Strings of Experiments - Looking at the Design Process as a Set of Socio-Technical Experiments

Thomas Riisgaard Hansen
Centre for Pervasive Healthcare
Department of Computer Science, University of Aarhus
Åbogade 34, 8200 Århus N, Denmark
thomasr@daimi.au.dk

ABSTRACT
In this paper I show how the classical notion of an experiment can be used as a metaphor to describe and guide the design process. I present socio-technical experiments as a type of experiments that emphasis both the sociological and the technical part of a design. I argue that focusing on socio-technical experiments can greatly benefit in addressing three core identified challenges.

The socio-technical challenge focus on how to design with a combined technical and social view, *the multidisciplinary challenge* is about how to structure design processes in multidisciplinary teams and *the translating challenge* addresses how to design for a context that is going to change with the introduction of the new design.

Further more *boundary zones* are presented as an extension of the term boundary objects that address how different design representation are handed over and used between different professions within the design team.

Author Keywords
Participatory design, multidisciplinary collaboration, translating socio-technical network, boundary zones, socio-technical experiments

ACM Classification Keywords
H.5.3 Group and Organization Interfaces**,**
Evaluation/methodology**.**

INTRODUCTION

The design of pervasive interactive systems is an increasingly complex task. There are a demand for new methods, models and techniques for coping with these new challenges [24, 38]. The success or failure of modern IT-systems are not only about good, technical sound systems, but it is as much about how these new systems fit in with the future users and the organization in which they are going to be a part of.

Proceedings Participatory Design Conference, Aug. 2006, Trento, Italy
© 2006ACM ISBN 1-59593-460-X/06/08...$5.00

We have at Centre for Pervasive Healthcare at University of Aarhus for several years work with designing technology for hospitals. A hospital is a highly complex work setting involving many different professions working together with diverse views on what is important and where information technology could and should be used. To match this complexity the people in the Centre comes with many different backgrounds e.g. computer science, ethnography, information studies, nursing, medical school, civil engineers and architects.

Working in a multidisciplinary team with the design of new technology for a complex organization has not been easy. In this paper I focus on three of the main challenges we have encountered and worked with.

- *The socio-technical challenge*: When designing technology that is going to be used extensively in an organizational setting by many different users the focus in the design process needs to be simultaneously on the technical and social/organizational issues, but how do you focus on the socio-technical network in the design process?
- *The multidisciplinary challenge:* Designing for socio-technical networks requires both a highly technical and a highly social understanding of the design hence there is a demand for a multidisciplinary design team that matches the complexity of the task, but how do multidisciplinary teams efficiently work together?
- *The translating challenge:* When designing for a context, it is not the current context that the design should be targeted. When a design is introduced into a socio-technical network the network translates in sometimes highly unpredictable ways. How do you design for a future setting that does not exist without your design?

In this paper I introduce *socio-technical experiments* as a new metaphor to structure and describe the design process. Participatory design is by nature an experimental and explorative approach to design, but by grouping together a set of design activities into a more classical frame of experiments I suggest a new frame for describing the design process.

The frame *socio-technical experiments* addresses to some extend the above described challenges by focusing equally on the technical and the social part of a design, by exploring future use situations and by highlighting how the strengths from different disciplines benefit the overall design.

A central term identified during this discussion is the idea about *boundary zones*, which is a flexible zone existing between different professions within the design team where knowledge can be shared and exchanged.

FRAMING THE SOCIO-TECHNICAL DESIGN CHALLENGE

One of the new challenges when designing pervasive systems is to break with the dichotomy between designing the technology and implementing the technology in an organizational setting. To elaborate on this point I will discuss the terms socio-technical network and translated socio-technical network.

A socio-technical network is a term explored by a number of authors e.g. Latour [32], Callon [9], Law [33], Haraway [22]. In their work they explore the relationship between the social and the technical, not as separate entities, but as highly interwoven as a form of network. They use the term socio-technical network to dissolve this distinction between the social on one side and the technical on the other. E.g. when a field study is conducted during a design process, what is studied is how previous designs are interwoven in the socio-technical network. Change in one part of the network will affect other parts of the network because of its connectedness.

