users in the actual design process?
- How do we speed up the UCD process?

The Role of the UCD Facilitator

Several roles are involved in the development work but we did only focus on the users, the designers/ developers and finally what we refer to as the UCD facilitator - who intermediates between the users and designers/developers. The role of a UCD facilitator can be as a go-between - i.e. somebody who actively steps in and resolves conflicts - or simply an observer. However, as a UCD facilitator you have shouldered the role of bringing people together, therefore you must not be partial or take somebody's side.

The role of the UCD facilitator is multi-faceted - UCD-facilitators can be matchmakers, interpreters or translators? UCD facilitators need to switch roles depending on whom they are talking to. When communicating with users, the UCD-facilitator shoulders the role of the designer. When talking to the designer the UCD-facilitator is regarded to be a user representative. We have to be aware of the power imbalance and conflicts. It should not be taken for granted that the designers are interested in working in a user-centered manner. But, the UCD facilitator must involve the designers and create enthusiasm amongst them for the UCD process.

The role of the designer may not be clear to everyone in the project. Thus, we have to acknowledge the problems of the designers - they just want to get their job done. As of yet, we do not fully understand how the designer role changes when he/she starts to understand the users, the work/area and context.

Users and the Design Process

People and work change, therefore we will have to cover as much ground as possible and find out what the extremes are. It might be fruitful to look at old projects and where they failed in order to find out what one should avoid when adopting a true UCD approach.

Parallel design and iterative development are, of course, essential ingredients in UCD. And essential for involving the users in the actual design process. It is useful to show users mock-ups with increasing level of detail to promote a discussion. If the users come down with a totally different solution it is either bad design or a matter of bad expectation management.

Users evaluate design and redesign. The design material that we work with can tie us together. Mock-ups and user-created scenarios are useful means for involving the users in the design process. It is important to ask the users the right questions about mock-ups such as "Where would you like to put it?" and "Where would you like to plug it in?" - not "What would you like to use it for?"

Make sure that you, and others, do not value the ideas of the designers more than the ideas from the users.

User Terminology

Users are often not familiar with the abstract concepts and terms used in systems development and design. They can easily communicate in terms relating to their own work activity but may get confused or feel intimidated if asked to use computer terms or design terms. You could however help the users think in design terms that are related to their reality by using low-fidelity mock-ups.

The Cost of UCD

How do we speed up the UCD process? Should we work with quick and dirty UCD? Is UCD too expensive? Perhaps, these are not the questions we should ask - but in what ways can UCD contribute to the design process?

User centered design is often criticized for being expensive. Is this really true? We feel that with UCD we can start to think of development in another way, and offer another model. If we just add UCD to an existing model, then it becomes expensive. You have to decide on a UCD approach from the very beginning or it will just become one expense among others.

Knowing when to stop the iterations is often not really a problem, because the decision to stop iterating is in many cases not yours. It could be a decision made by factors outside of your immediate control, e.g. project managers, delivery dates or contracts.

Organization

UCD can be viewed at an individual level and on a group level, as presented above. But, practical problems also occur on an organizational level. The following questions were raised during this session:

- How do you manage integrated development, that is, simultaneous development of the organization, skill attainment and development of the work activity in conjunction with the IT-development?
- How do we create a cultural context for user participation?
- How do we take the power relations into consideration when developing IT?
- How do you avoid organizational politics in UCD?
- How do you manage user expectations?
- Whose knowledge is important when introducing new computer support? Co-construction of shared understandings?
- How does user participation affect the ways you think about design?

It is politically correct to say PD, it is a sales argument but many examples of problems were brought up during our discussion on UCD and the organizational level.

Conflict and Power

Almost any development project contains conflicts between different groups, e.g. conflicts between management and workers. Management may want to computerize the work activities but the workers might not want any change.

The following example illustrates the question about power between management and the user groups: In this particular situation, management felt that they had worked in a participatory design manner. They felt that they had already sufficiently analyzed the work activities. Therefore, they did not want the designers to talk to the users or to the union people. Instead, management showed a video presentation of the new system to a group of users, and asked them to answer a brief questionnaire. Management thought that they had worked in a PD manner. The project manager agreed to this procedure and the users could do nothing to change it.

In another example the employees came up with ideas and even prototypes. Management did not care to start a new project and killed the new ideas.

Yet another aspect is that decisions are often made at the top levels of the hierarchy in an organization. People working on lower levels in the hierarchy have no say. Nevertheless, when introducing a systems development project or a new system in an organization, the workers are those who are influenced the most. Ideally, a new system generates changes in the organization and power structures from which the workers can benefit. However, it is a well-known fact that people are extraordinarily flexible but organizations are very bad on changing.

IT affects Power structures - one of the participants brought up an example from the Swedish Health Services where an Intranet project aimed at breaking down the power structures. When the project ended, the structures returned, simply because doctors still got special services carried out for them by other staff members.

Intentionality

What is the intention of UCD? Is it technology push or user demand pull? Technology push means that the technology and its possibilities is in focus while demand pull means to start by analyzing a real need or requirement from the user side - then you try to develop techniques to support it. Often it is the technology that pushes instead of the problems or needs that pull. In that case we will have to decide what our intentions are. Do we want to break down the power structures, or do we create something that reinforces them?

The discussion on power structures relates to the intention behind the systems introduction. If we want to change the power structures and flatten organizations with the purpose of democratization then PD is appropriate. If we introduce a new system well aware of the influence and needs to change the organization, but without it being the major goal, then UCD is appropriate.

We have a responsibility towards the users regarding cultural and social aspects.

Integrated design

We have to be aware of the fact that the organization changes when you enter. When a systems development project is started the organizational change is also initiated.

The world is not unchangeable. However, in traditional software development methods we tend to regard systems development as a separate activity that is not affected by or affects anything else. This is rather natural, as most of the traditional systems engineering methods tend to narrow the view down to system construction and nothing else. UCD can help you brake out from this view. UCD can help you break out from this narrow view in that it focuses on aspects such as skill attainment and work organization in parallel with the actual systems development.

Cultural Context for UCD

The following case descriptions illustrate the problem of creating a cultural context for user participation.

A Case of Organizational Obstacles 1

The first case was a case including almost every organizational obstacle that we could ever imagine. The setting was a big organization with a very powerful hierarchy.

The project was a research project on the impact of information technology and an office environment design project. The manager and the designers were willing to do PD, but they did not succeed because they had a certain perspective of their own roles and of the users. The users were not partners, but, at best, beta testers. The users were invited to workshops where they were presented ideas and prototypes. The users were supposed to state what types of modifications, they would like, but they were not able to propose other solutions and the modifications asked for were slight ones. Therefore, the users did not propose anything and did not seem to feel that they had to.

Although the designers collected data, their design vision were not very much influenced by the analysis of the data, but much more by their own perceptions and ideas. The designers took themselves as the best examples of users: “All users work in an office, and we do too, so we know the needs as well as (or perhaps even better than) the office workers involved in the design process.” There was a very strong feeling that the users did not know what they do and want. A designer stated that: “If you show them a red watch, they don't want it. But, if you then come back and show them the same watch, but green, they like it.” In fact, the designers did not create a situation in which they could enable the users to express themselves and to really explore alternative design possibilities. The designers did not really listen to the users.

Although, when a UCD facilitator was hired, he thought that he would be strongly involved in the design process and that he could use the numerous PD techniques that have been developed and that he previously has used in other PD projects. But, because the setting was not there he was completely unable to use these techniques.

The problem is to create a cultural context that allows you to communicate. You need to tailor your language for the different audiences. But, if the management does not believe in these techniques and the "philosophical" background of PD, the efforts will fail. Either it will fail at the level of the design process, as in this case, or at the level of going from a prototype to an extended prototype or even a product. As an example, an Air Traffic Control project [6] exposed the design and prototyping process and some of the

techniques that was used, as well as the different solutions that was explored. The project finished with a prototype that the controllers liked, but it was not possible to continue this project and develop, evaluate and evolve the prototypes because of financial reasons. Mostly the project ended because of organizational reasons, which is not clearly stated in the paper.

A Case of Organizational Obstacles 2

The second case was a governmental organization in which UCD had been promoted for several years. Being a governmental organization it does not pay its software developers very well. The result of this was that young software developers with less experience and skill were employed for a shorter period while acquiring experience after which they moved on to other, better paid jobs. The senior software developers stayed since their initial base was the work activity in itself. Having both knowledge of the work and software development they were indispensable and also very loyal to the organization. Moreover, the turnover of people in this organization is very high, software developers tend to work there for no more than a couple of years. The users, on the other hand, work within the organization for most of their lives. The organization contains about seven hierarchical levels and at all levels people have previously worked as users at lower levels. Even if this was several years ago they still claim to be experts on the work on all managerial levels. The organization is constantly reorganizing. Thus, creating a cultural context for user centered design in which 25 years old male software developers are to cooperate with 60 years old female user representatives is almost an impossible mission.

Lacking user contribution

We were also supported with an example of users that were not as contributive as you would want. The users tested a prototype but ignored the issues that the project wanted to test. The users did their own race why their tests did not supply the developers with very usable information.

Communication

Who should talk to whom and who needs to understand whom? These questions reflect the discussion on the topic communication.

Although some participants thought that a common view was impossible still the majority of the workshop participants talked about a common understanding and communication between the users, UCD facilitators and system designers.

Mutual Shared Understandings

Should the users have to learn to understand the designers? Not necessarily, but the designers must understand the user. The designer must show what the technology can be used for. Some argued that it is important for the users to understand the design constraints, others argued for the opposite. Designers should understand users, but, mainly, UCD is about helping users express their needs, ideas and expectations.

However, the users must understand that the design is a complex process involving trade-offs. This may empower the users. Users cannot express their needs because of the

complexity of the technology. Therefore its is our role as UCD facilitators to explain the technology to help users generate ideas about what they can use it for.

It is not clear from where you start the shared understandings. Is it confrontations and personal values or consensus and shared values that facilitate it? Basically, our shared understanding is based on the individual level - on attitudes, social skills, what am I supposed to do, and what can I expect from others?

Certain design models in architecture use themes to create a shared understanding of the important aspects in a building, such as transparency. Is there any way we could use the same technique in systems development - how would you make a systems designer think in terms of themes? What kind of themes could be used to describe, for instance, the important aspects of a user interface in a computer application?

Is it possible to participate as equals? In most projects the designers and computer people tend to take over, for instance, in workshops with users. Is it possible to participate as equals during the development process? One way of avoiding this is to start with task analysis, this puts the focus on the users and brings out the users' expertise.

Managing Expectations.

Successful management of user expectations is important for keeping the users committed and contributive in the design process but also for ensuring usability in the end product. How do we bring in the users? Are the users willing to compromise?

IT people sometimes make the mistake of propagating the attitude that – "if you just give us a requirements specification, we can create a system that will suit your needs". This creates expectations that cannot be met.

In order to avoid unrealistic expectations, models, i.e. mock-ups or prototypes, can facilitate the communication between the designers and users. However, we have to make sure that we do not limit the conceptions and ideas of the users.

We value more the time of the designer than the users so we try to make the communication go from the users to the designers and not the other way around.

Group discussions

During a one-hour session the workshop split up in three smaller groups. Each group chose which matters to discuss. The below sections describe the outcome of each group discussion separately.

Group 1

The first group discussed the following matters:

- How to introduce usability in an organization,
- User and designer characteristics,
- The role of prototypes,
- The UCD facilitator.

How to Introduce Usability in an Organization?

What do I do if I am the first usability person in a company? Should I build up a usability lab? In such case, where should I start? This was an issue that the group decided was important but that never was resolved.

User Characteristics

How do we work with the users in the design process? Should the users be involved in the aesthetic design process? People are not good at imagining things, but if provided with a prototype they immediately start doing things with it. If you ask people to tell what they would want to do in an abstract future they are very bad at imagining something else than what they have today. But if you give them prototypes to interact with and ask them leading questions they immediately start to do things with it. Concerning the aesthetics, users should not design. They do not have the ability, experience or even the interest to do so. But, given an appropriate context, the users could be made to perform magnificently with low-level mock-ups.

The Role of Prototypes

How do we make the user-centered approach live throughout the design? Very often the developers do not keep the main ideas of a designed prototype when starting the actual construction. An example was given of a design of a camera prototype. A big-sized functional digital camera was designed through a process of prototypes, mock-ups, videos, Director movies, etc. The client expected something that looked designed and they were very satisfied with the design? The main ideas of the prototype were preserved all through the production even though the industrial design changed, but the main usability aspects were preserved. One of the conclusions of this is that it is important to use different tools to produce mock-ups. One of the main goals with a prototype is to teach the developers what makes this product usable, and one way of communicating this knowledge to the developers is to design several prototypes with different tools.

Playing with Prototypes

Playing with the products is important, because when pretending to use a prototype you tend to discover several aspects of it that the user is not aware of and that are not obvious to the designer. However, physical products are much easier to treat in this way than software products. A hardware product is something that the user tends to pick up and immediately start interacting with. A software product takes a lot more imagination to deal with.

Market research, anthropology or customer/user demands should control the initial prototype, which should be very simple. For example if you are designing some sort of hand-held device, you should make it as simple as possible, only as a black box. Then the user picks it up and immediately tries to figure out where to switch it on.

Interpretation of the user reactions is very important for success. It is a question of seeing what is happening, and going beyond listening to the users.

Designer Characteristics

Designers as a profession have a very special way of promoting their work. Good design is not necessarily usable design, it rather focuses on aesthetic appeal. This means that

users want usable products but designers aim for design awards. This exclusive way of promoting each other's ideas obscures the general idea of creating usable products. The designers need to understand that users are clients that the designers are supposed to deliver usable products to. Perhaps you need to tame the designers from time to time. Bringing the designers to the users might give them some impressions that may change their minds about what good design is.

The context of work for the developers is also important. Having the designers meet the users in the user organization has proved to be efficient in changing the way the designers work. Solving the design problems by going next-door and asking the users directly is more efficient than trying to figure it out on your own.

The Role of the UCD Facilitator

We had quite an extensive discussion on multi-disciplinarity, actors and roles. What does the UCD facilitators do? Is he/she a researcher or practitioner? In order to be a good UCD facilitator you need a multidisciplinary background. It is the need for people who know a little bit about a lot of different areas. You need knowledge on human-computer interaction, cognitive psychology, ethnographical methods and design. But you also need to know a bit about the software that is being used, you need to know its possibilities as well as its limitations in order to communicate with the developers. In addition, you need to know enough about the work domain to be able to understand the essence of the work tasks. Last, but not least important, you need to be socially competent, with good abilities to communicate with people with various backgrounds. It is important to be able to inspire confidence both with the users and the developers. Are we demanding too much of our UCD facilitator?

Evidently there is a need for more than software developers, e.g. interaction designers. Recently this has been recognized and such educations are being defined at the different universities.

Shortening the Iterative Cycle

To be able to prevent the so-called "My-baby-syndrome" and to arrive at true iterative design it would be important to shorten the iterative life cycle time. Hewlett & Packard works with an iterative cycle time of 1-4 weeks, which has proved to be very successful. The iterative lifecycle consists in the beginning of lots of analysis, a little bit of design and almost no evaluation. As the cycles pass they include more and more of design and evaluation and less, but still some, analysis. Finally the evaluation and redesign takes over.

Group 2

The second group discussion started out with a discussion about iterative design. How do you plan and control such a process? How do you know when to stop?

The group also discussed different ways of involving the users.

Planning and Controlling Iterative Design

The group agreed that although the iterative process is more difficult to control, and although you do not know what the results will be when you start, the outcome is still better than the results of a non-iterative process. The normal procedure seemed to be a

deadline within which as many iterations as feasible were carried out. Milestones for controlling the process were suggested.

Several ways of dividing the process into smaller steps were suggested:

- Start with a pre-study, in which you outline the contents of the next step which will result in a prototype.

- Split up the system function-wise, and construct deep prototypes.

- Carry out at least two iterations - in the first iteration you compile and test ideas from/with individual users, in the second iteration you test these collective ideas with a group of users.

Ways of Involving the Users

The group also discussed how to involve users. The ways of involving users differed, e.g.

- 5-10 workshops with 7-10 user representatives once a week early in the process.

- Workshops every second month or so with up to 15 throughout the whole development process.

- Meetings with a small group of committed users who have volunteered to participate. The meetings cover any urgent topic, e.g. Where can we put the computers? Can you share computers? The next step is to introduce the prototypes to a larger group of users.

Working with the same users throughout the process was recommended.

