EARLY INVESTMENT IN USER ORIENTED DESIGN
VERSUS LONG TIME USABILITY ROBUSTNESS

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ABSTRACT
User involved design processes are considered important to include in an early stage of the application development. User involvement is, though, nothing new, but is the method effective? Are there any contributions to the robustness of the end product? Compared to the robustness hopefully achieved, is the early design involvement of the development process cost effective? In this paper we present a long-term case study, following the user involvement in the development process and the maintenance of an information system during five years. The system is compared to other competing information systems used in the same context and by the same users. The factors of maintenance, support, degree of use, robustness and cost effectiveness are compared and discussed. We conclude that early involve users are beneficial and very important for the end-product. The system is less updated and less redesigned then the other systems used in the same context.

KEYWORDS
User involvement, Information system, Design Process, Robustness, and Cost Efficiency

1. INTRODUCTION

When a new system is designed it is very common that the interface design and the interaction of the applications is designed last when the functionality is already completed. The interface is often, in our experience, something added just to make the application look good for the buyer. Within the field of Human Computer Interaction the importance of the users and the contextual requirements is in focus (Dix, et al, 2004, Shneiderman, Plaisant, 2005). The system should support different acts and different needs of the users, and should be flexible (Dix, et al, 2004, Löwgren, Stolterman, 1998). Interaction is developed over time through personal learning and analysis of the own actions and the system should therefore give the user possibility to evolve (Carroll, 2003). When designing a system for a large group of users, all with different knowledge of computers and different needs of tasks, it is important to work by a structured method that considers the differences (Sommerville, 2001, Dix, et al, 2004). To consider the different users a user involved design process could be included in the development at an early stage, the earlier the better (John, 2004). The user involvement could then contribute with crucial information about the user requirements and the contexts the system should be used in (Dix, et al, 2004).

User involvement and different design methods are nothing new and have been around for many years. There is, though, an ongoing debate about whether user participation is efficient in the design process or not (Sommerville, 2001, Butler, Fitzgerald, 1997, Singh, Kotzé, 2003). Are the methods effective? Are there any contributions to the robustness of the final product? Compared to the robustness hopefully achieved, is the early design involvement of the development process cost effective? Prior investigations seems to clearly indicate the benefits of early user involvement in the design process (Mao et.al. 2001, Heaton 1992, Novick and Douglas 1992, Rudd et. al. 1996). Interviews and surveys performed in the literature with e.g. project leaders give good support for such claims. The details of long term benefits and qualitative return on investment is hard to assess with such methods though, and requires detailed insight into both the design process as well as the actual usage over a longer period of time. Due to the time-scale and effort involved in
In this paper we present how we conduct a case study following the development process, the user feedback, and the following maintenance of the information system during five years. The users participated in the design of the information system. The system is compared to other competing information systems used in the same context and by the same users. Factors of maintenance, support, degree of use, robustness and cost effectiveness will be compared and discussed. Finally the status of the program five years later will be investigated. By this case study we try to answer the questions stated above and extend our conclusions to the general case regarding how user centered design methods affect robustness and price. We also try to summarize the lessons learned within the project.

1.1 Background to studied project

In any university it is important with sufficient information channels. The different channels should support the administrative and pedagogical needs of the daily activities and meet the specified requirements of the variety of roles among the users.

The project, on which this case study is based, was started due to a need for a better information system in the university organization. The students at the university needed a sufficient and more focused place for information. The personal and the teachers wanted a better way to reach the students with results, information and urgent requests. In year 1999 the project was initiated at the University of Trollhättan – Uddevalla (HTU), Sweden, at campus Trollhättan.

1.2 Status of the information systems at project start

In the autumn of 1999 a pre-requirement process was initiated for the new information system. First the status of the present information channels was investigated. There were several problems with the information channels at HTU. There was no common place to find information on and to find the information when it was up to date was very hard. Many teachers had their own web pages and some used regular physical message boards, which made it difficult for the students to know where to look for information. The Intranet did not offer much more than a static web site with general information. Student information, exam or exercise results and urgent requests were not possible to either post or read electronically in an easy way.

Two information systems were present; one TV-screen-based system, called Textetten, showing a broadcasted Microsoft PowerPoint presentation and one electronic system called Disco. Only two staff members were able to put information into the PowerPoint presentation, which made it rather inefficient and the time between updates could be long. Disco was a course system, where teachers could upload course material, exercises and exams. The students could hand in exercises. There was also a simple function for discussions. The problem with Disco was that it only supported specific file types and required some knowledge in HTML-coding which not all teachers had. To reach several student groups or students not in a course was impossible via Disco. In late fall the first requirements were collected and formalized into a document, and in the spring of year 2000 the design process of a new tool was initiated.