Whenever a new design is introduced into an organization or some organizational changes are made the socio-technical network is going to change into some new form. This new form is in this paper called the *translating socio-technical network*. The focus is here not on the current socio-technical network, but on a network that is changed due to the introduction of a new design. This new change network might be more stable, but will still be translating. A big challenge for designers is to come up with a design that works not in relation to the existing socio-technical network, but within the translating socio-technical network.

The socio-technical perspective acknowledge the participatory design tradition and points out the weakness in the approach where new technology is designed separated from the use context and the organization subsequent are changed to adapt to the technology through means of e-learning, organizational change etc. This approach is called “fallacy of the empty vessel” by Jordan and Suchman [38]. They criticize the approach for watching the users of a system as empty vessel just waiting to be filled with the knowledge associated with the new technology. Bruno Latour calls this approach the model of diffusion [31]. In this view new technology diffuses out into the organization and changes the social sphere whereas the intended use of the technology is unchanged. A focal point of critique is that the success or failure of a system is not only depending on how the system is designed, but on how it is grasped by the users and this is far from predictable [35].

Translating Socio-Technical Networks

In contrast to this approach Latour suggest a model of translation [31]. The socio-technical network is not a stable entity in this model, but the network is seen as constantly developing and adapting to changes [31]. When new technologies are introduced this network will get unstable and change, develop and try to evade the designer until the socio-technical network again gets more stable in some new form. In this new form, the design might be used quite different from what the designer intended with the system. An important point is that you cannot separate the technology from the socio-technical network and evaluate it in isolated.

A concrete example of this is from the nurses’ office in a hospital ward. Here four pc’s provided access to the electronic patient record. One of the problems with the system was that it was cumbersome to log in, find the right patient and scroll to the relevant information. The job of the nurse however, required her to respond to different urgent tasks and before she could finish her entry into the system she often had to move around the ward to attend other patient. To support this kind of behavior the system had a ‘lock the screen’ feature that the nurses used. The only problem was that they were around twenty nurses sharing the same four computers and within the first hour all the computers were locked. The other nurses that needed to get to the medical information were simply not able to use the computers [3].

Seen in isolation the technology worked as stated in the requirement specification, but within the socio-technical network there was a misfit and the nurses had to change their behavior and do all kinds of workarounds to get their job done.

The translation model tries to capture the translation that a socio-technical network undergo when a new design or technology is introduced into an organization. In this model a design is a dynamic entity that changes as it is implemented in the organization.

The translation model provides a good tool to describe the challenges a designer is going to meet. The designer is not supposed to design an isolated product, neither a product for an existing socio-technical network, but the designer has to design a product that will fit into the translating socio-technical network.

It is impossible to foresee which translation the network is going to make. However, the design team has to come up with a concrete design. The question is that even though it is impossible to predict the outcome of the translations, how can the understanding gained from the translation model be used to make better designs? And which concepts and techniques can help the designer in this process? The

translation model gives no hints on how to approach these questions.

Participatory Design and Related Work

Within the participatory design tradition the focus has been on how to involve the end users in the design process and many of the techniques within the participatory design field address some of the issues around *the socio-technical challenge* and *the translating challenge.*

Different techniques have been developed and explored e.g. the use of scenarios [10], video prototypes [37], mockups [29], future workshop [27], design games [26], user characters [14], thinking hats [34], design collaboratorium [8] etc. Many of these approaches describe a single technique or a single concept that a designer can use as a kind of tool from a tool box.

A toolbox is good because it provides a set of flexible tools a designer can adjust to the current situation. However the different tools or techniques are often focused on a single design activity within the design process and to address the socio-technical design challenges there is a need for a design model that ties these activities together. Several design process model are suggested within participatory design [20].

One model is presented by Buur and Bødker [8]. They have, inspired by the spiral model suggested by Boehm [6] and in cooperation with the Danish company Danfoss, developed a participatory spiral model, where a design process is seen as a set of iterations. Each iteration involves an activity with user involvement and a design activity without the users. The spiral aims at the development of a concrete product. The model is however only a rough frame for describing the design process and it does not go into details with the three suggested socio-technical design challenges. Another shortcoming is that the design events are part of the design process of a concrete product. This might not at first appear as a shortcoming, but it makes it difficult to reuse and pass on the knowledge gained from the design process. It also makes it difficult to work in several teams, because even though it is a spiral model it is still linear. There are no possibilities in the model for splitting the design events up amongst different design teams.