Half day or whole day workshops seemed to be the normal way of involving the users. In such workshops it is important to visualize the design ideas, e.g. photos, mock-ups, drawings, scenarios (written by the users). There are different advantages with different types of prototypes.

It is important that users are allowed to ”leave traces” in some way - e.g. by means of modifications to mockups/prototypes. Video-record the workshops - the videos can be used to verify modifications and to evaluate the meetings. They can also be shown to the designers and to management.

Group 3

The third group discussion concerned power roles and co-construction of shared understandings.

Language can be one way of maintaining power. Each time we enter a new work site to start working with a new user group we have to build a common ground for communication, a so-called co-construction of a shared understanding. This you have to do every time you start a group process. By doing this you will get the basic knowledge about, e.g., the work site, the work performed and you also make a common agreement on the language and concepts used and their meaning.

Roles

All persons working in a systems development team have their roles. The UCD facilitator role is to mediate. The facilitator must also have a position as well as designers and users have. The cooperation between users and designers is dynamic and the dynamics must also exist between the UCD facilitator and the user. As facilitators we contribute to the design and for being more equal in the development team we should regard ourselves as being designers - calling our selves designers.

To avoid being trapped in traditional roles and just seeing the technology as the big interest, maybe we should focus on implementation rather than on design. This might let us focus more on the social side. Even as UCD facilitators we are a part of the design.

Users and artifacts

Different people use artifacts in different ways and the term user is somewhat misleading since a user not only just use technology but is a person with a multiple range of other activities, interests and roles.

Designers try to design what people should do. We provide settings and develop tools and we should prescribe what should happen in this process, for instance in process automation and control room settings. Here, it is not a question of designing better control rooms, but to focus on what people do, trying to see the whole context.

We should try to design technology so that it can be used in various ways. Imagine a lorry setting. The driver sits in the lorry the whole day, driving. But, it is not the only thing he does. He might listen to the radio, talking with a friend in a cellular phone, eat or even shave his beard. If he has not reached his destination in the end of the day, he will sleep in the lorry. Our goal must be to construct other artifacts in a way that they could be used for multiple purposes. Such a goal is a new and maybe better goal to strive for.

A purpose to join in UCD

All involved parties have their purposes to join a cooperation process. It means work in the field that everybody wants to benefit from. You do not start to cooperate merely for its own sake.

To join you do not necessarily need an interest of the technology itself. To work with UCD or PD can have other goals. One of the participants in the group is driven by the goal to improve women's working conditions.

New technology has often not been as liberating for women as wanted. UCD can then become a tool for reaching greater goals than usable systems.

Practical methods for participatory design - Comments by Anne-Laure Fayard

"I think it is important to stress the fact that for me Participatory Design means that users are involved from the beginning and during all the design process (and not only at the beginning and at the end). Users are not only observed and interviewed at the beginning or not only test the final prototypes, but they play an essential role all through the design process. Therefore, PD implies first observation, i.e. field studies using ethnographic methods, video and interviews, as well as the critical incident technique. During the field

study, it is important to build a true relationship with the users, to succeed in having "empathy with them". Analyzing the activity is the first point, then the design process in itself starts (although it is important, if possible, to keep going back to the field and the data, during all the design process. It may often occur that the design process requires more analysis). The PD process consists in a series of workshops with researchers (HCI facilitators, ethnographers) and designers (and developers) and workshops with researchers, designers (and developers) and users. During the workshops with the users, you first present them what we call work scenarios which are created using the observations, videos and interviews. Scenarios should be at the same time very general and very specific. The users should evaluate these scenarios and tell if things really happen like that. These scenarios are the starting-point for brainstorming sessions where you imagine new solutions and ideas. You try to create new scenarios, design scenarios, which correspond to the first scenarios modified according to the ideas proposed in the brainstorming sessions. The ideas of the brainstorming are prototyped. It is essential that the first prototypes should be "quick and dirty", i.e. paper prototypes and video prototypes. One can also use the Wizard of Oz technique in order to give users an impression of what the system looks like. All these phases are iterative, until... and then you come back to the question: when should we stop the iterations, and I have no answer. I think it is important to have a system as flexible as possible, if this can stand as an answer...”

P.S. “The methods, techniques and the iterative approach described above, I learnt and used while working with Wendy Mackay on a research project on Air Traffic Control. These methods and techniques and the iterative nature of the process were fruitful.”

Conclusions

The workshop has illuminated several burning issues about UCD and PD in practice. The discussions covered the following topics:

- When and how to involve the user in a design and development process.
  The methods vary according to whether or not you have access to the users, whether they are the general public or a small, well-defined user group. No matter the circumstances, involving the users is always preferable, if not always possible.

- Practical experiences of prototyping and video recording in the analysis, design and evaluation process.
  Low-level prototypes are cheap and efficient means for having users generate new ideas about how to use new technology. It is however important to ask appropriate questions when the prototypes are evaluated. They can also be used for creating a shared understanding of the context in which the new system will be used.
  Video tapes are useful for capturing important aspects in the work context, such as pre-information about power structures, routine maneuvers and pieces of tacit knowledge, that otherwise may go unnoticed.

- Organizational obstacles to user centered design.
  These obstacles often include the unwillingness of management to involve the users. Management may feel that the users do not know what they want, or are unable to express it, or the goals of management may conflict with the wishes of the users. Other obstacles are attitudes within the development team, about users and usability. Or the designers' attitudes about good design, focusing on aesthetic appeal rather than usability.

- The role of the UCD facilitator in the development process.
  The UCD facilitator intermediates between the users and the designers. He/she often has to resolve conflicts and represents the users in the eyes of the designers and vice versa. A skilled UCD facilitator should have multi-disciplinary background, so that he/she can understand how humans interact with computers and other human beings, how computers and software works as well as the context of use.

- Communication problems that occur when people with varied skills and expertise communicate with one another.
  Respect for other people's expertise and skills is essential for bridging the communication gap.
  Although UCD is about helping the users express their needs, it is also important to acknowledge the need for users to understand the constraints of the technology and the complexity of the design process.

The workshop participants also contributed with several successful examples and a few horror stories about UCD and PD in practice.

The workshop participants concluded that there still is a strong need to market and promote UCD in practice today and we see as our mission to continue this discussion in the near future.

References

[1] "User Centered Design – Problems and Possibilities" Web-site for the PDC'98 - workshop http://www.nada.kth.se/cid/pdc98/workshop/

[2] International Organization of Standardization (1998) ISO/DIS 13407 (Draft international standard) Human centred design process of interactive systems.

[3] Ehn, P. (1988). Work-Oriented Design of Computer Artifacts. Stockholm: Arbetslivscentrum, Sweden.

[4 Bjerknes, G., Ehn, P. & Kyng, M. (1987). Computers and Democracy. ORT: Gower Publishing Company Ltd., England.

[5] The Swedish Work Environment Law. (Arbetsmiljölagen), § 2, part 1.

[6] Mackay, W.E., Fayard, A-L., Frobert, L. & Médini, L. (1998). Reinventing the Familiar: Exploring an augmented reality design space for air traffic control. In proceedings of the CHI '98, 1998 (Los Angeles, USA, April 18-23, 1998) ACM, New York, 1998, pp.558-565.

More Information

More information about the workshop, position papers from the attendants, as well as coming activities can be found on through the first author or by http://www.nada.kth.se/cid/pdc98/workshop/

Acknowledgements

The workshop participants are acknowledged for their input on the workshop and for their input on this report. The workshop participants were:

Ellen Balka (Simon Fraser University, Canada), Thomas Binder (Malmö University College, Sweden), Inger Boivie (Enator AB, Sweden), Eva Brandt (Technical University of Denmark), Jacob Buur (Danfoss A/S, Denmark), Anne-Laure Fayard, EDF-R&D Division, France), David Gilmore (IDEO Product Development, U.S.A), Jan Gulliksen (Uppsala University, Sweden), Anneli Hagdahl, (Linköping University, Sweden), Helge Kahler (University of Bonn, Germany), Helena Karasti,(University of Oulu, Finland), Ann Lantz (KTH, Sweden), Masood Masoodian (Odense University, Denmark), Markus Rittenbruch (University of Bonn, Germany), Steven Verjans (Odense Steel Shipyard Ltd., Denmark), Fredrik Winberg (KTH, Sweden)

About the Authors

Jan Gulliksen, Ph.D. in Systems Analysis performs research on user centered design in several applied projects (e.g. with the Swedish National Tax Board) at Uppsala University. Jan is also supervising the working group on user orientation at CID.
Ann Lantz, Ph.D. in Cognitive Psychology, working with user oriented system design and communities at CID and a project on knowledge exchange, communication and context in electronic networks.
Inger Boivie, MSc, works as a consultant with user-centered design and usability-related activities in a software engineering company. Inger also works part-time in the CID working group for user orientation.

Authors' Addresses

Jan Gulliksen
Dept. of HCI, Uppsala University
Lägerhyddsvägen 18

SE-752 37 Uppsala
Sweden
email: Jan.Gulliksen@hci.uu.se
Tel: +46-18.471 2849

Ann Lantz
CID, NADA, KTH
Lindstedtsvägen 5
SE- 100 44 Stockholm
Sweden
email: alz@nada.kth.se
Tel: +46-8-790 68 17

Inger Boivie
Enator AB
Kronoborgsgränd 1
SE-164 87 Kista
Sweden
email: inger.boivie@enator.se
Tel: +46-8-7036200

User-Centered Design as Negotiated Relationships

Ellen Balka
Associate Professor and Director, Assessment of Technology in Context Design Lab
School of Communication, Simon Fraser University
Burnaby, B.C. V5K 1K1
ebalka@sfu.ca

Biography:

In 1987 I began working with national, provincial and local women's organizations in Canada that were interested in developing or adapting computer networking systems for organizational communication. My work was influenced heavily by both feminist critiques of scientific expertise (e.g., Benston, 1986), and the emerging participatory design literature. Through this work I began to develop a critique of participatory design that reflected my attempts to utilize a participatory approach with voluntary and non-profit women's organizations (see Balka, 1995; 1997a and 1997b). In 1995 I began a project (now nearing its completion) that has included interviews with practitioners of participatory design and participatory ergonomics projects that have focused on designing technology for women users.[i] I established the Assessment of Technology in Context Design Lab (ATIC-DL) at Simon Fraser University, which serves as a focal point for researchers and practitioners from a variety of disciplines and work contexts to engage in user-centered design projects that include observation of emergent technologies in their use context. The project described here, although not specifically about women users, raises questions about power relations in UCD projects that are important to consider in relation to UCD projects with women end users.

Introduction

User-centered and participatory literature has addressed numerous issues to date. Participatory design boasts many approaches to working with users, as well as methodologies that are well suited to participatory design. While obstacles to user involvement have been identified (e.g., Grudin, 1991), limitations in terms of what user participation can and cannot deliver have been addressed (Hales, 1993) and it has been argued that the "relationship between user participation and conflict is more complex than previously considered" (Barki and Hartwick, 1994, p. 422), the phenomenon of power (between users and designers, between different user groups, between men (often designers) and women (often concentrated in specific user groups), and between

[i] A rationale for my continued focus on women users of technology can be found in the project proposal for my research that is nearing completion. The proposal text is available at http://www.sfu.ca/~ebalka/sshrc.htm.

management and workers has received surprisingly little attention within the field of user-centered design. Although approaches and methodologies have been developed to guide user-centered design processes, viewing the design process as a series of negotiated relationships that occur within a social system characterized by differences in power between various groups[ii] has often remained outside of the scope of inquiry of UCD.

Lacking a tradition of participation, practitioners in North America often must convince interested parties that worker (or user) participation is worthwhile. Even when all parties have agreed to engage in a participatory design process, many obstacles exist (Riech, Konda, Monarch, & Levy, 1996), and few guidelines exist to help those engaging in the process structure a good working relationship.

Through a brief investigation of a project that involved students and a teacher in the development of mathematics software, here I discuss one of the project's strengths (how the collaboration between users and designers was set up and managed), and one of its weaknesses (how conflicting goals made it difficult to realize some aspects of user input). I end with a list of questions the project raised for me. Although this project was not specifically about women, several issues that arose during the project relate to engaging in UCD with women end users.

Background and context

During the 1997-1998 school year members of the Assessment of Technology in Context Design Lab (ATIC-DL), the PolyMath Development Group (PDG) at the Centre for Experimental and Constructive Mathematics (CECM) (both at Simon Fraser University) and staff and students from the Island Pacific School (IPS) engaged in a participatory process that resulted in the development and implementation of network-based computer tools for learning in the mathematical sciences. Although we infrequently think of schools as work environments, they are the site of work for teachers (who in this case would adapt the math software in their classrooms), and it can be argued that they are also the site of work for students, whose work consists of learning.

The computer tools developed (which consisted of a series of JavaBean applets) introduce middle school children (ages 12-15) to geometrical mathematical concepts such as transformations and tessellations. The software tools were to be suitable for use by both students and teachers, and it was expected that teachers would be able to quickly modify applets. Students at Island Pacific School became active participants in the design process. They were briefed about participatory design and their role in the project when the project began. Their regular math teacher (a woman) was also a staff member of the PDG, and filled an important role on the design team (whose senior members were all men). Frequently after using the technology in the classroom the math teacher returned to the PDG and made changes to the software aimed at correcting its shortcomings. The math teacher performed a bridging function between the school and the design team. With assistance from members of the ATIC-DL, she developed and implemented strategies that

[ii] In North America and Britain such power differences, often expressed through large wage differences and dramatic differences in standards of living and quality of life, are often overtly expressed. In contrast, in Norway, Sweden and Denmark, it appears that a cultural commitment to and public discourse about equality simultaneously helps move those countries towards equality and make it difficult to overtly discuss some forms of power imbalances (e.g., power differences between male and female workers).

would allow her to obtain the students' views about the technology. She reminded other members of the design team of the classroom context during design meetings, and, to some extent acted as a representative for the children in meetings with the rest of the participatory design team.

A member of the ATIC-DL made weekly visits to the school to observe student and teacher use of the emergent technology, and members of the ATIC-DL facilitated three extended sessions that used a technique similar to PICTIVE[iii] (Muller, 1993) to elicit design input from students. Group discussion following design sessions and student journal entries about experiences using the technology were used to elicit additional design input from students.

Rationale for adapting a participatory approach

For PDG and IPS members concerned with what children could learn through use of the new networked based tools, it was hoped that a participatory approach would improve the quality of the tools, which in turn would lead to a better form of learning. The system developers hoped that a participatory process would result in a system that worked better. Members of the ATIC-DL were primarily concerned with the politics and philosophy of participatory design, although they stressed pragmatic aspects of participatory design at the onset of the project.

Project Structure

The project was funded through a national funding source as part of a larger project (the M3/Plexus Project). The ATIC-DL became involved in the project after development of the software had begun, but before beta versions of the software were implemented in the school setting. The ATIC-DL entered into a contractual relationship (modeled after a consultancy)[iv] with the PDG to provide an ethnographic analysis of use of computers and the math software in the school setting, and to facilitate users' (students') involvement in the design process. A member of the ATIC-DL conducted observations at the school on a weekly basis, and attended weekly project meetings at the CECM. Members of both groups held extended meetings at key points throughout the project.

Problems and Possibilities

Although developing software for use in a school environment is not a widely representative user-centered design context, throughout the project we encountered a number of situations that are indicative of the problems and possibilities of user-centered design. Some of what worked well for us, the problems we faced and the issues the project raised are briefly outlined below.

[iii] The technique developed, simCHET (simulated Computer-Human Engagement Trials project) is discussed in greater depth in a paper titled Premature Adoption of a Constructive Educational Technology: A Case Study, available at http://www.cecm.sfu.ca/~loki/Papers/PreAdopt/paper.html.

[iv] In Norway, Denmark and Sweden worker involvement in technological change is supported through legislation. In contrast, in North America neither labour law nor tradition supports user-involvement in technological change. In the absence of tradition and legislation, facilitating user involvement as a design team member or consultant is often the way to encourage user-centered practices.

Communication and Project Organization

This collaboration was jointly developed by the director of the ATIC-DL, and the research manager of the CECM and PDG. We had to convince both ATIC-DL staff (who would perform observation and facilitate user participation) and PDG staff (programmers, members of the design team and the IPS teacher who also worked for the PDG) as well as students at the school and their parents[v] that they should participate in the project. Aware that ATIC-DL staff and PDG staff might have some reservations about the proposed collaboration, the PDG research manager and I each met with our respective staff members and asked them to identify any concerns they had about the proposed collaboration. After discussing those concerns separately with our staff both groups met together to discuss the proposed collaboration.

