

Field Studies in Practice: Making it Happen

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Abstract: Field studies and user requirements analysis are highly valued practices in the human-computer interaction community. However, in companies, field study methods are not widely used and they still encounter resistance. In this paper, we describe a longitudinal research effort conducted in two companies to introduce field studies and make them a part of the product development process. A strategy called “Trojan horse” was developed in order to make the adoption of field studies easy and motivating in real development contexts. The strategy consists of four complementary parts: (1) introducing field studies using small-scale pilots, (2) applying a start-up package, (3) making field studies simple and flexible, (4) presenting the field study findings in a form that is familiar and easy to implement in product development. After two years' follow up, the results show that the strategy has been effective and the impact is longstanding in the two case companies.

Keywords: field studies, user requirements analysis, usability, user-centered design, industrial settings

1 Introduction

Field studies mean that users, their tasks and environments are studied in their actual context using qualitative methods (cf. Wixon et al., 2002). Hackos and Redish (1998) describe an extensive range of the field methods, and they provide practical advice on conducting field studies.

The power of field studies is in understanding the context of use and related user needs in the very early stages of product development. A new product is not used in a vacuum; users have needs relating to it depending on the context of use. Field studies are not based on what users say they need, but provide data about what people really do, and how a new system and its user interface should be designed.

Vredenburg et al. (2002) surveyed the use of user-centered design methods across the industry. They found that practitioners considered field studies (including contextual inquiry) and user requirements analysis most important in practice. However, although the methods were seen important, they were not reported to be as widely used.

Field studies have been discussed for years, but many practitioners have found it difficult to introduce these methods into companies because of resis-

tance (Gilmore, 2002; Hynninen et al., 1999). The common view is that field studies consume a lot of time and effort, and produce an overwhelming amount of data.

CHI'2002 panelists also discussed field methods and ways to adapt them to practical constraints (Wixon et al., 2002). The panelists' conclusion was that, in order to adopt and apply field methods broadly in software design, a number of areas should be developed. One of the basic areas recognized was the need to respond promptly to specific restraints imposed by design processes and designer needs.

The field study approach provides methodology for understanding user needs. However, using this methodology should not be separated from defining user requirements; context of use and the related user needs should be understood in the earliest phase of the product development. Engineers must decide on software architecture and performance requirements in the early phase of development. These decisions exert a strong influence on final usability, and they cannot be corrected by fixing user interface details.

In our experience, combining human-computer interaction and requirements engineering competence provide a real opportunity to improve usability

and product quality. Even though field studies may appear costly (cf. Vredenburg et al., 2002), they play an essential role in providing a user's point of view.

In this paper, we describe a longitudinal research effort conducted in two companies. Contrary to short case studies, longitudinal research makes it possible for us to follow whether field studies are really used in organizations in the long term.

A strategy called "Trojan horse" was developed and applied in the companies to overcome resistance and promote field studies. The strategy consists of four complementary parts: (1) introducing field studies using small-scale pilots, (2) applying a start-up package, (3) making field studies simple and flexible, (4) presenting the field study findings in a form that is familiar and easy to implement in product development.

We found that field studies can be practical in real development contexts. Results of this research provide an empirical basis for adopting field studies in real development contexts and making it possible to use these methods in practice as a part of product development.

2 Related Work

There have been many studies of process improvement, re-engineering, and introducing new practices into companies. Many of these studies have identified organizational and other obstacles, which explain why the change is difficult (e.g. Hutchings and Knox, 1995; Kaindl et al., 2002; Poltrock and Grudin, 1994).

The studies provide some advice on how to solve or prevent the difficulties. Moreover, Kaindl et al. (2002) describes five perceived high-level characteristics influencing the adoption of IT: relative advantage, compatibility (with existing values and practices), complexity, triability, and observability.

We have built our strategy on these findings and developed a suitable approach to field studies. The results of applying the strategy in the real product development contexts are compared to the related work in section 7.

3 Research Setting

The experience drawn on here comes from a longitudinal research effort conducted in two industrial partners as a part of the QURE (Quality through Requirements) project. The project was a three-year research project during years 1999-2002 at the Helsinki University of Technology in Finland. The aim of the project was to help industrial partners to improve their requirements engineering and user-centered practices. The research project carried out

research work on both HCI and requirements engineering.

As a part of the project, user-centered field studies were piloted to gather user needs in two industrial partners. The researchers' role was that of an expert who provided information, instructions, training, and support for the practitioners. The idea was that the pilots would be conducted in real product development contexts and by real developers, and researchers would give support and follow the costs and benefits of the field studies for the organizations.