Another model suggested model is called Cooperative Experimental System Development (CESD) and is presented by Grænbæk e.al. [20] One of the main contributions of this model is to separate product development concerns and design activities. With this separation it is possible to view design activities as contributing to several of the product development phases such as analysis, design or realisation.

The CESD model couples the different user centred design techniques to a system development process. It does indirectly address *the socio-technical challenge* and *the translating challenge* through some of the suggested user event, but it does not address the issue about how to design in one or more interdisciplinary teams.

Björgvinsson and Hillgren [5] do also focus on making experiments within Healthcare, but they do not provide the same framework as suggested in this paper.

SOCIO-TECHNICAL EXPERIMENTS

With the introduction of a *socio-technical experiment* a set of design activities is collected into an experimental inspired approach. A socio-technical experiment tries to investigate properties of a translating socio-technical network by experimenting with it. It is not the design as isolate entity that is tested but it is the combination of the design and its users that is tested.

A socio-technical experiment is inspired by classical experiments. At the beginning of an experiment a set of hypotheses is formulated that addresses some issues around the socio-technical design that could provide valuable input to the design process. These hypotheses are tried out during a *socio-technical test* and are subsequently evaluated.

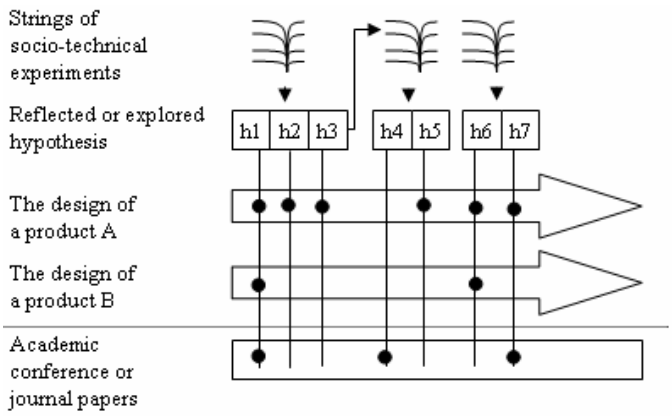

Figure 1. A socio-technical experiment

The outcome of the socio-technical experiment is however not an acceptance or disposal of the hypotheses, but a new set of *reflected hypotheses* and sometimes new hypotheses surface as a result of the experiment. These new hypotheses can then again be explored through new experiments.

The Four Main Activities

Figure 1 sketches a graphical view of a socio-technical experiment with a number of activities and with a continuum from designers to users depending on where the main focus of the design activity is located. The socio-technical experiment is divided into four main activities: The inspiration activity, the design activity, the socio-technical test and finally an evaluation activity

Inspiration: The goal of the first activity is to come up with a set of hypotheses for the test. The designer can draw on academic theories, related projects or even products. But the designer's context is seldom enough and a great source of inspiration is from the context of use. Suggested design

techniques during this task are field studies, workshops or user dialogs.

Design: This activity is mainly focused on preparing the setting for the test. Depending on the types of experiment the design can be the creation of simple mock ups to complex prototype development, but it can also be the design of procedures or strategies that focus more on the social structure than the technical setting. It is important to keep in mind that the design activity is focused on preparing a socio-technical test that can inspire the overall design and not necessarily a component that is going to be in the final design. Both users and designers can contribute to the design activity. Suggested design techniques are scenario-writing, mock-up or prototype developing.

The socio-technical test is where the hypotheses are tested by testing a stage socio-technical network. Depending on the test this activity can involve simple test with mock ups in a laboratory or it can be complex pilot studies in a real world setting. However, the complexity rises when moving towards real world settings and it is hence only late in a design process these types of experiments are recommended. Suggested design techniques are scenario acting and playing and managing pilot studies.

Evaluation: Finally the experiment is evaluated and the results are summarised in a set of reflected hypotheses. The evaluation is guided both by the designer's observation and feedback from the users.

An Example: Can a Tablet PC Replace a Hand Held Paper Journal?

Through field studies and reading related work it became clear that even though an electronic patient record has many advantages compared to a paper based record it also lacked the paper based records mobility and pervasiveness.