At that meeting each of the staff members from both groups was asked to raise his or her concerns, and as a group we discussed how we could address the concerns raised. The teacher was concerned that she would be evaluated (rather than the computing environment and software). The designers were concerned that they would receive a continuous stream of design input which would make it difficult to carry out their work. The ethnographer / PD facilitator was concerned that he would be asked to take on additional tasks at the school which would make it difficult for him to complete his work. Strategies for dealing with each of these concerns were developed. We decided that design input would be delivered only at critical points which were determined in advance. We jointly developed a structure for dealing with conflicts that might arise during the project, and we jointly developed a plan for introducing the project to the school principle, the students and their parents.

During the project and after it was completed, members of both the ATIC-DL and the PDG felt the project was a success. We believe that taking the steps outlined above helped build trust between the two groups, and made it possible for us to work well together. In North America, where user involvement in designing technology has not yet obtained widespread acceptance, structuring user involvement like a consultancy may provide opportunities to involve users in design, that might not otherwise exist.

Project Organization and Conflicting Goals

Although we did receive concrete design suggestions from both students and the teacher, in some instances we were not able to have features included that we would have liked to, and in other instances we were able to have features included only through informal negotiation. (For example, the teacher offered a junior programmer a meal at a restaurant in exchange for including grid lines in the software). Our inability to have certain features included in the software was related to conflicting goals of the systems designers.

One factor that influenced the development of the software was a general belief that any coherent system needed to be designed around a standard, otherwise it would have a short shelf-life. The PDG was a co-founder of the North American OpenMath Initiative, and a significant portion of PDG's human and financial resources are committed to the development of software that conforms to the emerging OpenMath standard. Development of the math software for IPS, though separately funded, benefited significantly from its

---

[v] In Canada, any research carried on at a university that involves 'human subjects' in any way (as this one did) requires ethical clearance. As this project involved children, we were required to secure informed consent from the students themselves, as well as their parents.

association with other PDG projects related more closely to the development of the OpenMath Standard. Programming staff (who worked on the IPS project in addition to other PDG projects) felt that although there was a temptation to customize for the IPS context, that they should remain within the OpenMath specifications. One result of this was that the design team was reluctant to dedicate time to implementing features that either did not conform to the OpenMath Standard, or for which no standards yet existed.

While the instance of conflicting goals described here had few significant consequences, it is indicative of a wider problem user-centered design practitioners are now facing in North America. Increasingly companies are reluctant to engage in 'custom' system design efforts, and agree to do so only when they believe commercial benefit can be gained in the future from involvement with users, who are increasingly seen as representative users.

For example, a major Canadian hospital has contracted a health software development company in the United States to develop health telecommunications software for the Canadian hospital. Commercial rights to the software will remain with the software development company, which hopes to market the new software primarily in the United States. Widespread concern exists among health care professionals and the hospital employees' union that the end goal of marketing the software in the United States (which has a private health care system) will make it difficult to ensure that the software 'custom developed' for the Canadian hospital will meet the needs of the public (state-funded) health care system in Canada.

In a sense, the project to develop mathematics software described here is very similar to the hospital project described above. In the school project, student users told members of the design team (sometimes directly, and sometimes through their teacher, who was also a member of the design team) what changes they wanted implemented. If user demands could be easily implemented or they were viewed by senior programmers as important in relation to the emerging OpenMath Standard, they were implemented. Ultimately members of the design team and not users decided which of the shortcomings identified by users were or were not implemented. Although the students could and did participate in the project, they did not have the power to completely determine the final form of the software. The features identified by users that were implemented reflected (in part) the power dynamics inherent to the student/teacher/designer power relations. Some features identified by student users as important were dismissed as unnecessary to learning objectives by the rest of us. As members of the design team, we assumed our socially sanctioned roles as more knowing adults, in relation to children. Although we are all good people and have a great deal of respect for the students we worked with on this project and we did listen to and learn from the students, we did not give ultimate control of the software to them.

The two instances of conflicting goals in the system development process -- in the hospital and in the school setting-- suggest that in a North American context even when user input is sought, other factors may have greater influence on the system development process than users. And, it highlights another challenge: even if a design team does want to implement users' suggestions, they may be constrained by management ultimately. Indeed, this problem has been articulated by several of the participatory design and ergonomics practitioners I have interviewed over the last two years.

Additional Issues that Arose

My involvement with the project described here raised questions for me about the authenticity of participation. I hope some of the questions below can be addressed during the workshop.

The terms of PDG's involvement with IPS that had been negotiated with the CECM prior to the inception of the project described here imposed limitations on the extent to which software implemented at IPS would be tailored to IPS, rather than suitable for adoption under the broader OpenMath standards. The MOUs drafted to support the project described here also imposed some constraints related to participation (e.g., that ATIC would only provide design feedback at the end of the second phase of the project). These constraints turned out to be limits that were not strictly enforced. However, the presence of those constraints led to questions about what participation means. If effective participation requires continuous commitment (Riech et al., 1996), can it be achieved when feedback to designers is not continuous?

Did we merely want IPS to be involved because we needed a place to test software under development, or were we really interested in responding to student suggestions? As stated earlier, members of both the ATIC-DL and the PDG feel this project was a success. To our surprise we discovered near the end of the project that the students did not really believe that they were contributing in any way to the development of the software, although they had contributed in concrete ways. This caused me to again consider a question that had arisen in all my work with women's groups: can participation in design result in a sense of empowerment among users who have limited power in relation to others involved in the design process? Can participation be authentic in a world where little tailorization or customization occurs, and user-participants increasingly act as proxies for larger user groups? Robertson (1996) points out that users of off the shelf (or previously developed) software are subject to design decisions that grew from prior design activities. If the product does not hold a prominent place in the lives of the participants, and the type of artifact helps determine the motivation for participation (Riech et.al., 1996), is it reasonable to expect that students will be motivated to participate in the development of educational software?

What did participation mean if we were unable to implement user suggestions? That users can participate in design exercises that do not ultimately reflect their contributions to the design process is a well-documented area of concern (Bowers and Pycock, 1994; Sanderson, 1996). Was the participatory process any more or less authentic if we truly wanted to implement ideas that resulted from user participation, but were unable to because of time, technical or economic limitations?

For me, participatory design (PD) had always been about work. In an educational setting, work includes both teaching practices and the learning practices of students (O'Day et.al., 1996). It was easier to see how the technology would contribute to the skill enhancement, democratization or autonomy of the teacher's work than it was to understand how to translate the ideals of PD to student-participant- users, whose work consisted of learning. This reminded me that each technology is simultaneously used by multiple groups of workers. Frequently in our participatory design efforts, despite our best efforts we better capture input from some groups of workers than others, although several groups of workers may all use the same technology towards different ends.

In this project, all of our users (other than the teacher) were children, and although we did implement many of their suggestions and treat them with respect, we also assumed and accepted our roles as adults with little critical reflection. The nature of childhood implies a power imbalance between children and adults that is widely recognized and accepted. In contrast, views about relations between men and women vary cross-culturally as well as within cultures, and are often the source of great debate. Although the way we think about the relations between men and women may vary depending upon a number of factors, just as in the school project described above where we took our relation to the students in a sense for granted, we may, as women and men on UCD teams take our roles for granted. This in turn may favour the implementation of some user suggestions over others. In the school project, members of the design team had power in relation to our student users because we were adults in a world that grants adults more power than children. The project described here suggests to me that in order to ensure that empowerment accompanies user participation and that UCD design teams do not replicate power imbalances found elsewhere in society, we must bring more critical reflection about the range of power relations that influence the design process to UCD practices.

Bibliography

Balka, E. (1995). Position Statement for Critical Considerations in the Creation and Control of Personal/Collective Communication Spaces. In A. Clement, L. Suchman & I. Wagner (Eds.). Workshop Proceedings: Critical Considerations in the Creation and Control of Personal/Collective Communications Spaces. Palo Alto CA.: Xerox PARC.

Balka, E. (1997a). Computer Networking: Spinsters on the Web. Ottawa: Canadian Research Institute for the Advancement of Women.

Balka, E. (1997b). Participatory Design in Women's Organizations: The Social World of Organizational Structure and the Gendered Nature of Expertise. Gender, Work and Organizations, vol. 4 #2, April, 1997, p. 99-115.

Barki, H. and Hartwick, J. (1994). User participation, conflict, and conflict resolution: The mediating roles of influence. Information Systems Research vol. 5 #4, p. 422-438.

Benston, M. (1986). Questioning authority: Feminism and scientific expertise. Resources for feminist research. November, vol. 15 #3, p. 71-72.

Bowers, J. and Pycock, J. (1994). Talking through design: Requirements and resistance in cooperative prototyping. In Proceedings of CHI '94. B. Adelson, S. Dumais and J. Olsen (Eds.). (April, Boston). p. 299-304.

Grudin, J. (1991). Obstacles to user involvement in software product development, with implications for CSCW. International Journal of Man-Machine Studies vol. 34, p. 435-452.

Hales, M. (1993). User participation in design: What it can deliver, what it can't and what this means for management. In P. Quintas (Ed.). Social dimensions of systems engineering: People, processes, policies and software development. New York: Ellis Horwood, p. 215-235.

Muller, M. (1993). PICTIVE: Democratizing the dynamics of the design session. In D. Schuler and A. Namioka (Eds.). Participatory design: Principles and practices. Lawrence Erlbaum: Hillsdale, N.J. p. 211-238.

O'Day, C.L., Bobrow, D.G., Hughes, B., Bobrow, K., Saraswat, V., Talazus, J., Walters, J. And Welbes, C. (1996). Community designers. In PDC '96: Proceedings of the participatory design conference. J. Blomberg, F. Kensing, and E.A. Dykstra-Erickson (Eds.). CPSR: Palo Alto. p.3-13.

Riech, Y., Konda, S.L., Monarch, I.A., and Levy, S. (1996). Varieties and issues of participation and design. Design studies 17. p.165-180.

Robertson, T. (1996). Participatory design and participative practices in small companies. In PDC '96: Proceedings of the participatory design conference. J. Blomberg, F. Kensing, and E.A. Dykstra-Erickson (Eds.). CPSR: Palo Alto. p.35-43.

Sanderson, D. (1996). Partial success and partial failure in a commercial development project. In PDC '96: Proceedings of the participatory design conference. J. Blomberg, F. Kensing, and E.A. Dykstra-Erickson (Eds.). CPSR: Palo Alto. p.73-80.

User-centeredness and product development

Avoiding isolated UCD competency and the TLA trap

Thomas Binder, School of Art & Communication, Malmö University College
Eva Brandt, Dept. of Technology and Social Sciences, Technical University of Denmark
Jacob Buur, User Centered Design Group, Danfoss A/S

Biography

Thomas Binder, 1960, did his M.Sc. in mechanical engineering in 1987 and his Ph.D. in Science and Technology Studies at the Dept. of Social Sciences in 1993 both at the Technical University of Denmark. At the Danish Technological Institute, he was among the first to employ a participatory design approach to hypermedia applications used on the shop floor.

Later he was part of the User-centered Design Group at the Danish company Danfoss along side with holding a position as external lecturer in contextual design at Aarhus University. At present he is studio director for a research studio on Space & Virtuality at the School of Art and Communication in Malmö, Sweden.

Thomas Binder has for more than 10 years been engaged in action research and participatory design. In his research he has focused on the social aspects of design and appropriation of artifacts. He has been an affiliated researcher at Lund University, Bremen University and MIT

Eva Brandt, 1965, did her M.Sc. in mechanical engineering in 1995 at the Department of Control and Engineering Design at the Technical University of Denmark. Since then she has had a position as research fellow in the User Centered Design Group at the Danish company Danfoss. Her Ph.D. project is a collaboration between Danfoss and The Department of Technology and Social Sciences at The Technical University of Denmark. The title of her dissertation is “Event driven Product development: collaboration and learning”.

Eva Brandt is engaged in action research and participatory design. In her research she has focused on how to bring about collaboration between engineering design teams on one hand and both internal and external stakeholders on the other. She has been an affiliated researcher at MIT

Jacob Buur, 1957, did his M.Sc. degree in electrical engineering from the Technical University of Denmark in 1984 and his Ph.D, degree from the Institute for Engineering Design in 1990. Following an employment as assisting professor with the University he came to Danfoss in 1992 with the responsibility of developing human machine interaction design into a core competence for the corporation. He is presently manager of the User Centered Design Group at Danfoss.

Jacob Buur has won international recognition for his research into the methodological basis for developing mechatronic products, i.e. the integration of mechanics, electronics and software. He has spent 2 years in Japan studying strategies for product development - in Japanese.

Introduction

In the call for papers to this workshop there is an underlying current in the issues raised: User centered design has apparently come of age and we have to ask ourselves, what is it that we are engaged in – Is it just another three letter abbreviation (TLA) that will live and die within the usual TLA life cycle of approximately five years; Is it a new specialist domain that has to find its place among all the other specialties involved in product development; Or is it really so that we should continue to claim that what we are involved in has a calling for everyone engaged in bringing technology to the market. In this position paper we will argue for the last point of view, based on our joint experiences as members of the User Centered Design Group at the Danish company Danfoss.

Taking a stance on user centeredness

Some years ago we made usability tests of an existing product for a particular product line. A number of problematic aspects of the design was identified and reported to the engineering team. A year later the engineering team returned with a new design, which we once again tested with invited users. The result was discouraging. Although all the originally identified problems had been dealt with, the new product had as many flaws as the old. We were puzzled by this incident, not because it was hard to understand what had happened, but because it questioned the contribution that we could bring to product development (Buur & Nielsen 1995). We saw three directions in which we could go. We could take over responsibility of the conceptual design and thus deliver a more fully specified ’solution’ to the engineering team. We could strengthen our competency and communication of what matters for the users, with the hope that we in this way could establish a better basic understanding of human-machine-interaction among the design engineers. Or we could involve the users and ourselves more in the overall product development process.

’Soft zones’ between users and the engineering team

As it turned out we have been going increasingly steady along the last route (Bagger et al. 1997). When we were involved in design of a new refrigeration controller, we collected a group of engineers spanning the full product development process from software and hardware engineering over manufacturing to marketing. With this group we went through a number of design sessions where housing, connectability and interaction design were tried out on a combination of paper prototypes, wooden mock ups and computer simulations. As part of this process six users participated in two full day sessions where

they together with the engineers evaluated different designs and sketched new interfaces. We spent two months in this way ’playing’ with the new product, deliberately softening the borders between the expertise of the different groups involved. The results were good. In a relatively short period of time we had been able to surface concerns with respect to e.g. injection molding or assembly that has earlier distorted similar conceptual design (for a general treatment of this theme see end (Buur & Andreasen 1989)). The cost was that some suggestions had to be given up, but the fact that e.g. the manufacturing people had also been involved in discussions with the users meant that the design we finally went for, came out almost unaltered in the end.

Workshops throughout the development process

Beyond reaching out for collaboration with the engineering team and the users in the conceptual phase we see also a need for keeping users involved during the more detailed engineering phase. Particularly in larger development projects options and constraints tend to pop-up continuously all the way through to manufacturing. In these projects we have argued for a continuos involvement of the users, and we find the workshop format useful for bringing together users and engineering team. In a large development project on a new series of water hydraulic components a group of machine manufacturers and end-users from the food industry were invited to follow and take part in the detailed engineering of the new product program. The group participated in four full-day workshops over a one-year period. Our role was to facilitate the process and find suitable representations of the on-going design (Brandt & Binder 1997). Two things came out of this process that has later become part of user centered design ’repertoire of resources’. First we found that stretching the conventional representations of design work was both necessary and possible. In engineering design most design representations are directed inwards towards people with the same competency, but in order to engage in dialogue with other groups, design suggestions has to have a richness that makes it possible to span the gap between the concerns of different groups. We found wooden mock-ups to be particularly useful in this project, and learned to use the mock-ups as shared anchoring points for the dialogue between users and engineers (E. Brandt 1998). The second thing we learned was that the workshop sessions were as highly valued for the internal coherence it created in the engineering team as for the input it provided from outside. In development projects the collaboration between many different competencies seems to call for a type of dialogue internally that is basically not unlike the dialogue between users and designers (Binder & Nielsen 1996).