3.1 Case Companies

The participating companies were Kone Corporation and Tekla Corporation, both of whom are product development organizations producing both new versions of older products and entirely new products.

Kone has about 23 000 employees and it produces elevators and escalators. Kone is the world's fourth largest elevator company. Kone was an initial partner of the QURE project and the work reported here started in February 1999. The first pilot was started in November 1999 and the second pilot started in February 2000.

Tekla has approximately 500 employees and it develops software products and services for managing infrastructures. One of its products, Xsteel is the world's leading application for steel construction modeling, detailing, and fabrication support. Tekla joined the QURE project in May 2000 and the field study pilot was carried out in June 2000.

3.2 Initial State of Practices

In the early phases of the QURE project, the initial requirements engineering practices in three industrial partners of the time were assessed. As a part of this assessment, the initial state of user-centered practices was examined by interviewing in these industrial partner companies. The goal was to identify initial developmental conditions and possible improvement needs. Three designers representing different projects were selected from each of the companies.

It was found that the projects were technology driven. Five out of nine projects had no direct contact with users, or contact was not established until the late prototype phase. Even if a project had direct contacts with users, gathering user information was occasionally passive, methods were informal, and the gathered information was not documented in two of the companies.

Two of the companies did not have usability experts, groups, or special usability resources. The companies did not have defined practices for usability

ity in place, although several kinds of usability engineering practices were used in some projects. It was found that user-centered practices had not generally been adopted.

The developers were quite aware that user and customer practices should be improved. Six interviewees reported that they would need more information about customers, and three of them similarly mentioned users. Some of them felt that there was a need for more information and instruction on how to gather, describe, and classify user and customer requirements.

3.3 Improvement Actions

Kone was one of the initial partners of the QURE, and it decided to invest particularly on requirements elicitation activities. The interview results of their initial state motivated them to develop a more user-centered requirements process. Direct contacts with users and customers were seen as a success factor in projects.

In Kone, a multidisciplinary team was formed to improve requirements elicitation practices. The members were persons who participated in requirements elicitation in practice. The first step was to set goals for the improvement work. The team members shared the impression that Kone needed to improve its user-centered practices and the practitioners needed support and guidelines.

The multidisciplinary team gathered existing information and conducted a stakeholder analysis to identify essential stakeholders who would be affected by the products. In addition, varied user groups or segments were identified which were not earlier explicitly recognized in product development. The resulting list was considered a useful starting point for projects.

Subsequently, after a QURE researcher had presented field studies as a potential new approach to gaining user and context of use information, the team decided to pilot field studies, and team members also completed the field studies. The goal was to test new methods and document user information for a freight elevator development project.

Tekla joined the QURE-project one year later and it did not participate in the initial state interviews. However, its situation was very similar. Tekla started to define requirements processes and at the same time, a single development person was piloting field studies for a product development project. In Tekla, usability had already been found important, and the QURE-project offered an opportunity to start to perform concrete improvement actions.

A “Trojan horse” strategy was adapted in Kone and Tekla in order to make the adoption of field study methods easy and motivating. This strategy is described below.

4 Trojan Horse Strategy

Field studies were unfamiliar to the developers, and this kind of user point of view was new to them. In addition, in real product development context, no time was allocated to visiting users. In Kone, salespersons were suspicious toward field studies and allowing product development people to visit their customers.

To overcome resistance and make field studies practical in these conditions, a strategy called “Trojan horse” was developed. The thinking was that field studies are introduced with a whimper rather than a bang, methods are made easy to adopt, and the results are presented in a practicable, familiar form.

The strategy consists of four parts:

- Introducing field studies to product development using small-scale pilots.
- Applying a start-up package.
- Making field studies simple and flexible.
- A simple way of presenting the field study findings in a form that is familiar and easy to implement in product development.

4.1 Introducing Field Studies Using Small-Scale Pilots

The goal of the pilot studies was to test field studies and evaluate the costs and benefits for the companies. The companies could achieve reliable information about the costs and benefits of the new methods in their own context. Costs were evaluated as spent person hours, and the benefits were evaluated using interviews and questionnaires. Based on this information, a decision could be made whether to implement field study methods and practices or not.

However, no resources were allocated to performing field studies in these companies. In addition, the developers found it difficult to pilot field studies as product development projects had tight schedules. Based on previous experience we could promise benefits even from very small studies requiring 30 person hours of work. Thus, the selling argument was, “let's try this, you don't spend much time or effort, and you can see the results for yourself”.