A hypothesis was formulated: A tablet based PC would combine the advantages of the paper based record with the advantages of the electronic record.

In the design activity a set of scenarios was formulated involving the use of a tablet based electronic record. During a design workshop with several nurses and doctors at the university the hypothesis was tested, and the reality proved to be a lot more complex than expected. Based on the test a reflected hypothesis was formulated:

"It is possible to support mobility with a tablet pc but there are a lot of things to consider. A tablet pc is at the moment to heavy to carry during a whole workday, they are easy to steal, and can maybe not be properly cleaned. They might not be robust enough to handle a fall to the floor. And if there is a heart attack alarm, how can the technology be put down fast without breaking it? "

This example shows how a socio-technical experiment does not accept or reject a hypothesis, but is able to unfolded the hypotheses and show some aspect of the translating socio-technical network the designer have to consider.

The Experimental Model

The motivation behind a socio-technical experiment can be the development of one or more concrete products or it can be by a wish to explore a new technology in a socio-technical setting, but an important point is, that a socio-technical experiment can be treated as independent design activity.

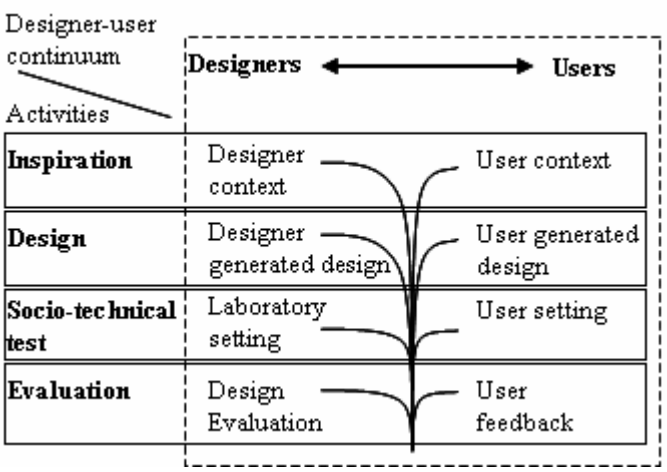

Figure 2. The Experimental Model

This implies several advantages. It is with this separation possible to use the results of the socio-technical network, in many different settings. The reflected hypotheses can for instance be used in the design of one or more specific product or they can be published in scientific journals. It also makes it possible to have many socio-technical experiments running in parallel investigating different properties of the design. And it is possible to have several multidisciplinary teams working on input to the same design process. Figure 2 shows an overview of the suggested experimental based model. The reflected hypothesis h1 is used in the design of two different products and published, whereas h3 is only used in the design of product A, but is also used to formulate new hypotheses that are explored in h4 and h5. Product A is thus the result of a string of experiments (h1, h2, h3, h5, h6, h7)

In one of the design projects focusing on the future infrastructure for hospital [12], one design team investigated how to log-on to a system [3], another design team investigated social-awareness [4] and another team investigated properties of mobility [7]. All separate design activities carried out by people with different backgrounds, but contributing to the same project. At the same time the results were published and some of the results were later used by IBM in the design of a mobile Electronic Patient Record Solution [2].

Viewing the design process as a set of socio-technical experiments, as described in the experimental model, provides an easy way to divide the design process amongst multiple groups and addresses the *multidisciplinary challenge.* The division allows several different

multidisciplinary teams to work together in parallel on different issues concerning a design.

AN EXAMPLE: THE AWARE-PHONE PROJECT

The framework presented is a result of many different design processes carried out at Centre for Pervasive Healthcare. In the following I will however discuss socio-technical experiment grounded in the design process of the Aware Phone.

The goal of the AwarePhone project is to reduce the number of unwanted interruptions within hospitals by providing awareness information [4].

In the AwarePhone project an experimental approach was used. The inspiration to the AwarePhone was grounded in related work around awareness and in field studies focusing on interruptions in hospitals. The basic idea in the design is to collect and provide awareness information on a mobile phone about the current activity of the person you are going to call. Instead of just calling "in the blind" the user can look at the awareness information and decide to interrupt by calling, choose another person to call, or to send a message.

Different ideas behind the phone have been evaluated at several socio-technical test and 17 mobile phones are currently deployed in a pilot study at a local hospital. Figure 3 is a picture from the operating ward where a technician is using the system.