Working with ’rich design materials’ in-between decision points

When trying to overcome the apparent isolation of our HMI-competency by becoming more full-blown players in the staging of product development activities, we had to give up our exclusive right to interpret the ‘voice of the user’. Further more we had to find a way to position the type of activities we engage in, with respect to the more formal

structure of project management and decision making. We have dealt with these new conditions by directing our own work as well as the involvement of users towards what we call design events. These events are working sessions where we bring together stakeholders not only to negotiate or choose between already finished designs but rather to collaboratively explore and craft images of the product to be designed. Design events of this sort are best scheduled in counter-phase with the formal decision points. Close to decision points everyone in the design team is getting ready to fight for their solutions. This does not provide the most fruitful ground for joint exploration of alternatives. Nevertheless decisions are still to be taken and much is at stake for us as well. In a recent project where a new software platform is to be developed we have experimented with what we call 'rich design materials' that can keep design issues alive and open also across decision points. In this particular project we have worked with a mix of future use scenarios and very crude models of future interfaces both created jointly by designers and users. Through out the project we have taped and edited design sessions on video that we have later been able to show, comment upon and revise also in discussion with e.g. the project steering committee. We are optimistic about what can be achieved by continuing in this direction and have the feeling that we will improve as we get a better understanding of what kind of materials and situations that actually feeds the design work.

Towards new perspectives on product development

Coming out of a usability design tradition we realize that the road we have taken is not the only way to go. In an on going research project with other industrial usability groups, we learn from colleagues who have chosen to rather strengthen their insight and analytical competency in understanding the way users interact with technology, than engage in actual design (C. Nielsen 1998). We will claim however that somebody has to do what we are doing. If the process of product development shall become open and flexible enough to accommodate the fruitful potential of user-centeredness, both the way developers think about design and the patterns through which it is organized, has to be changed. It is perhaps a larger endeavor but as we will briefly touch on below it promises to unlock other potentials as well.

Facing the conflict with requirement engineering

Requirement engineering is in our environment still the dominant framework. The preference for requirement specifications is not only what most engineers were trained for in the engineering schools. The whole idea of establishing and negotiating specs is so intrinsically connected to the way product development work has been organized for at least the last fifty years. We have often met colleagues, who could see the need for bringing 'what the user want' into product development, at the same time as they have fiercely fought with us for 'canning' user-inputs into specs. To some extend one could say that the whole notion of 'users' as opposed to electricians, housewives or whatever more common labeling we use on each other give some backing for this utilitarian approach to user-centeredness (T. Binder, 1996). From our experience we must say that although we have often tried, no marriage between user-centered design and requirement engineering has ever been happy. The gap between not being able to engage with users

because the specs are not established, and not wanting to engage with the users because specs have now been locked, is typically too narrow to lead to any kind of fruitful exploration of where to go in product development.

Being competent on both 'product' and 'process'

We started out with a mission, which we could spell out product-wise as guidelines. We 'translated' work from the HCI community to the field of mechatronics (C. S. Hansen 1996). We worked on what it meant to go from GUI's to SUI's (Buur & Black 1995), and we put considerable effort into understanding that 'usability' is not something we can derive from the characteristics of the product (P. Nielsen 1998). What kind of competency is it then we have gained and has to nurture? We believe that our field calls for a genuine design competency, which deals with interface issues in the most extended meaning of this word. We have not left the concern for 'the product' or supplemented it with an abstract concern for 'the process' rather we believe that we have discovered that product and process is so closely intertwined in design as in use, that we have to simultaneously engage with both (Binder et al. 1998). In this way we have ended up being hopefully creative renewers of a type of product development which is highly sensitized towards application domain and use context.

Literature

Bagger-Nielsen, Kirsten, Jacob Buur and Thomas Binder, From Usability testing to User Dialogue, Proceedings from International Ergonomics Association Conference in Tampere, June 1997.

Binder, Thomas and Klaus T. Nielsen, Industrial Culture and Design Methodology, in Rauner and Rasmussen (eds.), Industrial cultures and production, Springer, London 1996.

Binder, Thomas, Designers in Dialogue, in D. Vinck and J. Perrin (eds.), The Role of Design in the Social Shaping of Technology, COST A4, EU Commission, 1996.

Binder, Thomas, Eva Brandt, Turid Horgen & Gregory Zack, Staging events of collaborative design and learning, Proceedings from the Concurrent Engineering Conference in Tokyo 1998.

Brandt, Eva and Thomas Binder, Customer/User workshops in product development, International Conference on Engineering Design in Tampere, August 1997.

Brandt, Eva, How do mock-ups support collaboration between designers and users? (forthcoming) 1998.

Buur, Jacob & Allison Black,GUIs more SUIs: more of the same or something different?, Information design Journal, Elsevier Science B.V., 1995.

Buur, Jacob & Andreasen, Mogen Myrup, Design models in mechatronic product development, Design studies, vol 10 no 3 1989.

Buur, Jacob & Nielsen, Pi, Design for Usability - Adopting Human Computer Interaction Medthods for the Design of Mechanical Products, Proceedings from International Conference on Engineering Design in Praha, August 1995.

Hansen, Claus Sehested, Simulation of man-machine Interaction - simulation, interaction and product development, Institute for Engineering Design, Technical University of Denmark, 1995.

Nielsen, Christina, Testing in the Field, Proceedings to the 3rd Asia Pacific Computer Human Interaction Conference, Tokyo, 1998.

Nielsen, Pi, Design for Usability, Department of Control and Engineering Design, Technical University of Denmark (forthcomming) 1998.

A case study in human-centred design

The Swedish National Employment Service - AMS

Designing a graphical user interface for the new AMS Information System - AIS.

Nigel Claridge (nigel.claridge@nomos.se)
Tomas Berns (tomas.berns@nomos.se)
Nomos Management AB
www.nomos.se

Introduction

The Swedish National Employment Service - AMS developed a new computer system the objective of which was to support the Swedish employment process, career counseling and job-related rehabilitation. It was to be used by some 10 000 Swedish employment officers on a daily basis as it contained information about employers, job vacancies and a register of all job seekers. In the future, members of the public will have access to parts of the system through the Internet.

By November 1995, a prototype Windows-based user interface had been developed internally but there were some serious concerns about its usability. AMS commissioned that interface to be evaluated for usability by external independent usability consultants. Both expert inspections and a user testing method were applied. Results indicated clearly that the then current interface did not support the efficient and effective execution of tasks. Based on these results AMS decided to halt the interface development process and restart design.

This short paper gives an overview of the user-centered design process that was applied in the development of AIS from November 1995. The subsequent user-centered design activities that were carried out are briefly described together with some of the benefits they had for the development as a whole.

The actual work carried out included the following activities: Context analysis of AIS, an Expert (heuristic) evaluation on AIS, measurable goal formulation, a Parallel design activity to create a new user interface design concept, design support activities, three iterations of user-based testing on the new AIS design concept, a SUMI evaluation on the current AF-90 system and all iterations during the development process. A series of focus groups were run early in development to glean functional requirements from end-users and then later in development to establish possible reasons preventing a smooth introduction of the new AIS system to the workplace.

The main principles of user-centered design as applied to AIS

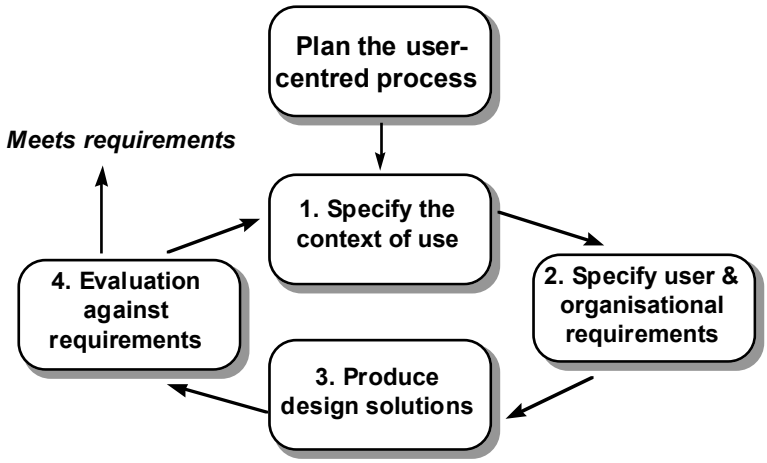
The principles described below are aimed at incorporating the user's perspective into the development process. They are presented as a compliment to existing strategies rather than a replacement.

- ***an appropriate allocation of function between user and system.*** Determining which aspects of a job or task should be handled by employment staff and which can be handled by AIS software and hardware is of critical importance. This division of labor should be based on an appreciation of human capabilities, and their limitations, as well as a thorough grasp of the particular demands of the task.

- ***the active involvement of users***. One of the key strengths of user-centered design is the active involvement of employment staff. The extent of this involvement depended on the precise nature of the design activities but generally speaking the strategy was to utilize employment officers who have real insight into the context in which an application will be used. Involving employment officers also enhanced the acceptance and commitment to the new software as staff came to feel that the system was being designed in consultation with them rather than being imposed on them.

- ***iteration of design solutions.*** Iterative software design entailed the feedback of end-users following their use of early design solutions. These ranged from simple paper mock-ups of screen layouts to prototypes with greater fidelity which ran on computers. The users attempted to accomplish 'real world' tasks using the prototype and the feedback from the exercise was used to develop the design further.

- ***multi-disciplinary design teams***. User-centered development is a collaborative process which benefits from the active involvement of various parties, each of whom have insights and expertise to share. The development team was made up from representatives of all those groups who had some 'stake' in the proposed software. The team included managers, usability specialists, training and support staff, software engineers and of course the end user themselves, i.e. the people who used the final product.



From ISO/DIS 13407 - "Human-centered design processes for interactive systems"

The rest of this short paper follows the four main stages of the user-centered design process as set out in the draft international standard ISO 13407 - "Human-centered design processes for interactive systems" and what happened in each stage during the development of AIS.

1. Specifying the context of use

Several of the AIS stakeholders met to identify the issues defined in the context of use. Project members included user representatives. All were familiar with the current employment services were carried out and the way in which registered job vacancies were matched with suitable job seekers. Having worked in employment offices, they were familiar with the characteristics and needs of the employment officers, job seekers and companies offering job vacancies. This knowledge was documented and made available to the project team as a whole for both interface design purposes and evaluation activities.

The context analysis was carried out, including structured 'focus group' meetings with representative groups of employment officers. This resulted in the documentation of key knowledge held by individuals, and essential background information obtained from the focus group work, including:

- A profile of employment officers and how they carry out employment services (Task description of main tasks likely to be carried out using the system).

- Employment officer knowledge, skills and experience.

- Environmental issues in terms of technological issues, organizational issues and work environment issues.

2. Defining requirements

The context of use led into the next stage was to define the user and organizational requirements of AIS. Much information was already in place and extensive requirements work was not carried out. However, a series of simple task analysis activities were carried out to confirm parts of the requirement documents, in particular the way in which work was carried out at employment agencies. Also, focus groups with employment officers were used to glean functional requirements based on perceived problem with the

current text-based AF-90 system. Possible interface designs were not discussed. Measurable usability goals were formulated at this stage and goals became a guiding factor for the interface design work and all evaluations.

This approach to requirements concentrated on user tasks and not interface implementation ideas. No untried interface design details were set as a "requirements". An iterative approach to requirements developed as a result feedback from design evaluations and walkthroughs. Requirements were modified accordingly.

3. Design

Interface design work began with a parallel design activity using four different interface design ideas based on a common set of requirements. The final design concept was not actually any one design idea but a combination of ideas from each of the four. The result was ***one*** conceptual design which supported the requirements and upon which continued user interface development could be based.

Continued interface development occurred around other activities in a small design group such as brainstorming and very simple paper prototypes of modifications to the design concept. Early "walkthroughs" of these concepts were carried out by project members, usability experts and employment officers. These quickly indicated the best design alternatives in terms of task suitability, overall complexity and intuitiveness.

The design concept was then prototyped using Visual Basic. The resulting prototypes gave a clear picture of how different functions could be implemented, and how user tasks would be carried out with the system. The design was developed iteratively and each stage was subjected to more formal testing with users. The testing identified 'thresholds' which prevented the users from carrying out basic tasks. After testing improvements and changes to the interface were implemented.

4. Evaluation

Usability evaluations were carried out throughout the development process, although they varied significantly in their nature.

Early during development, expert inspections of initial design sketches/prototypes provided quick and efficient feedback into the process, as did 'participatory' evaluations carried out by experts working with users on slightly later prototypes.

Usability laboratory testing of fully operational prototypes were carried out on three separate occasions carefully planned to co-ordinate with completed design activities. Tests were run with groups of representative users - employment officers - according to the profile defined in the original context of use. The tests gave detailed feedback about actual user performance with the interface, their subjective assessment, and lists of specific interface details that could be improved.

Throughout the development process and at each user test, a subjective questionnaire - Software Usability Measurement Inventory, SUMI - was used to measure real user satisfaction and to identify interface issues requiring further improvement. A SUMI evaluation of the current text-based system - AF 90 - was carried out as a benchmark upon which to develop the AIS interface.

5. Conclusions

The spirit of Human-centered design was central to the successful development process of AIS. The new AIS interface design benefited from the application of user-centered activities and now fulfil the majority of the usability goals for efficiency, effectiveness and satisfaction set originally. The usability effort in terms of time and resources has been assessed but no cost/benefit assessment done. The costs of developing the AIS product prior to initial usability activities, and achieving less than satisfactory results, was significantly more than the resources required for usability activities.

AIS is an case book example of a successful project using a user-centered design process. The project was successful in two key respects which to some extent was supported by the results from the SUMI evaluations: that the development process including the tools and method applied were correct and that the AIS interface product itself was easy to use, with the correct functions for the intended users and their tasks.

An interesting off-spin from the AIS work is that there is now an increased awareness and understanding for usability issues and the benefits of incorporating users in the development process. Although AMS development staff has not yet been trained in usability, there was an effective spirit of “learning-by-doing”. Information about evaluations and results were quickly fed back into the organization, which created an interest and a discussion forum among important groups.

Participatory Design in Work Context:

Why Is It so Hard to Involve Users?

Anne-Laure Fayard
EDF - R&D Division
Department GRETS
1, Avenue du Général De Gaulle
92241 CLAMART
FRANCE
Anne-Laure.Fayard@edfgdf.fr

Abstract

Participatory design involves four types of actors: designers, human factors experts, managers and users. This paper explores gaps between theory and practice based on my experience with two industrial participatory design settings.

Introduction

Project leaders and managers in France give lip service to the idea of participatory design. Books such as *Psychology of Everyday Things* (Norman, 1988) have influenced both industry and academia. However, in practice, users are often left out. Why is it so hard to involve users? Participatory design involves more than just designers and users; it must also include human factors experts and managers as well. This paper examines how the different prejudices, competencies and goals affect participatory design projects.

We studied participatory design in two work settings in France. The CENA (Centre d'Etudes de la Navigation Aérienne) is responsible for the design and implementation of new technologies to support French Air Traffic Control. Researchers, including engineers, computer scientists, cognitive ergonomists and former air traffic controllers, often have difficulty communicating across disciplines. The DER (Direction des Etudes et de la Recherche) is the R&D Division of EDF, the French power company. The R&D Division involves researchers from a variety of disciplines such as engineers, computer scientists, physicists and social scientists.

I studied two projects at the CENA, one in Toulouse, the other in Paris. The first was managed by a former air traffic controller, originally trained as an engineer, who developed a conflict detection system with an interdisciplinary team. The second, the Cameleon project, was explicitly set up as a participatory design research project, exploring the Augmented Reality design space for augmenting paper flight strips (Mackay et al., 1998). At EDF, I studied a more general research project looking at the use of information and the causes of the Cognitive Overflow Syndrome (COS), in order to design new work environments. Based on these experiences, I became interested in the

different roles people play in different design projects. This paper analyzes - grounded on these two experiences - the motivation and perspective of the different actors involved in the design process.

Designers

"Designers" includes graphic designers, software developers as well as engineers. The designers I studied were not trained to include the users' perspective. I noticed the following difficulties.

Seeking a solution

Two MA students in computer science working on the Cameleon project have difficulty listening to the controllers. They would present prototypes and try to convince them that their solutions was optimal. They initially resisted to the controllers' objections and then, abruptly, decide to modify the prototype by throwing away the code and starting over. As computer scientists, they were always given a clearly defined problem and asked to find a solution. The notion of exploration of a design space by testing and mixing various solutions was not easy to understand for them.

Design as a form of expression

At the beginning of the Cameleon project, the designers imagine a series of complex functionalities for augmented paper flight strips. The controllers rejected most of these during the first workshop, emphasizing on their need for a system that is simple to use. Designers often build complex systems as a form of expression, obtaining satisfaction from their skill in solving complex systems. The notion that designers must be at the service of users is often difficult for them to accept.