4.2 Applying the Start-Up Package

The developers actually performed the field studies themselves. The researcher provided information, instruction, training, and support. A ready start-up

package for field studies was offered for companies in order to facilitate the adoption and use of the new field study methods. The package described the field study methods and process, and it included ready guidelines, a checklist, and two training packages.

The first training package was a general introduction to user-centered design and field studies. The second package was a “Just-in-Time” training, in which the intervention occurs at the time the team needs it (see Hutchings et al., 1993). Consequently, when the team was about to carry out the first field study, it was given a half-hour's training on how to communicate with users, and on general principles of field studies. These general principles were adapted from Beyer and Holtzblatt's (1998) principles of contextual inquiry.

4.3 Making Field Studies Simple and Flexible

The companies were reluctant to invest in field studies before seeing their effectiveness. Therefore, we had to offer a very simple and flexible approach to field studies, so that the developers could try them in practice almost immediately.

We already had evidence from two earlier case studies that these kinds of simple field studies are useful even in a short time frame with relatively low costs (Kujala and Mäntylä, 2000a, 2000b). The field studies were performed in two companies developing different products; 27 and 46 person hours were spent in performing field studies. In both, the developers were interviewed and they evaluated the results of the field studies as useful. In addition, in the latter case study, the field studies with six users were compared to a baseline design process that included usability tests of 33 users. When the resulting functionalities were compared in a usability test, it was found that the field study led to a more usable product.

The used field study methods were ethnographic interviewing combined with observation or other complementary methods influenced by earlier work. Particular attention was paid to the cost-effectiveness and usability of the approach. It combines existing methods and embraces varied views from cognitive psychology, ethnography, contextual design, and task analysis.

Instead of the usual bottom-up approach, where large amounts of data are collected and then analyzed, a top-down approach was used, and interviewing topics were predefined. In addition, the user study team set objectives and identified the most critical themes for each study. In the top down approach, certain details of understanding may be lost as it does not start from scratch; however it is more

easy to learn and an overwhelming amount of raw data is avoided.

The predefined topics were used in preparing interview questions. The goal was to gather critical information from each topic and keep the topics in mind while observing users and their environment. The idea was not to follow the prepared questions strictly, but to use them as a checklist and to try to understand the users' perspective.

The topics included:

- *Background information.* The goal was to help the analyst to interpret the results and classify users. The typical questions were about age, profession, technical orientation, and previous computer and work experience.
- *Users' goals and preferences.* The goal was to understand what users want to achieve, what is important for them, and how an intended application can support their tasks and allow better ways to achieve the goals.
- *Users' knowledge, skills and experiences.* The goal was to discover what users can and cannot do, and how they employ objects and symbols in accomplishing their goals. Thus, it would be possible to utilize their existing knowledge, skills, and conceptual models in product development.
- *Current processes.* Understanding current processes helps in identifying task hierarchies and task sequences that are natural for users, and gives timing and other benchmarks for the performance criteria of a future solution.
- *Context of use.* It includes user characteristics, tasks, equipment, and a physical and social environment in which a product is used (ISO 13407, 1999).
- *Pros and cons of current processes and tools.* In redesigning the current process, it is necessary to identify advantages that users are unwilling to give up. An intended system should include most of the benefits and solve the current problems.

The field study methods were also tailored to the companies' and developers' needs. For example, the interview topics were used as observing topics in the study of elevator use, and the topics were adapted to fit the subject area. After the first pilot study, we gained a better impression of what to look for in elevator world, and a company specific report template was created.

Task sequence:	Problems and possibilities:
Step 1: When trapped in an elevator, passenger makes an emergency alarm.	<ul style="list-style-type: none"> • Passengers want to get out of the elevator as soon as possible • All kinds of passengers must be able to make an alarm call (blind, foreigners etc.) • Sometimes passengers may make false alarms unintentionally. • Passengers may be in panic. • Passengers need instant confirmation that they have created a connection to the service center operator and that they are going to get help.
Step 2: Unoccupied service centre operator receives the emergency alarm call and asks for information.	<ul style="list-style-type: none"> • Different versions and types of remote monitoring systems. • Passenger is the only information source. • Service center operator does not notice the emergency alarm call.
Step 3: Service center operator completes transmission of information to the system and sends it to the area serviceman.	<ul style="list-style-type: none"> • Laborious phase for the service center operator. • Simultaneous calls must be differentiated. • Serviceman cannot see all information. • Inadequate information from a site system. • Possibility: Instructions as to how to operate the system. • Possibility: Possibility to open phone line from Call Center to the elevator.
Step 4: Service center operator calls the serviceman and reads the description of the failure.	<ul style="list-style-type: none"> • Extra work for the service center operator.