Figure 3. The AwarePhone used at a local hospital

INSPIRATION ACTIVITY

The first mentioned activity focus on generating and describing interesting hypotheses about the socio-technical network. Inspiration can come both from looking at related work and from studying the user context.

Related Work

One way to investigate a new area is to get inspiration from what is written and done elsewhere. It does not necessarily have to be academic work and projects, but also for instance different types of experimental art projects can provide rewarding insight. Artistic project can be used to explore our attitudes towards things that might come but are not yet realized. Technical, context specific or computer supported cooperative work literature can provide good descriptions and discussions about different aspects of the area to be investigated.

Overall many kinds of literature might be used to contribute to the creative process of generating hypotheses. Because many different kinds of literature can be used, it is also a task where a group of multidisciplinary people cooperating in this task, will be able to generate interesting hypotheses that are inspired by the different approaches.

For instance in the AwarePhone project we started out with a vague idea about how social awareness could help reduce the number of interruptions between clinical staff on a hospital. Our first approach was to search for literature about awareness and looked at all different types of awareness from artistic awareness projects [18] to more concrete technical solution on awareness problems [15].

User Context

Studying the literature will generate a lot of ideas, but it is seldom enough [36]. There is a general need for getting to know the domain and work situation [30]. The people who have the best experience with the current socio-technical network are the intended users. There are numerous techniques in which users are involved in trying to identify aspects of either the current socio-technical network or the translating socio-technical network.

One of the techniques we often use at the Centre for Pervasive Healthcare is to conduct simple field studies [24]. The purpose of the field studies is to get inspiration to the hypotheses and to identify some of the obvious design constraints within the use context. Having conducted field studies also greatly helps in asking relevant and provoking questions in subsequent workshops. Another advantage of conducting field studies is that people studying the user context without any previous knowledge about the context is able to question basic assumptions that is taking for granted by members of the user context.

The different results accumulated from the user context are summarized in a report. Several different approaches at structuring this report for a design context are discussed by for instance Hughes [24] and Bardram [1]. This report is an important design document and is used to pass on some of the constraints and possibilities from the user context to the design teams. Another import role of the report is as input to different kind of workshops and confrontation with the users.

Doing field studies can be supplemented with different kinds of exploratory workshops and user confrontation. They are great tools to pass some of the observation from the field studies back to the users and get their reflected view on these observations [27]. One of the big challenges is to move the focus of the user from the current work situation or socio-technical network to a new and maybe complete transformed socio-technical network. Several techniques and techniques have been developed to address

this task, for instance future workshops [27], design games [26] and thinking hats [34].

Another great resource during this task is to involve some of the users more closely in the design process or just to have regular conversation with the users. Simple conversation with the intended users is a cheap way to bring valuable feedback to the design process.

In the AwarePhone project we carried out simple field studies for two weeks at a local hospital. As supplement to this work we held a three days workshop where one of the topics was on how to reduce the number of unintended interruptions. The outcome of the first activity was four hypotheses about how to initiate cooperation between clinicians. The hypotheses:

H1: that distributed awareness would be able to reduce the number of ill-timed interruptions.

H2: A combination of automatic captured and self reported awareness would be beneficial.

H3: The system should support direct communication through voice.

H4: If messages was used it should be possible to prioritize them.

The hypotheses generating process is as pointed out a creative activity where multidisciplinary teams have a strong advantage, because they can bring more perspectives and angles on the current design challenges. The outcome of the analytic activity is as mentioned a set of hypotheses about some aspect of the translating socio-technical network that could be relevant for the design team's choices of design solution.

These hypotheses are then going to be the guiding questions for the following activity, where a design is presented and the test is prepared.

THE DESIGN ACTIVITY

The purpose of the constructive activity is to design a socio-technical system that can be tested out in the *socio-technical test*. One of the important things in socio-technical tests is to incorporate the hypotheses in the test so that the basic assumptions in the hypotheses are challenged. The best way of learning something about the translating socio-technical network without implementing it is to run a pilot-study, but pilot study is really resource and time consuming and requires both stable prototypes and a large involvement both from the designers and users [22]. An alternative especially earlier in a design process is to play out scenarios.