What designers think of users

The software developers at the CENA on both projects assumed that controllers 1. cannot understand the technology; 2. do not know what they need; 3. cannot generate design ideas. They presented "finished" ideas and were frustrated that the controllers only criticized them. At both CENA and EDF, designers fear this aspect of talking to users. They organize design debriefings to users as little real power as possible and to force users to comment in design rather than use terms.

Designers as typical users

The Toulouse project was directed by a former controller, which helped him to see the limits of previous projects and gave him insights and new design ideas. The problem was that he found it very hard to listen to design ideas from other controllers, assuming his own experience was typical, and that therefore his own design solutions were good. He argued with controllers who questioned the functionalities of the system, challenging their ability to analyze their work and therefore, the validity of their opinions. We saw other examples of this in office environments: designers over generalized their own experience.

Human Factors Experts

"Human factors" includes people with backgrounds in psychology, ergonomics and social sciences. Neither the cognitive ergonomics, nor the social scientists I spoke to were trained in participatory design.

What are they looking for?

One ergonomist at the CENA analyzed communications patterns among controllers by studying videotapes of controllers working with a simulation of a new system rather than actually observing them in the control room. Another ergonomist built a computer system to generate task models based on formal descriptions of the controllers' work. They describe themselves as working with users, but actually have very little contact with the controllers. They are interested in an abstracted representation of the work. They are trained to analyze the cognitive processes of people and to build cognitive models of these processes.

Goals

Cognitive ergonomists and sociologists are not plainly interested in design. They equated design with technology, which they were not explicitly interested in. Cognitive ergonomists at the CENA viewed their job as generating abstracted design guidelines and evaluating prototypes based on these principles and on standard ergonomic principles. At EDF, the social scientists mediate between management, designers and users. Unfortunately, they do not play a role in the early design phase, but help users adapt to new tools and study the impact of the tools on the organization after the design is complete.

The Management and the Organization

"Managers" includes upper management and project leaders.

What managers think of users

The CENA research brochure explains that they are interested in controllers' reactions, but that, "of course", the controllers are not capable of doing the design themselves. French organizations are particularly influenced the Hegelian conception of the almighty state. This is reflected in the top-down structure of projects and the resistance to participatory design and empowered users.

Justifying your budget`

One CENA manager resisted the notion of incremental improvement to the existing system. He justified his budget by proposing huge, expensive, all-powerful "solution" which reflected the expertise of his organization. Small inexpensive solutions to particular controllers' needs were seen as too insignificant for him to work on.

Freezing Design

At CENA and EDF, managers are pressured to show something even if the design was not ready. Once the system is shown, it is treated as a design commitment by upper level management and further change is discouraged.

Users

"Users" includes the ultimate users of the system.

Users Input

At the CENA, controllers were involved in early design discussions. Both controllers and designers discussed abstract design ideas, and each thought they understood what the others were saying. Many months later, the controllers were shocked to see the designers' very different conception of the system and say it was unusable. Designers felt betrayed, because they believed they already had obtained feedback from the controllers and that they had changed their minds. Controllers also felt betrayed, because they believed they had clearly expressed their needs and that they had not been listened to. During the Cameleon project, controllers were positively surprised, when they realized that their reactions and proposals were influencing the prototyping process. We used a set of techniques, including paper and video prototyping, and the Wizard of Oz, for presenting our ideas to the controllers. These techniques allow us to get their feedback and to quickly react to their comments.

Individual Differences

One very experienced controller objected to a feature that he thought can have a negative impact on the students' training. During workshops, controllers reacted differently to the prototypes' features according to their function, their expertise and their way of working (using more the RADAR than the strips, or vice versa). At EDF, one user during a design debriefing rejected a system for managing interruptions, while the other users said it might be useful. He did not consider that interruptions were a problem; he even considered them as belonging to his job.

Conclusion

In participatory design projects, different actors share the same design goal viewed from different perspectives - design, human factors, management and practice. They must be involved in a global process, which requires a variety of approaches and techniques (Mackay&Fayard, 1997). It is important to create a positive context for participatory design in the work setting by supporting and enhancing communication between different actors, and by actively involving users from the beginning to the end. Users are more than an important source of information on existing work practices, they are potential innovators. They adapt their practices to new technologies, but also adapt technology to their needs, interpreting the technological possibilities in relevant manners according to

the context, and using new systems in ways that have not been thought of by designers (Mackay, 1990).

Limits to participatory design are mainly social and organizational; they cannot be deleted in the short term, but require long term processes. Participatory design should be supported by strong social and cultural practices. To develop such practices, it is essential to:

1. *Create a positive context for participatory design in the work setting*. Users must be actively involved from the beginning and all along the design process; we must create a trust relationship between users, designers and researchers and convince the management to support the process.
2. *Iterate and interact*. Participatory design implies an iterative and interactive process and therefore requires "quick and dirty methods" (Bannon, 1991). In the Cameleon project, we used several techniques such as paper and video prototyping, brainstorming, the wizard of Oz technique and scenarios. These techniques enabled us to present a lot of ideas to air traffic controllers and to quickly prototype new ideas coming out during workshops with them (Mackay & al., 1998). Quick prototyping allow users to play with prototypes, get an idea of what the system would be like and give rapid feedback.
3. *Support triangulation.* Different actors share the same design goal viewed from different perspectives - research, design, practice. They must be involved in a global process where their different roles reflect not a division of labor, but a variety of approaches. Moreover, to have a real cross-disciplinary collaboration, each actor should be able to really communicate and understand what people with a different perspective are saying.

Acknowledgements

Special thanks to Wendy Mackay. This paper is the result of numerous discussions we had on participatory design methods. Her comments and remarks were very helpful. Thank you also to Brigitte Saintive, Valérie Lebois and Helka Folch at the DER.

References

Bannon, L. (1991) From Human Factors to Human Actors: The Role of Psychology and Human-Computer Interaction Studies in System Design, *Design at Work: Cooperative Design of Computer Systems* (pp. 25-44), Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Norman, D.A. (1988) *The Design of Everyday Things*. New York, NY: Basic Books.

Mackay, W. (1990) *Users and Customizable software: A Co-Adaptive Phenomenon.* Doctoral Dissertation, The Massachusetts Institute of Technology. Cambridge, MA.

Mackay, W. & Fayard, A.L (1997) HCI, Natural Science and Design : A Framework for Triangulation Across Disciplines, *DIS'97 : Designing Interactive Systems.* Amsterdam, Holland.

Mackay, W., Fayard, A-L., Frobert, L., and Médini, L. (1998) Reinventing the Familiar: Exploring an Augmented Design Space for Air Traffic Control. In *Proceedings of ACM CHI'98 Human Factors in Computing Systems.* Los Angeles, California: ACM/SIGCHI.

User-Centered Design in Practice

David Gilmore, Rebecca Trump, Velma Velazquez, Peter Coughlan, Jane Fulton-Suri, Ilya Prokopoff, Alex Grishaver, Jeanne Fitzgerald, Eric Saperstein
IDEO Product Development
Pier 28 Annex, Embarcadero
San Francisco, CA 94127

Introduction

IDEO has been involved in user-centered design for many years, primarily in relation to hardware products, but increasingly for products with a substantial amount of screen-based user interaction. Over the past 2-3 years, as more and more clients have explicitly requested our user-centered approach, IDEO has increased its human factors and interaction design potential substantially.

From a number of case studies we can identify at least three critical areas in the successful implementation of user-centered design: *ownership*, *interpretation* and *language*. But before describing these further, let me provide some background with the case studies used to exemplify these points.

a) Group Work Spaces

As part of an ongoing process of relocating various functions in one client's organization, we were asked to help translate user needs into workspace designs. The organization's experience so far with this participative process had been disappointing, with few redesigned spaces being used as intended.

The client's process was very bureaucratic, involving many meetings and providing constraints on what users could request. For example, the first step was oriented around the group specifying their business goals and discussion of office spaces had to be grounded in these business goals.

Our involvement was to try and address this mismatch in two particular projects, but with the intention of providing a methodology for future projects too. We began with some structured interviews with a selection of employees, using a set of carefully chosen photographs of spaces – both work- and leisure-oriented. These interviews were designed to elicit some key attributes of spaces from the users' own perspectives. These attributes would be used later to evaluate different proposals.

These evaluations were, of course, not the only criteria for making design decisions and there was much three-way negotiation among users, designers and the IDEO team.

At the same time as the interviews were being conducted, we were building 1/12th scale models of their planned workspaces, with furniture, partitions, equipment, etc. We transported these models to the various offices and had day-long discussions with employees about the design and layout of their space. These discussions were focused on their actual work activities – the fact that the models were all plain white plastic and foam core seemed to be critical in enabling groups to focus on how furniture might support

their work, rather than being pre-occupied with the fabric, color or shape. For each of the many arrangements of space that were collaboratively constructed during the day, a photograph was taken and reasons for the choices were documented.

Following these discussions posters were created showing the various different plans and layouts, enabling the whole organization to see their own and others' ideas.

All of the output from these processes was then fed back to the space designers to help them finalize the designs and make arrangements for furniture selection.

Neither site has yet moved into their new space, so we cannot completely evaluate the results, but one clear lesson was that the process of discussion helped to change peoples' views of the nature of their work – their choices changed quite dramatically between the original internal process, our structured interviews and their constructed model spaces.

For example, in the structured interviews, a need for enclosure was frequently articulated – for visual and acoustic privacy. But when they were building their models, the groups were quite clear about wanting open space to enable serendipitous encounters.

b) Electric Vehicle Recharging

A few years ago IDEO was asked to help design recharging stations for electric vehicles, even though such electric vehicles didn't exist at that time. It might seem that user-centered design is not possible for such a futuristic product, but it just required us to be more creative and interpretative in identifying the users and their needs.

We watched people's interactions with gas pumps, with parking meters, public pay systems and public electric devices – from these, scenarios were constructed about potential users of electric vehicles. These scenarios told about their lifestyles and daily routines, gave examples of journeys using their electric vehicle and imagined the events that would be involved in recharging it.

The designers used these scenarios both as inspiration and as an evaluation tool for their ideas. Eventually prototypes were built and tested, but only in the last year or so has the reality of electric vehicle recharging stations arrived – we have not yet been able to evaluate the validity of our scenarios against reality.

c) Focus Groups for a Consumer Electrical Product

Anyone doing user-centered design for a consumer product is likely to encounter a focus group. Psychologists, designers and human factors professionals tend to be fairly dismissive of focus groups' contribution to design, but they are a key part of user-centered design in practice.

On a recent project for a radical new consumer electrical product, which had a new shape (curved instead of boxed), orientation (vertical instead of horizontal) and color (white and blue instead of black), focus group reactions to the product were very strong and generally negative (especially on color and orientation). This may have been because the groups were asked to describe their existing products and desires for around 10-15 minutes the models were revealed, potentially creating a mindset for particular colors and forms. Interestingly, as different color schemes were discussed and people chose the color that suited them, their reaction to the shape and orientation began to improve.

Furthermore, exposure to the animations of the behavior of the product (using Director movies) led to substantial changes in reactions, since the product had a style of

behavior which people immediately recognized as more useful than they were accustomed to. This led them to consider more places for the new product, where the vertical orientation was not a problem. Rethinking where in the home this product would go led many of the people in the focus group to re-evaluate their reaction to the radical design.

In reviewing the outcome of the focus groups with the client we had to consider whether the reactions warranted abandonment of the project, redesign of the product or more careful design of the marketing. This discussion had to be informed by the client's original brief (for an adventurous challenging design which could redefine this market), by the positive reaction of the client's CEO (who felt this was a good direction for their company) and by the positive reaction of journalists to the design (who wanted pictures for their cover stories).

Ownership and Responsibility

In user-centered design there are real issues about who is in charge and who the design is really for. The designers are still likely to expect to be judged by their peers in the usual way and the users may be more likely to judge by how well their requests were met, rather than by whether the design actually works.

Furthermore, designers in a user-centered process may feel less creative and less innovative, as they may believe that their task is simply to meet the users' requests. And, of course, users can feel increasingly frustrated as they are consulted *ad nauseam*, but seemingly to no avail, as the final design is usually not a translation of their own visions.

There is a real danger of the user feeling patronized, as designers feel bound to say, "Yes we heard you ask for <x>, but we thought <y> would be better for you." Meanwhile project managers can see budgets spiraling out of control as every new user request has to be met.

Understanding these dangers and hazards is the first step towards solving them – which requires all the involved parties to engage in true dialogue. It is as important for the users to understand the designers' need as it is vice versa. And both need to understand the goals of the project management team. One obvious (but often overlooked) requirement is to set up expectations that avoid the shopping list approach – where users ask for one of everything because each sounds good and desirable, but they gain no overall sense of budget or design coherence.

Interpretation Essential

Hand in hand with the need for clear lines of ownership and responsibility as just outlined is the fact that designers cannot simply provide all those features that users request. Instead designers are bound to interpret what it is the users 'really need'. A central question, therefore, is who does the interpretation and how?

If we take a product as apparently straightforward as a running shoe, we can ask people about various qualities of running shoes, but in many instances it will turn out that we desire a sports science specialist to help us interpret people's comments. For example, it turns out that many people, when evaluating potential running shoes, assess 'shock

absorption' by squeezing the heel of the shoe, but this omits the time scale over which the shock is absorbed, which is central to comfort. The sports scientist provides an interpretative bridge between the user and the designer, who may dismiss the patently incorrect judgements of the user.

Once we move beyond footwear to car rechargers, or group working environments, the need for interpretation becomes both more obvious and more difficult. More obvious because we can see more clearly the users' lack of experience or lack of articulable knowledge and more dangerous because, having perceived the users' naiveté about design, we can now interpret their words to allow us to design just what we wanted to design anyway!

One solution is to involve the whole team (and users too) in as much of the process of observation, interpretation and early concept development as possible. In this way differences in perspective can become more explicit. Experience at IDEO has shown that although human factors specialists may have a special perspective for interpreting users' needs, they have just one of many necessary perspectives. Frequently designers and engineers will see (or hear) things, that would otherwise have been overlooked.

One technique which we use on projects involving observations of users is for designers to accompany the human factors observer to the user's home, or workplace or wherever and join in the observation process. We also encourage human factors participation in the concept development brainstorms.

Finding a communication context

Recognizing that the design process is a dialogue of interpretation between user and designer, we can see the need to address the question of the context used for that dialogue. For verbal interactions the communication context is akin to finding a common language, but our experience has shown that there are important aspects of users needs which users may not be able to articulate, but which may be observed or revealed in appropriate contexts.

One area where users have problems is dealing with the hypothetical – "imagine you had a new <x> ... where would you want to put it?" One strategy which we use which works well is to build some simple models of the new object (sometimes just painted rectangular blocks) and to present these to people and ask them to place them in their home. Alternatively, for products such as remote control devices, we have asked people to place the button and commands on a blank remote, rather than asking them to evaluate our completed model. In these cases providing the physical starting point helps the users to find the language needed to convey their ideas.

In constructing these models, or ways of training users in important concepts, we are searching for a common language to share between the user and the designer – finding the right levels of abstraction for communication. Sometimes it may be necessary to provide an expert vocabulary (or discourse) that can give users an understanding of important technical aspects of the product being designed.

In our group workspaces project we built 1/12th-scale models which were plain white and functional, though different qualities were represented. For example, the model chairs included stools, task chairs, meeting chairs and lounge chairs. In this way we were able to present the models at a high enough level of abstraction for the users to engage with, but not so realistic that they were distracted by irrelevant properties such as color or

fabric. Thus, we deliberately constrain the vocabulary as a way of directing attention towards an appropriate level of design.

Focus groups presenting product models can enable or hinder the users' expression of their needs, depending upon the choices presented to the group, and the order in which topics are discussed.

Understanding User-Centered Design

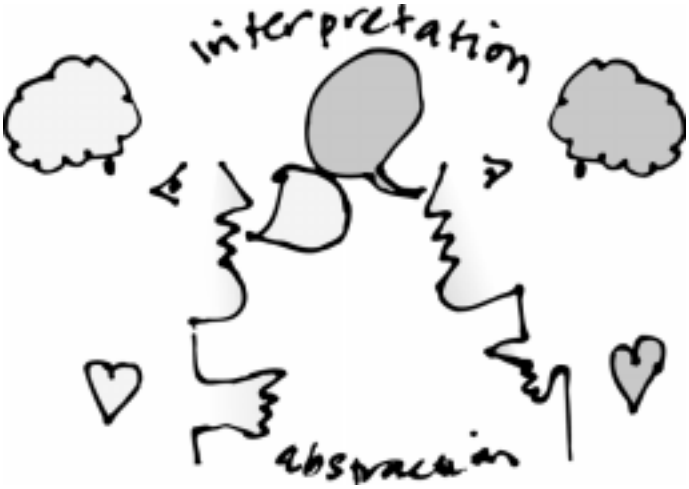


Figure 1: User-Centered Design as a cycle of interpretation and abstraction, addressing words, thoughts, feelings and behavior.