Table 1: An example of a user need table.

4.4 Presenting Findings in a Practical Form

We found that it is not easy for technically oriented developers to utilize the findings of the field studies when written reports, photographs, and videos are used. A slightly more formal way of presenting user needs was needed, so that designers could use the information in analyzing and rationally selecting good combination of user needs for inclusion in future systems

We developed user need tables to make field study results organized and easy to utilize and link to use cases (Kujala et al., 2001). An example of a user need table is shown in Table 1.

User need tables are the means whereby several kinds of user information can be summarized. They describe users' task sequences, and link users' problems and possibilities to task steps. Problems are obstacles that arise from users' characteristics, their physical and social environment, or overall situation. Possibilities represent users' more implicit needs, and suggest how users' tasks can be supported and improved. Later, we also added a high priority column to the table in order to attach priority information to the user need table.

User need tables can be directly translated to use cases. Users' task sequences are redesigned by correcting the problems associated with the task steps. The redesigned task sequence can be used in use

case descriptions to describe what and how the product should do from the user's point of view.

The use case driven approach is a popular solution provided by software engineering to help with the problem of gathering and representing user requirements (Rumbaugh, 1994). Use cases are widely accepted among designers, providing an opportunity to transmit user needs and the user point of view to requirements engineering.

5 Results

The improvement actions in the two case companies were found successful. The field studies were evaluated as useful by the companies, and the field study methods are now in use. After two years follow-up, the field study approach has become an established practice in Kone, and in Tekla, the improvement work has successfully started.

When evaluating long-term consequences, improving practices by a multidisciplinary team in Kone was most effective. The team members committed to improvement actions as they planned them, and the results of the field study pilots and the resulting positive effects on customer satisfaction were noticeable in various parts of the organization.

The benefits of small-scale pilot studies were clear. Persons without knowledge of behavioral science could easily learn to conduct field studies when appropriate support was available. Although the

investment was modest, 112 person hours, the field study results were useful and visible. The team members became convinced of the importance of field studies and the effectiveness of the methods.

The results of the pilot study were presented for others, which encouraged more people to join the team, which carried out a new, larger field study (277 person hours). Based on the experiences obtained from the two pilot field studies, Kone decided to invest in field studies, and has recruited a usability specialist whose responsibility is regularly to organize new field studies.

In the two years following the pilot field studies, Kone performed several single customer visits and four field studies, in which approximately 80 users and customers were visited. In addition, new persons from Kone have been trained and involved in performing field studies so that they can learn the methodology.

Adapting field studies as a part of the product development process was additionally visible in a clearly measurable form, when the state of requirements engineering practices were assessed again in 2002 using Sommerville and Sawyer's (1997) REIAMS maturity model. The score of requirements elicitation practices had risen between May 1999 and May 2002; the proportion of maximum scores rose 140% (from 15% to 36%).

In Tekla, the first assessment was carried out in June 2000 and the second in November 2002. Thus, the improvement period was seven months shorter than in Kone, and therefore the effect was smaller. The score of requirements elicitation practices rose 10% (from 21% to 23%). In addition, Tekla focused their improvement actions on documenting, which had identified as the main weakness in basic practices. In the documentation area, the proportion of maximum scores rose from zero to 29%.

In Tekla, field studies were piloted in a single project in which only one person participated, and thus the results were not so comprehensive and visible. However, Tekla has now invested in improving user-centered practices. A usability engineer has been appointed for the company and a usability engineering team has been formed in order to develop usability engineering processes for Tekla. The management has given support to the work, and usability is now recorded in the high level strategy.

The goal of the usability engineering team is to integrate user-centered methods as part of the product development process. The team plays an important role in giving information, arranging training, and supporting product developers in adopting new methods and practices.

In Tekla, the usability engineering team proposed user and task analysis activity and other usability activities as elements of general software process description. The activities have been initially accepted. In process descriptions, user and task analysis embraces the notion that initial assumptions about users should be tested with real users. The field study approach has been considered important, and 17 persons have trained to complete field studies. Documenting persons in particular have started to do field studies.

Now the usability engineering team is looking for a project where all the usability activities could be piloted. This idea was presented to the product development management team, who promised to select a small and important project starting in the beginning of the year 2003. Before the project will start, the usability engineering team is planning to produce all necessary process descriptions, templates, and guidelines to support the project.

6 Lessons learned

All four parts of the "Trojan horse" strategy supported the adoption and application of field studies. The following lessons have been learned about each of the parts.