As pointed out by Carroll scenario-based design techniques belong to "a complementary tradition that seeks to exploit the complexity and fluidity of design by trying to learn more about the structure and dynamics of the problem domain, trying to see the situation in many different ways, and interacting intimately with the concrete elements of the situation"[10]. Scenario based design has the same focus as socio-technical test, their purpose is also to reveal more about the structure and dynamics of the problem domain or more specific the translating socio-technical network.

A starting point for doing scenarios is to get inspiration from the field studies and general user involvement [10]. To do this it is important that the reports from the field studies are available and written in a structured way. This allows the design team in an easy way to take some of the described episodes and use them in the creation of socio-technical scenarios. This transaction where a field study report is taken from an ethnographic domain and transformed into a set of socio-technical scenarios in a design domain I call a *boundary zone*.

The boundary zone term is inspired by Star and Grisham's term boundary objects. Boundary objects are objects used by different parties in different localities; they are robust enough to maintain identity across heterogeneous use, but plastic enough to adapt to the constraints and needs of the different parties working with them [38].

Where boundary objects are plastic objects, boundary zones are plastic zones shared by different professions. Within a boundary zone different representational objects of similar knowledge exist, but the representation is formed by the different professionals. The representation objects will however still be mutually understandable amongst the different professions. Boundary zones also resembles Ehn and Kyng's discussion of Wittgenstein's language games within designs [29], but where language games focus on providing a shared language within a design group boundary zones acknowledge the need for different representations, but stresses at the same time the need for common properties that allow for a translation between the representations.

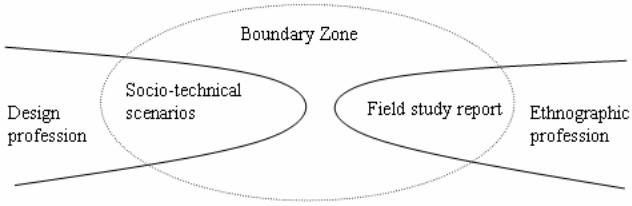

Figure 4. Boundary zone between the design and the ethnographic profession

Figure 4 illustrates the notion of boundary zones. The socio-technical scenarios and the field study reports are within the boundary zone. The socio-technical scenarios are inspired from the field study report and adapted to the design process at hand, but they are not the same representation. However, the socio-technical scenarios are also understandable for the ethnographer who will be able to review and comment on the scenarios. The boundary zone can be seen as a transformation zone where representations are negotiated and handed over between different professions.

A boundary zone is also a way of addressing *the multidisciplinary challenge.*

The following example is from the field report in the AwarePhone project.

"A young doctor is treating a patients wound. He has to cover the wound with some transplanted skin. The wound is however not looking nice and the young doctor do not know whenever he should proceed and cover the wound or if he should wait. He runs around the ward to find a more experienced doctor. He finally finds a free doctor one floor up and together they go down to se the wound" (field report day 6)"

This episode was used as inspiration to a socio-technical scenario that starts:

"1) A patient at the ward is feeling ill and is contacting the nurse. The nurse finds a doctor that does not seem to be busy and calls this person".

The field episode and the scenarios are grounded in the same episode, they are in a boundary zone, but they are still different representation. At the same time the socio-technical scenario tries to address the hypothesis about distributed social awareness with the task: "find a doctor that is not to busy".

Designing Prototypes

Within the design activity it is also necessary to develop some kind of representation of the technology in the socio-technical scenario. Depending on the specific scenarios a set of mock-ups [29] or prototypes [16, 19] need to be prepared. Using mock ups is preferable if the scenarios are very exploratory and creative ideas about the translating socio-technical network is the goal. Is the goal however to explore more specific aspects of the socio-technical network, prototypes are to be preferred. I will focus the discussion on the development of interactive prototypes, but some of the issues will also be relevant to the design of mock-ups and other kinds of technical representation.

Design prototypes are a common way to represent technology in socio-technical scenarios and the development of prototypes often requires people with technical skills. Another boundary zone can hence be seen between the design profession and the technical profession.