If we try to find a single perspective which captures these three important aspects of user-centered design, we can describe it as a process involving cycles of interpretation and observation between user and designer, focussing not only on what is said and done (i.e. publicly shared), but also on what is thought and felt (i.e. the private or subconscious). Figure 1 depicts this representation, showing a dialogue of interpretation and abstraction between designer and user, which is intended to lead to a shared understanding about thoughts, feelings, words and behavior.

Intranet as a result of a Participatory Design project – a case description

Anneli Hagdahl, B.Sc., Vivian Vimarlund, M.Sc., Toomas Timpka, M.D., Ph.D.
MDA, Dept. of Computer and Information Science, Dept. of Social Medicine,
Linköping University, Linköping, Sweden.

Introduction

During the early 1990's a Participatory Design (PD) project was performed in order to develop the first Intranet within the Swedish primary health care[vi]. Today the system has been in use for three years. The aim of this paper is to present some experiences from the project and use them to illustrate the effect an Intranet can have on a health care organization. Issues that must be taken into consideration and developed in future information systems development projects within the Swedish health care will also be discussed.

Case Description

The goal of the PRIMUS 2000 project was to develop a model for computer-supported organizational learning and total quality management in Swedish health care. The project was implemented at a primary health care center (PHCC) in Linköping and was a collaborative project between the PHCC, a research group and a software company. The PHCC employed, at the time of the development project, eight general practitioners and 52 staff, consisting of nurses, district nurses, assistant nurses, secretaries, dieticians, occupational therapists and physiotherapists. The project organization was composed of a steering committee, an advisory committee, four quality groups and a participatory design group. The quality groups cut across the different professions at the PHCC and every employee was member of a group. The groups dealt with four quality topics: management strategy quality, working-life quality, patient quality and clinical services quality. Group activities were performed in parallel with the daily work, combined with lectures on quality management. The PD group handled ideas and information from the quality groups, trying to integrate the interests of the staff, the designers and the engineers. The software development was performed using Action Design, a method which suggest that the requirements specification is developed in a small-group setting, and agreed upon within the organization (Sjöberg, 1996), and an object-oriented methodology. The prerequisites of the PRIMUS 2000 project contained a tight time schedule and a demand that the organization's normal activities, i.e. providing health care services to the citizens, should not be affected. The PD group's first task was to learn about quality management,

[vi] This primary level of the health care system has the aim of providing treatment of all kinds of health problems. The team at a primary health care centre consists of general practitioners, district nurses, child and maternity care and physiotherapy.

information technology and organizational learning. The knowledge was then transferred to the rest of the organization through the quality groups.

Method

The case study is based on interviews performed during 1996-1997 at the PHCC. Representatives from all professional categories have been used as informants and the semi-structured interviews consisting of open-ended questions took place in the workplace setting. In the analysis, issues relevant for this case study have been selected. The study has been performed as an exploratory case study with the aim to develop relevant hypothesis and questions for further examination (Yin, 1994).

Results

Intranet design

The result of the PD project is an Intranet with the aim to support and increase the efficiency of the internal information flows. The head of the secretarial group has been given the responsibility for day-to-day administration and maintenance of the system. The Software Company can be contacted in case of a major problem. The Intranet contains four different functions:

- A knowledge database
- A computerized patient record system
- Electronic mail
- News

The knowledge database contains information for classification of diseases, information about drugs from the pharmacy, a presentation of the PHCC and its staff (including contact information). The nurses and the junior doctors mainly use the database and some doctors also report using the Internet as a complementary knowledge database. The computerized patient record system is for documentation of patient cases. The general practitioner reads the record before meeting the patient and enters the diagnosis and the prescribed medication. Other information, such as the patient's social relations and comments on clinical findings is recorded using a dictating machine. The secretarial group is then responsible for the transcription into the computerized patient record system.

All staff has an individual internal mail-address, allowing intra-organizational contacts. In addition, the general practitioners, the district nurses and the other therapists also have an Internet e-mail address. The e-mail function in the Intranet is used daily by the staff. An improvement in the internal information flow has been found in the contacts between the district nurses and the general practitioners. Previously, all questions

regarding a patient case had to be handled by telephone or during personal meetings. These questions can now be solved using the e-mail function in the Intranet resulting in a higher health care service quality.

The news system is used for distribution of information from the different staff meetings taking place every morning. Representatives are responsible for reporting important issues from the meetings to the Intranet administrator. The information is then transcribed and published on a www-page. Previously, the information from the daily meetings was distributed on a printed paper to the staff at the PHCC. In this way, the information was only available to the staff working within the building, excluding e.g. the district nurses who spend most of their day visiting patients in their homes.

Intranet experiences

The case study data show that the involved personnel had experienced both positive and negative effects. In the traditional organizations boundaries were stipulated through structures and hierarchies or titles that connected the power to authority. This organizational structure was rigid but it had an advantage. The roles of the managers and the employees within this structure were simple, clear and relatively stable. However, after the implementation of the Intranet, the traditional organizational map described a world that no longer existed. The central information was now coming from a different source than before. The fact that the Intranet administrator is in charge of the information gathering and distribution showed to imply a critical factor for influence on the organization's power structures.

An issue signaled positive was that the information is today published on a www-page and therefore the staff can choose when to read it having as a consequence the possibility to give more flexibility to the users on how to use their own time. Another consequence is that the " new" information provided by the Intranet is better considering due the fact that user's considered that the information has been selected, analyzed and situated in the "real" power hierarchy. Despite these benefits it was signaled that the different members of the organization differently experienced the new situation. For instance, some individuals indicated risks for misunderstanding the role of the Intranet administrator. The Intranet administrator can filter information or "discriminate" the diffusion of information to some groups in the organization. Another issue was that the Intranet administrator knows who does not check the news-pages daily and sends the information by e-mail to these persons. This results in an increasing workload for the secretarial group, a risk for "information overload" and special treatment of certain groups in the organization.

Maybe the most important change from the implementation of the Intranet has been the use of the mail-system. Everyone considered that the e-mail system has improved and shortened the information links between the general practitioners and the district nurses, which, from the patient's perspective, results in a higher quality of health care services. An interpretation of this finding is that the goal of the clinical services quality group has been fulfilled. Despite all positive references to the e-mail system it was also signaled that the e-mail system is used for private purposes, which further increases the risk for "information overload" and the establishment of other (informal) information channels within the organization.

Moreover, in the interview, a nurse reports that the quality groups do not have had regular meetings after the implementation of the Intranet. This has had as a consequence that former hierarchical structures come back in the organization (traditionally, a health care organization consists of a hierarchy with the doctors at the top) when the PD project was over.

Conclusion

The implementation of a computerized information system in an organization might lead to a goal conflict between the organization and the technology. In the strive to democratize an organization in a participatory design project, issues such as changing power structures run the risk of being disregarded. When the responsibility for the information gathering and distribution is delegated to a person who is not the formal leader of the organization, there is a risk for uncontrolled and unwanted changes in the organizational power structures. Many of the staff at the studied PHCC experienced the system design not being adjusted to fit the work-flow, resulting in them having to adjust their behavior to fit the functions of the system (Vimarlund, 1996). This implies the need for conformity between the quality groups' intentions with the design project and the implemented system. Additionally if, after the implementation of a new system, quality groups do not have regular meetings anymore, and if additionally hierarchical structures come back in the organization as a consequence of this, when the PD project is over it can be a source for frustration or can give motive for reject the new system when it is finally implemented. This is an issue, which has to be taken into consideration in future PD projects.

References

Sjöberg, C. (1996): Activities, Voices and Arenas: Participatory Design in Practice, Linköping Studies in Science and Technology, dissertation No.439.

Vimarlund, V., Ljunggren, M. & Timpka, T. (1996): Implementation of Computer-Based Patient Records in Primary Care: The Societal Health Economic Effects, Proceedings of the 1996 AMIA Conference, American Medical Informatics Association, pp.503-508.

Yin, R.K. (1994): Case Study Research - Design and Methods, Second Edition, SAGE Publications, USA.

Practical criteria co-constructed in participatory WPASED workshops

Helena Karasti, University of Oulu, Finland
Helena.Karasti@oulu.fi

Biography

Helena Karasti got her MSc degree majoring in Information Processing Science at Oulu University in 1993. Since then she has been involved in a research undertaking with the Clinic of Radiology in Oulu University Hospital. She is interested in the study of technologically mediated work practice and the design, evaluation and use of information technologies, especially those that might enhance collaborative work practices. Her PhD-thesis, titled "Bridging Work Practice and System Design" will be finished by the end of 1998.

Introduction

The issue I want to raise in this position paper is that *user-centered* and *work oriented design* need to be thoughtfully combined to provide for the kinds of understandings of work practice that can be of relevance for system design. The practical reasoning of practitioners in the particular work domain can be of irreplaceable value in informing the requirements process, but mere user participation does not provide for the needed kinds of understandings of work. Nor do the traditional requirements engineering methods provide for suitable means to be used in bringing together users' experience and analysis of work practice with system design. Studies of workplace are definitely needed, but we need to find ways to bridge analysis of work practice with system design. The co-constructed design choices (requirements, practical criteria) should get warranted appreciative of both work practice and technology concerns.

This position paper briefly describes the co-construction of *practical criteria*[vii] in a WPASED (Work Practice Analysis and System Evaluation and Design) workshop and discusses some aspects of it in comparison to more traditional requirements engineering tradition (Jirotka and Goguen 1994).

[vii] *practical*: 1) actively engaged in some course of action or occupation, 2a) of, relating to, or manifested in practice or action: not theoretical or ideal, b) being such in practice or effect, 3) capable of being put to use or account, 4) disposed to action as opposed to speculation or abstraction
criterion: 1) characterizing mark or trait, 2) a standard on which a judgement or decision may be based (Webster's Collegiate Dictionary)

Background for WPASED workshops

This position paper is based on detailed analysis of the discursive practices in one video based WPASED workshop, which was conducted in relation to an experimental Tele-radiology system development project. First in the project a tele-radiology system based on personal computers was developed (Reponen, Lähde et al. 1995). The system was taken into clinical use for consultations in difficult or emergency cases in October 1995 and the experimental phase ran until January 1996 (Karasti, Reponen et al. 1998) . Fieldwork was carried out to study the actual clinical tele-radiology work practice in everyday settings in both locations by participant observation, in situ interviewing and videotaping (Karasti 1997a) . After the fieldwork video-based WPASED workshops were organized in March and May 1997 to offer an alternative, participatory, work practice oriented intervention into the development project to support in system evaluation and redesign. The planning, organizing and some initial experiences of the workshops are reported in (Karasti 1997b) .

A wide range of participants was gathered to the workshops: practitioners, researchers and administrators from the two radiology work communities, designers from the two companies collaborating in the tele-radiology system development, and academic researchers. We especially wanted to have practitioners present, not so much on account of politically correct or democratic reasons but more from *work practice* point of view, to represent the multifarious situated, partial *views* of tele-radiology work 'from within'.

Video collages of radiology work practice were edited to be worked on in the workshops. Entire sequences of actual work, in this case radiologist's image interpretation sessions, were selected to show the work 'as it is', in its unfolding character, including both the routine smoothness and the problematic situations of everyday practice. Both existing ways of working were included, the traditional way of working based on film and related light screens and alternator technologies and the emerging tele-radiology work practice based on digital images on monitors and computer workstations. For a more detailed discussion on working with videos see (Karasti 1997).

The video collage formed a shared object of collaborative activities in the workshop. The participants co-viewed sequences of actual work, the tape was paused and discussion started. The participants engaged in an analysis, they commented, made questions, offered interpretations, shared experiences, recounted related knowledge of several contexts, etc. They juxtaposed and compared the two technologically mediated work practices, which supported in evaluating the new tele-radiology system in use. Problems with the system became identified and potential improvements were suggested and assessed. Requirements for tele-radiology that had not been considered in the initial design were co-constructed. Some initial design assumptions and concepts were reconsidered and new ones outlined. Both work practice and system design issues were raised on a continuous basis. (Karasti, forthcoming)

Practical criteria vs. requirements engineering

The co-construction of practical criteria for the redesign of the experimental tele-radiology system was an ongoing achievement of participants in the workshop. It was not given a

priori what kind of framework or conceptualization it should suffice. The creation and simultaneous use of the criteria for addressing design issues was more of an emergent, unfolding process of collaborative analysis, comparison, evaluation and envisionment.

Most importantly, *practical criteria is based on actual work practice and lived experience*, not some idealized and/or speculated abstractions of it 'from without'. In the workshop firm grounding was laid through collaboratively analyzing and constructing shared understandings of work practice and system use. The collaborative activities in the workshop recurrently started with viewing videotaped instances of work. The participants commented, made questions, offered interpretations, shared experiences, recounted related knowledge of several contexts, etc. In the unfolding collaborative analysis of videotaped work practice topics and issues from actual practice were raised. Practitioners' (in this case radiologists') lived experience provided that the categories 'from within' the work practice were intimately intertwined into the co-construction of shared understandings.

The practitioners were able to relate the specific instances of videotaped work activities to the 'common' and the 'typical' of everyday routine work practice. The participants collaboratively searched for meanings and essentials of mundane work practices in aiming to characterize representative aspects of image interpretation. Starting with the 'particulars' of situated work activities the participants produced '*sets of sensibilities*' (Button and Dourish 1996) of work practice. Sensibilities are more akin to characterizations of the means by which working practices arise and are constituted rather than descriptive details of specific activity, therefore they are highly relevant for system design looking for abstractions and generalizations for requirements. At the same time they are germane to the work, appreciative of its nature and endogenous characteristics.

The first part of the workshop was intensively focused on explicating the *traditional work practice,* supported with the edited video collage starting with two entire sessions of image interpretation in traditional environment. The co-constructed understandings of traditional work practice served as a shared foundation in the subsequent collaborative activities where participants moved on to scrutinize *the experimental tele-radiology work practice and system use*. The possibility to juxtapose the different technologically mediated work practices gave participants another kind of perspective to understanding the change caused by the tele-radiology system. The analytic distance, in comparison to the everyday working and coping with the experimental system, allowed the practitioners to reflect on their work. The smoothness of the routine traditional practice became appreciated and a legitimate point of comparison in evaluating the experimental system and its use.

Classical requirements engineering methods typically have a different conception of the horizons of change and development. They treat the issue as if there were an existing set of requirements out there that just needed to be captured (Jirotka and Goguen 1994) which suggest a static and a historic view of work and of technology as the driving force of change. In the co-construction of practical criteria the interest is more appreciative of the history of change in work which becomes visible in the 'layers' of technologically mediated work practices and the ongoing development 'from within'.

In addition to the evaluation of the tele-radiology system, identification of problems in its use and finding improvements for them the participatory work practice oriented emphasis lead to two kinds of requirements engineering related activities in the co-

construction of practical criteria. First, the participants were called upon to evaluate and reconsider the initial design concepts. Reconsideration became necessary as the experiences gained during the experimental period of clinical system use and the co-constructed understandings of radiologists' image interpretation work suggested outright discrepancies between the initial assumptions and the actual tele-radiology system use and work practice. In the initial design phase system requirements had been elicited from the point of view of system development and its set of technological interests and problematics, which is typical to the more traditional requirements engineering approaches. In traditional requirements analysis and elicitation what to look for, that is the questions, needs and concepts, is taken for granted, they are from within system development, 'from without' the work practice. System designers impose their view of the requirements to a work practice organization. In the workshops, based on their new understandings the participants were able to start co-constructing alternative design concepts more accurately and intimately aligned with the actual work practices.

Secondly, the participants were challenged to engage in articulating and co-constructing the 'essentials' of tele-radiology work practice, identifying the aspects of radiology work that are so crucial that they cannot be overlooked in design. In this the participants had to compare traditional and emerging work practices. They needed to try to consideration what of the traditional practice is essentially needed also in the tele-radiology work practice. A further complication is the factor of unknown consequences of the changed technological mediation of work. In this case the participants were already aware from the previous phase that not everything from the traditional work practice could be preserved, i.e. the large film space of light screens would be reduced to computer screen(s). In the workshop the participants explored the implications of the decreased image space size for the image interpretation work and in this process they were able to delineate a *set of essential sensibilities* from the tele-radiology work practice point of view.