6.1 Small-Scale Pilots

A small-scale pilot study represents a good opportunity to introduce field studies in a technology oriented company. Like a Trojan horse, a small-scale pilot study looks harmless and the possible results look tempting.

- Small-scale pilot studies did not require huge resources, but the results convinced companies and developers. In Kone, a project manager, four salespersons and the field study team evaluated the results as very useful in a survey ($M=3.8$, in which the scale was from 1 (useless) to 4 (very useful). In addition, the customer evaluated Kone as superior after the field study and made a new service contract with it.
- A positive snow ball effect was achieved; small studies led to bigger ones, and field studies become a permanent part of the product development process.

6.2 Start-Up Package

In addition to small-scale pilots, training, comprehensive guidelines, method and process descriptions are needed in disseminating field studies company wide. Guidelines and process descriptions support learning by doing. Otherwise, good practices and skills can disappear through turnover of personnel in the development organization.

- A half-hour's "Just-in-Time" training for field study methods enabled developers successfully to communicate with users and perform field studies. However, it was beneficial that some of the team members had previous experience in the field of usability.

6.3 Simple and Flexible Field Studies

Our experience suggests that the introduced field study methods need to be simple and cost-efficient enough to be practical in present product development conditions.

- Methods that were easy to learn and use were a basic precondition for the adoption and spread of field studies in these development contexts.
- Predefined topics helped in structuring observation and reporting. This is visible in the modest number of person hours used in field studies. In Kone, the team of six persons spent 111.5 hours in the first pilot study (including the researcher's effort).
- However, the results were impressive enough to convince team members and others in the organization.

6.4 User Need Tables

It is not enough to carry out field studies and gather user information. The results gained from field studies need to be presented in a clear and usable way to technically oriented developers so that the information is easy to use in product development.

- Developers in both companies found the user need tables useful. They thought that the tables helped them to write use cases. Thus, the impression of working with "a huge pile of unstructured data" was absent.
- When the user need tables were not available, the designers did not know all the details of the user tasks to be completed or the natural order of the tasks, and describing the use cases by users' language was difficult. Thus, the use case descriptions lacked the necessary amount of detail.

7 Conclusions

The "Trojan horse" strategy was found to be effective in making field studies easy to adopt in real product development context. The effects have been long-standing in the two companies. In Kone, where the multidisciplinary team planned process improvement and piloting, the field studies have become an established practice. Tekla started the work one year later, however; the usability engineering team has already successfully started to integrate field studies in the product development processes.

The practical significance of the results can be evaluated by comparing them to earlier research findings. First, in the literature, field study methods are frequently considered complicated in practice (e.g. Hynninen et al.). The present study shows that simple methods are valuable and they are easier to introduce to product development. They do not require extensive training, and the methods can be learned by doing when sufficient support is available. Moreover, simple methods reduce the risk that usability expertise itself might become a bottleneck in disseminating new practices company wide, as was the case in Ericsson (Carlshamre and Rantzer, 2001).

Furthermore, in present product development conditions with tight schedules, it is difficult to introduce new practices to product development. For example, in Olson and Bakke's case (2001), an introduced lead user method was abandoned after a year despite the fact that the pilot research had been good and several derived product concepts had been successfully implemented. In the present study, field studies have established a firm foothold in two companies during several years follow-up.

Carlshamre and Rantzer (2001) offer another long-term experience of disseminating usability within the Ericsson Corporation, where they successfully introduced a usability method, Delta. In three years, the method was integrated with the official system development model and then, it was acknowledged as one of three "vital few actions" for Ericsson. However, the success in the dissemination of the method organization wide was not so marked. The lessons learned about the problems in dissemination were in line with our experiences. Carlshamre and Rantzer found that methods should not be complex, and that developers do not want anything that represents an addendum to the established development process rather than an integral part of it. They suggest that usability needs to be integrated to the point where it is not even talked about much.

It was also our conclusion that usability must be an integral part of other processes. Technical oriented developers are often more interested in user needs and requirements quality than usability, but field studies play a role in improving both requirements quality and usability. In our approach, technical developers are helped in using the field study results by linking the results through user need tables to use cases, which are familiar to them.

The dissemination of field studies organization wide is still in progress in these companies, and it will be their biggest future challenge. Characteristic of both companies was that a person interested in

usability became a contact person who was a central person in arranging field study pilots. Now both of them are usability experts in these companies and they play an essential role in disseminating field studies further.

The broad dissemination of field studies is a considerable challenge and more research effort is needed to identify all the essential factors. However, we have identified the basic conditions for introducing field studies. We believe that the developed strategy and the lessons that we have learned will apply in other practical system development situations.

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