Before the prototype system can be created a set of requirements to the system's behaviour need to be specified. A widespread technique is the use cases technique [13, 17]. Use cases are scenarios that describe the user's interaction with an interactive system with some level of details. The use cases are determined by the socio-technical scenarios, but where scenarios are open use cases have to be specific and address different kind of alternative behaviour the system has to react to. Figure 5 illustrates this new boundary zone.

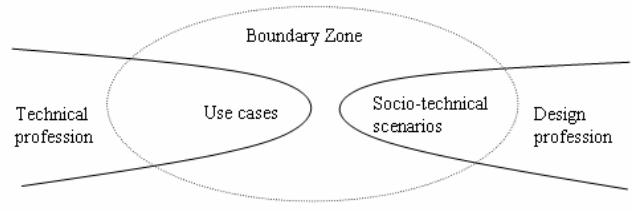

Figure 5. Boundary zone between the technical and the design profession

Socio-technical scenarios are used to formulate the use cases and the use cases can be discussed and evaluated by design professionals.

In the AwarePhone project we implemented a prototype system running on mobile phones and with a central server. We used use cases to specify the requirements to the system. One use case that supported the earlier presented socio-technical scenario was:

Use case x: Check other persons status
Main Actor: Doctor or Nurse (D/N)
Situation: A D/N wishes to get information about another doctor's or nurse's current activity.
…
Main Scenario:
1. D/N activates a list of all personal on the ward
2. D/N finds the relevant person by scrolling the list
3. D/N reads the relevant information of the display
Extension:
1a: The phone is off.
…

The above use case is grounded in the socio-technical scenario but it is a different representation and with a different purposes.

The outcome of the design activity is the design of a test for trying out a socio-technical network based on e.g. a set of scenarios and a set of prototypes.

Socio-Technical Tests

The test can differ from large scale pilot studies to smaller workshops. The ideas behind the AwarePhone have been tested out both in workshops [4] as well in a larger pilot study [22]. I will however in this section focus on testing with workshops and present some challenges for workshop tests.

The boundary of a prototype: The problem this challenge addresses is how to pass on the purpose or the scope of the test to the participating users. The test setup might only cover a little part of the envisioned systems functionality and only parts of the user's context can be modelled. Communicating the distinction between a working product and a prototype can sometimes be challenging and getting the user to accept that some part of the system is not implemented is a challenge when carrying out the test.

The skilled user: This challenge addresses the problem about how to learn to use the system. The main focus of the test is not to test the learnability of the design, but to get an idea about how the design is going to be used in the translating socio-technical network where the users use the system everyday. But how can you simulate that a design has been continuously used by the users during a half day workshop?

One suggestion that came up at a workshop was to let one of the designer acts as the skilled users. The participating users can then ask the skilled user when they encountered any problem with the system without breaking with the scenario frame. However, it is not a solution without drawbacks and other solutions need to be discovered.

Carrying out collaborative socio-technical scenarios: Many of the tests we work with are based on collaborative scenarios and some scenarios address distributed collaboration. In one test we had two doctors, two nurses, a set of servers and four mobile phones that had to collaborate distributed in one scenario. It is really challenging to write scenario and act them out when people need to be distributed and need to collaborate.

One approach is to write linear scenarios, where each distributed person carry out a task in sequence for instance a doctor call another doctor. This doctor waits until s/he receives the call, then s/he might look up some information, send it to a waiting nurse etc. A clear problem with linear distributed scenarios is that there is some inactive waiting time for the users not currently active and that this line of work is clearly different from their normal use situation.

Another approach is to write non-linear scenarios where a lot of activities might be going on in parallel that sometimes has to be coordinated. This approach will in many cases more accurately reflect the user's context, but it is really hard to coordinate from the test designers perspective and we have not tried to carry out these kind of scenarios yet. However, it is a big challenge and new techniques and more experience is needed to address this challenge.

Debate of the hypotheses: The last challenge that will be discussed here are the debate of the hypotheses. The purpose of the test is to get the hypotheses debated. If a workshop is poorly planed it is possible to get through it without actually getting any feedback on the hypotheses. Therefore, it is a challenge to keep the focus of the test in mind and be sure that the hypotheses are debated. Sometimes statements like "this is a good idea" are nice to hear, but it is important to know why it is a good idea. The purpose is not to verify our own ideas, but to get new perspectives on the ideas. A suggested technique is to round the workshop of with a discussion or focus group interview about the hypotheses to get the participating users opinion on the hypotheses after they have tried them out. The challenge is to always have the hypotheses in mind and to be sure during the workshop that the users reflect on all of them.