The co-construction of tele-radiology 'essentials' was perhaps the most challenging task the participants faced in the workshops. It had not been adequately addressed in the initial design phase. From the point of view of classical system development methods the analysis of the work practice is largely left to intuition because it is assumed that once the analyst has access to the 'information', it should be a straight-forward task to identify such analytic elements as 'objects', 'processes' and 'tasks'. The common belief is that because these elements are 'natural' in some sense, they should be straightforward to recognize (Jirotka and Goguen 1994) .

Practical criteria is not only influenced by the work practice, as it is constructed in collaboration where also other perspectives and design relevant contexts are present and intertwined into the process. In co-constructed practical criteria specific understandings of work practices get integrated with technology potentials and restrictions. The above mentioned 'ideal' of traditional radiology work practice, the co-constructed understandings of traditional work practice, the experiences gained of the emergent aspects of tele-radiology work practice, and evaluation of the tele-radiology system in use represent the more work practice oriented contexts. The co-construction of practical criteria for design was also about exploring the new possibilities and restrictions digitized imaging and tele-radiology offer and evaluating these design ideas by comparing them with the work practice contexts. Technological design considerations, however, were

brought to bear after or in conjunction with the co-construction of issues from work practice point of view, not the other way around as had been the case in the initial, technologically oriented design of the experimental system. In this the practitioners' abilities based on their refined professional expertise, contextual and historical knowledge of work practices became appreciated and accounted for in i.e. ruling out unrealistic ideas. They were able to detect the implications of the design propositions to their work practice and assess what is not in accordance with their work practice.

There is a list of design issues raised in the workshop in the appendix. They may seem somewhat haphazard and non-systematic to an outsider of the domain of (tele)radiology work practice and its computerized support. A knowledgeable party would, however, see that the items on the list are very relevant issues from the image interpretation and radiology work practice point of view as well as the development of tele-radiology systems point of view. In the co-construction of practical criteria different kinds of aspects are explored, rich understandings from many levels are gained, from the most eminent design concepts to the minutiae of interface design. Practical criteria is endogenous to the work practice, it 'grows' from the actual work practice and lived experience of practitioners. It is more attentive to the work environment where the system is/will be used in comparison to more traditional requirements engineering methods more confined to the hierarchical and structured categories 'from within' design interest and stepwise refinement progress of the analysis and elicitation.

References

Button, G. and P. Dourish (1996). Technomethodology: Paradoxes and Possibilities. CHI'96, Vancouver, Canada.

Jirotka, M. and J. A. Goguen, Eds. (1994). Requirements Engineering - Social and Technical Issues. Computers and People Series. Cornwall, UK, Academic Press Limited.

Karasti, H. (1997a). Notes on gendered experiences in fieldwork related to a teleradiology experiment. Women, Work and Computerization: Spinning the Web from Past to Future, Proceedings of the 6th International IFIP- Conference, May 24-27, 1997; Bonn, Germany, Springer-Verlag.

Karasti, H. (1997b). Bridging the analysis of work practice and system redesign in cooperative workshops. Proceedings of Designing Interactive Systems Conference: Processes, Practices, Methods, and Techniques (DIS'97), August 18-20, 1997; Amsterdam, The Netherlands, Association for Computing Machinery, Inc. (ACM), NY.

Karasti, H. (1997). Using video to join analysis of work practice and system design: A study of an experimental teleradiology system and its redesign. 20th Information Systems Research Seminar in Scandinavia, IRIS'20, Social Informatics, August 9-12, 1997; Hankø Fjordhotel, Norway.

Karasti, H., J. Reponen, et al. (1998). The teleradiology system and changes in work practices. Computer Methods and Programs in Biomedicine (forthcoming in 1998)

Karasti, H. (forthcoming).

Reponen, J., S. Lähde, et al. (1995). “Low-cost Digital Teleradiology.” European Journal of Radiology 19: 226-231.

Appendix - design issues discussed

*old text form patient records are also needed, not just images
*grayscale adjustment should be for individual images not for all images on the monitor screen (is discussed in more detail later)
*images should contain information about the examination details to help the selection for images for interpretation
*change from one patient case to the next one has to be swift
*juxtaposing two images side-by-side
*two monitors needed
*black background for images in windows *changeable place for the toolbar
* workstation environment, a holder for a coffee cup or a key board cover
* hanging of images before transferring them * date of examination included in the image header
* arrangement of images on the computer screen * background color for request should be gray * request not displayed together with the images, available on need * a ruler should be included for each image as an absolute reference for measuring * functions for image processing * 'one button functions' for image processing * selection of ways to interact with the application (mouse, keyboard, menus, scroll bars, toolbars etc.) * everything should be doable by using a mouse
* basic unit for tele-radiology is patient with examinations not transferred packet of images * comparison of images * image articulation work
* image rotation works but slowly with large, high resolution images
* grayscale adjustment - two different ways/functions needed (a possibility for adjusting while reading images, another from raw data) - current histogram function difficult to use, mouse good
* image resolution categories and terms for them to be used in the tele-radiology system (based on work practice categories & names)
* a 'paw like tool' for moving enlarged images in windows (current scroll bars not usable)
* image enlargement by cropping and stepwise (both needed) * suggestion for a design concept of choosing to juxtapose two images and their synchronous processing on screen * scale for showing enlargement factor * three button mouse for using image processing functions

User-Centered Design of the Magic Lounge

Masood Masoodian, Niels Ole Bernsen
Natural Interactive Systems Group, Odense University
Science Park, DK-5230 Odense M, Denmark
masood@mip.ou.dk, nob@mip.ou.dk

Biography

Masood Masoodian is currently working as an assistant professor at the Natural Interactive Systems Group, Odense University, Denmark. He has a Ph.D. in the area of CSCW from the University of Waikato, New Zealand. Over the past few years, Masood has been working on design and development of collaborative work environments. He has also carried out many empirical studies of human-to-human communication in computer supported collaborative work environments.

Niels Ole Bernsen is professor, Ph.D., and head of the Natural Interactive Systems Group, Odense University, Denmark. His work focuses on the development of prototypes, theory, development support tools, evaluation metrics, and standards for next-generation natural interactive systems, such as advanced spoken language dialogue systems, web-based meeting environments, web-based corpus annotation systems, wearable systems, etc. He is the originator of a theory, Modality Theory, for the understanding of uni-modal and multi-modal interaction.

Abstract

This position paper describes some of the lessons learned from User-Centered Design of a computer-based virtual meeting environment, called Magic Lounge. Magic Lounge is a virtual environment in which ordinary people can meet to communicate with one another, or work collaboratively on professional and non-professional group tasks. The majority of the intended users of the Magic Lounge will be non-expert computer users, who will require an intuitive and easy-to-learn software interface. The user group involved in the development process consists of inhabitants of small Danish isles.

Introduction

Magic Lounge (http://www.dfki.de/imedia/mlounge/) is one of thirteen Esprit Long-Term Research projects funded as part of the European Intelligent Information Interfaces (i^3) initiative. The aim of the Magic Lounge project is to design and implement a virtual meeting environment which provides the necessary tools for communication and interaction needs of geographically separated individuals who want to get acquainted or

collaborate with one another. Magic Lounge will be offering services such as: intelligent multi-party communication management allowing recording and retrieving of communication history in a multi-media fashion, speech-operated information retrieval for embedding third-party information services, content-based media conversion techniques, such as speech-to-text, text-to-speech, and analogue graphics-to-text, coping with heterogeneous communication devices (PC, PDA and telephone), and speech and gesture-based interrogation and navigation of information spaces.

Magic Lounge will be used by people who may just want to chat or make new acquaintances. However, they may also want to carry out goal-directed group activities which may be fully virtual or combine physical meetings and virtual meetings. These activities may be hobby-related or work-related, involving tasks such as visiting and searching other information spaces (WWW, local databases), planning, joint problem solving and so on.

The intended users of the Magic Lounge are ordinary people who are distributed geographically. In particular, the Magic Lounge development process focuses on the inhabitants of the smaller Danish isles. At this stage, eight of these islanders have volunteered to participate in the iterative design and testing process of the Magic Lounge software. These initial users of the Magic Lounge have different professional backgrounds but share an interest in the use of computer technology for creating novel means of interaction between the general populations in the remote islands, as well as connecting these to the outside world.

User involvement

User involvement is an integral part of the Magic Lounge research. The users are involved with the process of iterative design, development, and testing of the Magic Lounge. This process began at the first Magic Lounge project meeting in which some of the users were present. Since then, the users have received and responded to a design questionnaire, the results of which have been integrated into the design of the first Magic Lounge software prototype. The users have also been visited and interviewed individually by a socio-anthropologist. These interviews were all videotaped, and some parts of them are currently being put together to create a video presentation of the users' vision of the Magic Lounge. At the time of writing, the first Magic Lounge prototype is being installed in the users' homes.

The rest of this position paper describes the process of user involvement in more detail, so that some of the practical problems associated with user-centered design can be identified. It should be noted that Magic Lounge is also a research project. Therefore some of the issues discussed here are also relevant to those who are interested in involving general user populations in scientific research projects with the aim of developing software products.

Issues

As with any other user-centered design and development project, one of the main concerns of the Magic Lounge project has been the selection of the "right" user population. Although Magic Lounge is being developed for use by the inhabitants of the smaller Danish isles, this does not mean, of course, that other potential user groups should be ignored. The important thing is to identify the specific needs of the intended user community, and then compare these against the requirements of other communities to see whether any of the needs are specific to the intended group. If focusing on the specific needs of the intended user community forces the Magic Lounge to become less useful for other user groups, then a decision has to be made regarding whether those needs should be supported or not.

So far the design of the Magic Lounge, to a large extent, has been shaped by the suggestions of the Danish isles user group. The users' design ideas were collected using a questionnaire consisting of 24 questions. In this questionnaire the users were asked to identify their needs by describing a use case scenario and answering the questions of the questionnaire in relation to their selected scenario. This method of gathering user ideas was very constructive and allowed a wealth of information to be collected. No initial use cases were given to the users, so that their ideas would not be influenced by the preconceived design ideas of the Magic Lounge research and development team.

However, the use of this method for gathering user ideas is limited by the type of the selected user group. Different users have their own characteristics and requirements. When a product is going to be used within a particular type of organization or environment then the targeted user group can be identified to some extent. It is however, much more difficult to choose a suitable user group when a software product is intended to be used by the general population rather than a selected group within an organization. This is an important issue which Magic Lounge research team is constantly dealing with.

Another type of problem which projects such as Magic Lounge have to address, is that even when a user group has been identified, it is not always easy to select the representative sample users. The sample users of the Magic Lounge have all volunteered to participate in the project, and so they all have some motivation and enthusiasm. But they are also very different in terms of their computer skills, their needs, and their overall vision of an ideal virtual collaborative work environment. These differences in their characteristics influence their vision of a useful system. For instance, those user group members who are advanced computer users want the Magic Lounge to include "everything" without worrying too much about the way the components of such system are presented or associated with one another. The less advanced users, on the other hand, want only a few functionalities, without having a vision for what else is possible.

In user-centered design, the type of end product that is being created can also be affected by the personalities of the selected users. For instance, there is a big difference between the requirements of people who are introverts and those who are extroverts. In environments such as the Magic Lounge certain users want to be able to interact with the others, while some are only interested in receiving information without contributing much themselves. Tailoring the system to the needs of both of these user groups may not always be possible.

Even when the targeted users have been identified and their design ideas collected, it is not always that easy to convince the development team that those ideas are useful, or that they can be implemented using a particular technology. This is even more challenging when user-centered design concepts are being applied to a scientific research project in which new research ideas have to be tested even if the users aren't really interested in using them. Research ideas can in fact sometimes be against the ideas of the users, and if they are implemented they can create a negative attitude in the users who were against them.

A final factor that plays an important role in the effectiveness of the user-centered design process when applied to general product development, is the degree to which the members of the sample user group are committed to the project. Unlike the case of product development for an organization in which users are paid to work, in general product development the users are not usually paid for their services. For instance, in the Magic Lounge project all of the users are professional people who work full time. The free time that they can devote to the project is therefore limited. Some of the users are prepared to spend a large portion of their free time on the Magic Lounge, whereas the others are less committed. This means that certain users like to be involved in all the aspects of design, development, and testing, whereas some of the others want to be involved in only some parts of the process. People who are more committed are also more likely to feel happy about using and testing a prototype that is not perfect. They are also less likely to ask for support for installing and testing prototypes. People with less time or skills, on the other hand, are more likely to require support, and they are generally less likely to use prototypes that have bugs.

Conclusions

The paper has pointed out to some of challenges that have been identified during the early stages of the user-centered design of the Magic Lounge. Identifying the practical problems that are associated with user-centered design does not mean that this type of design is not useful, or that it is too difficult to put into practice. However it implies that, if possible, measures should be taken to avoid such problems. User-centered design has also many positive aspects when compared to other design methodologies. The authors hope that both the negative and the positive aspects of user-centered design will be discussed during the workshop.

Bringing Information Technology to the Shop Floor:

The problem of defining the scope of context

Karsten Boye Rasmussen & Steven Verjans

Mærsk Institute for Production Technology
Odense University
DK-5230 Odense M, Denmark
+45 6557 3551
karsten@mip.ou.dk

Automation Department
Odense Steel Shipyard Ltd.
DK-5100 Odense C, Denmark
+45 6397 1086
sv@oss.dk

Abstract

User-centered system development takes its point of departure in the tasks and working context of the immediate users, often within their most narrow working units. However, when the system development explicitly pursues organizational development alongside information technology development, it becomes evident that the narrow working unit is situated in a larger corporation. The development must therefore include the corporation's fundamental structures of information, division of labor, decision, power, and ideology. The problem stated in the paper is: how do we define the scope of the context? The problem is illustrated through a description of a development project at Odense Steel Shipyard.

Introduction

Problem statement

Software design starts by analyzing the context in which a system will be used. In order to assure greater usability the approach of user-centered design (UCD) is an obvious choice. The key to UCD is the involvement of a representative user group in the analysis and design process. The users will clarify the analysis by delivering a snapshot of the present situation: the current tasks, organizational design, working situation as well as an outline of possible improvements, specifically the needs for IT-support. At best, the discussions result not only in a system requirement specification but also in hypotheses of the possible changes that the information system will cause in the tasks, organization and environment, again often in the form of snapshot (scenarios of the future, [1]).
The problem we are faced with in our project is the following: Does the direct intention of supporting and enhancing the actual process of change influence the identification of users? The end-users of the system are surely identifiable, but this smaller work-group

cannot be viewed in isolation. The system will affect the environment, and local design decisions in the work-group have to take into account the general organization, the accustomed power relations, and in a production environment the extremely important practical solutions that are often the basis of the production. The notion of 'system in context' leads to the problem of defining the scope of the context.

Project: IT support for workers at shop-floor level

This paper describes an information systems design project at Odense Steel Shipyard, cfr. also [2]. The project's aim is to develop a generic software architecture with a number of flexible tools that can support production workers in their day-to-day jobs by providing them with as much relevant information as possible, and thus enhance their work involvement, motivation, and job satisfaction. Working on these human resource aspects is viewed as a means to reach the enterprise's final goal — to minimize cost and maximize productivity.

The project approach is a deliberately unfocused development of flexible software that can organically grow with the developments of the organization. The organizational change itself is expected to proceed in smaller steps to avoid the risk of software and organizational development that later proves unwanted. The project is initiated by the management, but the workers are seen as the central driving force.

Case: Pipe workshop

The pipe workshop produces between 40,000 and 50,000 pipes per year. The shop has about 60 workers and operates in production lines utilizing machines for pipe cutting, automatic welding of flanges, and pipe bending. A development project including a pipe-welding-robot has been introduced in the workshop.

Information, stakeholders & power relations

In this section we will briefly describe the functionality of each of the planned software modules and then analyze the relationships between each module with the central issues in the corporate context.

Information as "Task instructions"

Single pipes

This module is considered as the most obvious one in the application. It aims to replace the current rudimentary task instructions on paper with detailed visual and textual descriptions of the pipes to be produced, as in Figure 1. This kind of visual support is mainly important for the more complex pipes.

Figure 1: Image of a pipe to be produced

The error rate in pipe production is quite low. However, defects in quality are expected to be more frequent among more complex pipes. Consequences of defects can be very expensive, as replacements have to be made as 'rush-orders'. Showing the pipe in 3-D before production is believed to augment the worker's mental image of the pipe (s)he is producing.

Pipes in context

Instructions for the production of pipes come from the design and planning departments. However, from the workers' perspective some of the pipes seem more difficult to make than obviously necessary. 'If they had only designed them 10 centimeters longer, than we would have saved 5 hours in production…'

By giving workers access to the context in which this pipe will be assembled, a larger degree of understanding may be accomplished. Moreover, it will provide the worker with a sense of the larger picture in which his/her work fits.

The task instructions can be regarded as 'harmless' for the power structure since the worker is following directions (orders) on a single and individual task. A user-centered design approach for this module would involve a representative group of workers.

Information as "Communication"

Communication implies that the worker no longer only receives information, but also can initiate or more often respond to information. The experience of a sub-optimal construction as described above could be communicated to the design department that now no longer is just an information provider, but becomes a stakeholder in the design process of our information system. A successful implementation of the communicative feature will require a commitment from the receiving part (design department) that communication will be appreciated and utilized. Moreover, the current work flow of the design department may not allow them to react to these messages — due to lack of time, for instance — and may also need to be adapted.

Finally, this communication facility will challenge the current power structure. Should all communication pass through the hierarchy of the shop, should the sender always be the person 'responsible', or can the note be sent without special permission? The communicative facilities of the system will lead to an extension of the user group, including both people from the other departments (e.g. design), as well as more local lower and middle managers.

Information about workflow and division of labor

Another software module aims at providing the workers with information about the workload and the local planning of workflow. This will lead to a better understanding of the necessity of overtime work.

After the initial cutting and bending of pipe items the pipe production basically requires three skills: a pipe-smith assembles different pipe pieces by tack welding, a pipe-welder finishes the welding and workmen transport pipes between all areas. The current production flow has a separate location for each of the main production processes involving a considerable amount of transportation between the cells.

The software should be able to support a more product oriented organization, where a team of workers containing all the needed skills focuses on getting the pipe finished as soon as possible, even if that would mean that a pipe-smith welds pipes if the welder is too busy, or vice versa. The latter type of organization is expected to (a) prove more effective (less transportation and thus shorter throughput time), and (b) enhance worker motivation through a higher sense of 'group work'.

However, the introduction of flexibility of skills is trespassing onto the domain of the workers' organization at the shipyard. Each of the skill groups belongs to separate clubs of the trade unions at the workshop. The complexity of the power relations between the unions and the management thus becomes an important issue in the system development.

As the module is intended for a flexible support of more organizational designs, our user-centered design team will have to include local representatives of trade unions in order to discuss changes. It can be foreseen that the discussion about removing trade barriers is viewed as extremely crucial and will inevitably lead to negotiation between top management and general union representatives.

Acquisition, planning and scheduling of tasks

Experience at the yard shows that the current planning system — a decentralized top-down system — works. Ships get finished in good quality within reasonable limits. However, this system can only cope with unexpected events by introducing large buffers in the planning, which clearly effect the production time and cost of a ship. The current advanced planning algorithms are capable of dealing with large changes in plans, as long as they are regularly updated with as much information as possible about the actual state of plans and sub-plans.

The planning module we have envisaged for this project will enable pipe shop foremen or workers to make and adapt local plans within the framework of the overall planning. The foreman or worker will be able to not just follow the top-down-plan but to act upon contingencies and move work-tasks between weeks and let the computer calculate effects of the changing reality.

But if the foremen/worker takes over the acquisition and scheduling of work in collaboration with a computer system, this will cause redundancy among white-collar workers presently engaged in the top-down planning. Implementation of the system will thus have serious effects also on 'non-users' of the system. Currently the acquisition and scheduling of tasks is part of the central decision-structure at the shipyard. As the power of making decisions about one's own reality is seen as most central for worker involvement, planning should ultimately be carried out by the workers themselves or the

work teams. The workers' immediate superiors (foremen and gangers) will consequently be affected by this change in the power structure.

The design of the task-module will require analysis of the current planning needs, methods and tools. The involved informants will be the current planners and lower management, people whose present power or even job will become threatened.

Task-time registration: crucial, but extremely delicate

The project will need to prove or falsify the hypothesis that utilizing "human resources" can raise productivity. And this proof must be given in cold and hard facts. Otherwise the initiative jeopardizes itself, as it opens itself to hard fact criticism.
The method for proving the value can easily be determined in terms of costs: the materials cost and the amount of hours needed for production can be compared before and after the project. It is technically feasible to log information about work-tasks, the flow of work objects, as well as the activity of workers at the machines or work areas.

Moreover, a motivational force of the workers in a product group will be their possibility to evaluate their performance over time and in comparison with other groups. Finally, a motivating reward system is most obviously linked to the productivity of each group in terms of hours needed for the production of their products.

However, at present the number of actual production hours is not precisely recorded at the shipyard, since the production hours are part of an overall negotiation between the yard's management and trade unions. As such, production hours are a very delicate quantity. As a consequence, the monitoring or logging of activities will demand complex negotiations and establishment of an atmosphere of trust rather that control. The present time registration system resembles more a self-fulfilling prophecy than a regular reporting in so far as the trade union representatives make sure that the reported production hours are consistent with the negotiated amount.

A user-centered design team that wants to tackle the task-time issue at the shipyard would need to contain representatives from top management, board of directors, and the trade unions.

Conclusion - Problems

We have shortly described how what started as development of an information system is experiencing problems of defining and limiting the set of relevant stakeholders and how the system can be viewed as challenging the power structure and ideology at the yard.

Furthermore we can expect that the more the software will support change the more problematic each issue in the design of the software will be.

The problem remains: How to define and limit the user group? Do we start with a minimal change scenario with only workshop participants? Will later expansion of the group cause extra problems? Will added users from outside the workshop contribute to the development? Or will a late introduction force participants into an attitude of "no surrender" rather than enthusiasm for the future information system? Suggestions and discussion are most welcome.

Acknowledgements

The research described in this paper is partly funded by the Commission of the European Communities, within the ESPRIT framework, under contract nr. 22626. This funding is gratefully acknowledged.

REFERENCES

1. Carroll, J.M., *Becoming social: expanding scenario-based approaches in HCI.* Behaviour & Information Technology, 1996. **15**(4): p. 266-275.

2. Verjans, S. *IT-supported organisational changes in a production shop floor: a case study*. in Proceedings of the 24th Annual Conference of the IEEE Industrial Electronics Society - IECON'98. 1998. Aachen: IEEE.

Virtual Organizations as a Challenge for UCD

Markus Rittenbruch and Helge Kahler
Institute for Computer Science III, University of Bonn
Research Group HCI & CSCW (ProSEC)
Roemerstrasse 164, D-53117 Bonn, Germany
e-mail mr@cs.uni-bonn.de / kahler@cs.uni-bonn.de

Biography

Markus Rittenbruch and Helge Kahler are working at the Institute for Applied Computer Science at the University of Bonn in the Research Group HCI & CSCW (ProSEC - http://www.cs.uni-bonn.de/~prosec/). They are engaged in several research projects. Markus has studied computer science and psychology and is working on his Ph.D. thesis about awareness in GroupWare. Helge has studied mathematics, sociology and business administration and is working on his Ph.D. thesis about tailorability in GroupWare.

Abstract

Virtual organizations in their different forms are becoming more and more common. In this position paper we present the case of a virtual organization consisting of 200 Germany-wide distributed freelancers. The fact that the virtual organization does not have a geographical center, that the work and the local structures of parts of the organization are very heterogeneous and that the freelancers have to put in "their own" time for e.g. participatory design poses numerous challenges to UCD.

Introduction

Within the last years a growing number of “new” concepts of organizations has emerged. One of them which is currently discussed a lot is the virtual organization (VO) / virtual enterprise Within this new type of organization different considerations about the role of the organizational setting for the process of software design have to be made. Especially for the user centered design (UCD) new questions are arising. Organizations which are more flexible, less hierarchical, existing without a central control, working geographically distributed and depending on self organized team structures, just to name a few qualities, seem to have different requirements to the design, introduction and use of software. Since our understanding of UCD includes a major contribution of participants the question arises how a software can be designed participatorily, usable and appropriate in consideration of the organizational setting of a VO. Note that there are several types of VOs that must be distinguished ranging from project oriented groups of persons through regional unions of factories to large enterprises which outsource parts of their value chain

with which they keep cooperating (cf. Rittenbruch/Kahler 1998 for a longer discussion of these).

Our workshop paper will touch upon a few of these issues. In our current research projects we are investigating a concrete VO (a collection of project oriented groups of persons) and are aiming to improve both the introduction, adaptation, and usage of GroupWare for the specific organizational needs and the organizational setting for an efficient use of GroupWare. We are particularly considering GroupWare although most of our considerations can be transferred to the usage of interactive systems in general.

UCD in a virtual organization

We want to give a short overview of our field of investigation. Sigma (name changed) is a service provider which is geographically distributed over Germany. The main areas of Sigmas activities are training e.g. for software packages and consulting. Sigma is a Germany-wide distributed network of about 200 mainly freelancing consultants and trainers who build small or large teams to work on projects. The distributed organization members usually working in their "Home Offices", i.e. using some part of their homes for their office equipment like telephone, fax or computer. Along with the growth of Sigma recently eight regional branches were established in different parts of Germany. The goal of the establishment of the branches was to structure Sigma's coordination of activities better which had become much more difficult with the growth of Sigma and at the same time relate to the fact that personal acquaintance and relationships play a very important role for the organization. This importance is also expressed by Sigma's equivalent to classical personnel management, which consists in a network of trust where a project leader just approaches personal acquaintances when looking for people to join a new project. If this is not successful the project leader asks other Sigma people if they can recommend her someone for the job. The hierarchies are flat and consisting of 3 levels, top-management, management of the local branch and consultant / trainer where hierarchy basically means involvement with Sigma but not authority to issue directives. Furthermore project managers can be established for training and consulting projects (for further description cf. (Rittenbruch/Kahler 1998)).

Sigma is using a GroupWare, which shall be called SigSys here. SigSys is an off-line mailbox system that can be accessed by any project member that is granted permission by the Sigma management. Currently about 150 persons have access. SigSys can be operated via modem or ISDN, a digital network for telephoning and data exchange. With SigSys people can exchange mails within SigSys or to and from the Internet and access Sigma intern mailing lists dealing with issues of certain projects or regional groups. The access to these mailing lists is restricted. Moreover, SigSys permits the sending and receiving of binary data like text documents or overhead presentations that are often exchanged between members of a project team. Considering this, SigSys has a comparatively simple functionality but has some advantages compared to an ordinary Internet access via a provider, particularly being a medium for the internal usage within Sigma with the respective access restrictions and possibilities for regulation and being easier to install and cheaper.

SigSys has been introduced before the start of our research project. In a first step we are trying to improve the existing system in cooperation with the developers. In a second step a new GroupWare which fits the needs of the users and reflects the special organizational settings will be realized. For that we performed different empirical investigations like interviews, group discussions and observer studies which focus on different aspects of the organizational setting like communication, decisions, power, organizational culture as well as the use of the SigSys-system. Based on our empirical work and theoretical investigations on VOs we came across the following problems for the use of GroupWare in VOs. We are differentiating two categories of problems:

1. Problems in the process of participation

2. Problems in systems use

These categories only relate to problems evoked by the particular organizational circumstances in VOs. Furthermore we identified a lot of usability problems regarding the use of SigSys that we think are of less interest here. Most of them are caused by lacking user participation and a not up to date technical basis and all of them are particular problems of the SigSys-system. For that in the following we are going to concentrate more on general problems of UCD in the particular context of VOs.

Problems in the process of participation

Talking to the users is vitally for UCD. A lot of different methods for participatory design (PD) can be distinguished. For design in the context of VOs of a special type we have to ask which methods fit best and what are the general problems with PD in those VOs. The following issues will describe a selection of problems that we found to be universal problems of participation processes in VOs of the Sigma type.

- ***Availability of time and money:*** Classical methods of PD take for granted that the participants are released from work for a period of time. Normally managerial decision or free decision of employees, which are permanent workers, realizes this. In a network of self-responsible freelancers it is much more difficult to manage the process of PD. When everyone is responsible for his income and has a self-conception to be a independent contractor it seems to be difficult to find free personnel resources for PD. The problem appears within all activities, which are related to the network as a whole. It remains unresolved until now.

- ***Indistinct responsibilities:*** In organizations with distinct hierarchies managerial decisions are obliging in general. Organizations with little or no hierarchies seem to have a strong need for discussion and consensus. Although this may be seen as a nice democratic approach we found this to be a hindrance for organization-wide processes like the participation in the design of a GroupWare. At Sigma we found that a round table aiming at the improvement of information- and communication-flow within Sigma people were mutually shifting the responsibility for this to others,

so the round table was lacking essential contributors. This was caused by unclear responsibilities as well as time problems.

Problems in system use

While practicing UCD a lot of motivational factors have to be considered regarding the use of the system. We have identified some hindrances for the system use and are important factors for the UCD-process in the context of VO.

- ***Motivational factor: political acceptance:*** Regarding to the use of the system different "political" opinions can emerge within the staff whether a system is adequate and usable. This can lead to a situation that the introduced system is rejected by a group of organization members. Within our field of investigation a group of computer professionals rejected the SigSys-system. The introduction of the system essentially did not occur participatorily. Therefore a group of computer specialists within Sigma could not contribute their conceptions of an appropriate system. Until today this group has not accepted SigSys due to the introduction process and other conceptions of quality and suitability of the system. A further group, consisting essentially of managers, is considered to be expressed supporters of the system. They do accept the strategic decision of the top management for the introduction of the system and make an effort to support the use of the system within Sigma. We do not think that the phenomena of "political acceptance" is crucial for VO exclusively. However, we assume that the specific management of VO leads to a higher degree of different political opinions related to the employment of a particular system.

- ***Motivational factor: subjective system relevance:*** Our results suggest that there is a inter-individual difference in the necessity to use the system. In the context of our exploration we could identify two causal factors of subjective relevance:

  Informedness: Different individuals within Sigma are "informed" differently. The informedness of an employee reflects his knowledge about the organizational coherence and indicates if the right persons to turn to in order to get relevant information are known to him. In the context of our exploration we discovered that some persons were so well informed that they frequently already possessed information before it appeared in SigSys. Other individuals depended to a great extent on the information presented in the system. Aspects like being new to the network and spatial or personal marginalization complicate access to information.

  Cooperation-Necessity: Due to individuals' different roles within Sigma the necessity to cooperate with other people or groups differs. The necessity to cooperate also influences the necessity for the use of the system. With individuals with small necessity to cooperate we found that that these used the system only for short periods of time (*frequency of the use*) and participated little in forums (*intensity of use*).

The subjective relevance of system use has to be taken into account while tailoring the system for the particular needs of users. Furthermore classical design issues like the “critical mass of user” and “disparity in work and benefit” (Grudin 1994) are highly related to this phenomena.

- ***Heterogeneity of use:*** Within Sigma we identified problems which were due to the very heterogeneous use of the SigSys-system. On a short term inquiry for trainers to build up a team, addressed to a SigSys panel, too few trainers responded. The initiator of the inquiry could not differentiate whether the trainers a) were not interested, b) were busy or c) had not read the message at all. Complex negotiations by telephone followed, which should have been avoided by the application of the system. We found that SigSys is used very differently. Concerning the *frequency,* the use differs between several times daily and almost never. Concerning the *intensity of use,* we identified differences between the regular participation in all panels up to the use of selected partial aspects of the system. The heterogeneity seems to be caused among other things by lacking arrangements about the use of the system.

Open questions and challenges for UCD

The aspects of UCD that apply to Sigma are by no means new in the discussion or unique to VOs of a special type. We do, however, believe that the specific requirements of VOs seem to intensify some of the problems. We think while practicing UCD in a VO its necessary to take into account the specific environmental setting rather then wondering later why e.g. the participation process fails.

As a generalization we can ask three open main questions:

1. How can UCD deal with particularly divergent user needs and incoherent organizational requirements?

2. How can participation be realized in the processes of system-development and -introduction taking the mentioned problems into consideration ?

3. Supposing that the use of GroupWare is vital for success of a networked organization and that a critical mass of users is needed to succeed what has UCD take into account to foster motivational aspects?

In the light of our insights depicted above we believe that designing GroupWare for Sigma and other virtual organizations that are highly flexible poses many challenges to UCD. Only if these can be mastered the potential of virtual organizations to fully use their flexibility for their benefit can be unfolded.

References

Markus Rittenbruch and Helge Kahler (1998). *Supporting Cooperation in a Virtual Organization*. Proceedings of the Nineteenth annual conference on information systems (ICIS), Helsinki, Finland (in print).

Jonathan Grudin (1994). "*Groupware and social dynamics: eight challenges for developers*." Communications of the ACM 37(1): 92-105.