A Note Concerning Pilot Studies

The approach when carrying out pilot studies is a bit different. Still scenarios are described, but instead of playing out the scenarios the described scenarios are compared to the actual use of the system and the differences between the described scenarios (what was expected) and the real use is compared and used to generate reflected hypotheses.

EVALUATION

The final activity of a socio-technical experiment is to evaluate and sum up the conclusions.

First, the socio-technical test can generate new hypotheses. During the test new themes can be introduced by the participating users not identified through the analytic activity. These hypotheses can then be further investigated in new socio-technical experiments.

Secondly, if the socio-technical test is carried out successfully the assumptions behind the hypotheses put forth have been discussed and reflected upon and the outcome should be a new set of reflected hypotheses.

A reflected hypothesis is not just a proposal or simple statement, but a proposal that incorporate some of the conclusions drawn from the field studies, the design of the prototypes and most important from the socio-technical test. The reflected hypotheses cannot identify how the socio-technical network is going to translate. But because the hypotheses are reflected they can provide valuable insight to the designers of pervasive interactive systems about some of the mechanisms that influence the translating socio-technical network.

In the AwarePhone project the four original suggested hypotheses were evaluated (H1-H4). E.g. the hypothesis about social distributed awareness was discussed and during the workshop especially a young doctors stated it could be a valuable tool in prioritizing amongst more experienced doctors as the following transcript from the test shows:

Young doctor: "I think it would be a clear advantage to be able to se what other doctors are doing. It is also a way of prioritizing. For instance at our ward there are three of the old you can draw on. Then it could be nice from the beginning of the day to be able to se who you can draw on and where they are, are they operating. People in the outpatient department are always easier to interrupt. That is the way it is. It shows a way of prioritizing." (tape 2, 28:06-)

The test also resulted in two new hypotheses. One of them was about the importance of considering the role of the patient when designing mobile technology for doctors and nurses. In the workshop the patient wanted to take part in the interaction. Figure 6 illustrates how the patient is left out of the interaction during the test. How to design

technology that allows the patient to be included was a new hypothesis that has been tested in later experiments.

Figure 6. The patient stress the importance of being part of the interaction with the technology

CONCLUSION AND FUTURE WORK

We have since the AwarePhone project used the framework and socio-technical experiments in several other projects e.g. [21] to provide a frame to the design process that fits in between a description of single design events and descriptions of entire design processes. With this paper I have presented a view of the design process inspired by an experimental approach.

Socio-technical experiment was suggested as a method that addresses *the socio-technical challenge.* By doing socio-technical experiment it is the socio-technical network that is tested and not the technology or the user. It is shows how these test can produce reflected hypotheses that can be valuable input in one or more concrete product development processes.

Another challenge was how to co-operate in one or more multidisciplinary teams. Two different suggestions were discussed. By separating socio-technical experiments from the design of a concrete product it is possible to initiate and delegate different socio-technical experiment to a set of different teams. This enables the possibility for several teams to work on different aspect of a design in parallel. Secondly, *boundary zones* were introduced as a flexible zone where representations from one profession within a design team are passed on and transformed into a representation relevant for another profession within the team.

The last challenge was how to design for a translating socio-technical network. A socio-technical experiment is addressing the translated and not the current socio-technical network. However, how to design for a continually translating network is only slightly discussed and how to make flexible designs that supports continuing translations is a new challenge.

As briefly described in the section “Socio-technical tests”, our current focus is on how the framework can be used to describe large scale socio-technical experiments - experiments where the tests are not just workshops, but longer pilot studies of the technology in use [22]. We hope through our insight into large scale pilot studies to be able to extent the notion and understanding of socio-technical experiments further and discuss some of the consequences from the users’ perspective concerning being a test person for an extended period of time.

ACKNOWLEDGMENTS

I would like to thank the members of Centre for Pervasive Healthcare and especially Jakob Bardram, Morten Kyng, Mads Ingstrup, and Randi Markussen for valuable comments on the manuscript. This work has been financially supported by the Competence Centre ISIS Katrinebjerg project #107.

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