2. DESIGN PROCESS

The design process in the project started with a brainstorming session within the development group, which resulted in two paper prototypes based on the pre-requirement collected during the autumn. The paper prototypes were tested in collaboration with students and redesigned. From the paper prototypes a “digital paper prototype” was created, simple HTML-pages without intelligence, where the structure could be tested in an easy way. The prototype was meant to use to collect requirements from the intended users.

Next step in the process was to involve users to test this prototype. We worked with an iterative process split into two parts. In the first part we let the departments evaluate each other’s solutions and in the second part we tested different technical solutions and let the users in the reference group try and evaluate them. A larger number of users, consisting of students, teachers and administrative personnel, were involved in the evaluation process. A common mistake when selecting users is to underestimate the diversity of individuals
(Kujala, Kauppinen, 2004), we therefore tried to select a broad spectra of different users for testing. Five main areas were focused; the technical functionality, the graphics, the interaction structure, the navigation and the role based user functionality. The prototype was placed on a web hotel, were the users could test the system. The work model is shown in figure 1.

Five different educational programs were involved in workshops and each program gave their comments and questions, in the end of the workshop they appointed one or more representative. The representatives and some other interested staff members formed a reference group several new workshops were then held with the reference group, where they could ask questions, test the prototype and see how different tasks were performed. The reference group then helped analyzing the staff at the university and categorized the users into user types. These were then again evaluated together with the reference group. After each workshop notes of the groups’ evaluation were collected. The system was changed accordingly to the new ideas and thoughts from the reference group.

The iterative process was concluded with a large public meeting were all teachers and the reference group as well as students were invited. After the meeting a release candidate was implemented.

2.1 Department workshops

Within the project, five workshops were held in cooperation with the department manager of the different departments. Data of the comments and experiences made were collected at the workshops. The first workshop was at the computer science department, some of the IT-technicians and a few of the administrative personnel also attended the session. The second workshop was held at the department of real estate and building technology, the third at the department of electrical engineering. The fourth and fifth workshops were held at the department of upper-secondary schooling and department of mechanical engineering. The data collected in the study is further presented in the following section.

2.1.1 Comments and discussions at the workshops

In the workshops the prototype was discussed and the comments were collected. Between the workshops, changes were made to the prototype to improve the system according to the demands of the previous session. The new changes were then sought approval of within the next workshop. The following section describes the discussions of the workshops in general.

The technical solutions like databases and portability were debated, routines for passwords and usernames as well as security issues were also brought up. A desire of compatibility with other platforms than Windows NT and Intel-based computers was stated. Questions about a connection to LADOK (a Swedish system for administration of student grades) came up and it was decided that such a connection was not possible to establish, due to regulations in LADOK. Requests for possibilities to upload files were brought up as well as some kind of more obvious navigation. The design and purpose of the system was discussed as well as comparisons to other similar systems, like Disco. Pros and cons with this system were compared to Disco and other external alternative systems. The functionality that the system should support was also discussed. A concern about that the students might not use the system was brought up and questions about how to solve such a problem were discussed. Texetten was talked about and a suggestion for a limited amount of characters given. Simplicity and usability was a demand. The different types of rights that the system could use were argued and a question about e-mails came up. The users wondered if all students could get e-mails when a message had been posted in the system. It was concluded that the IT-staff had asked specifically for
that such a solution not would be created since that would dramatically increase to the workload of the e-mail sever.

2.1.2 The reference group

At the workshops one or more representatives were selected to be further involved in the development process of the system. The representatives should keep the departments informed about the project and also discuss changes and new ideas. We additionally influenced some of the novice users to be part of the reference group. Finally the group consisted of fifteen people out of hundred workers and had a differentiated age and gender distribution. The group also consisted of a mix of novice and expert users.

The first assignment for the group was to answer a questionnaire with questions about the prototype. The questions concerned layout, functionality and documentation of the system.

A week after the questionnaire was sent out, the first reference workshop took place. With approximately one to two weeks apart, workshops were held during a three-month period. The system was thoroughly discussed and tested. The questions or opinions were brought up on the workshops or mailed to us via e-mail.

In the workshops the file management was discussed and how it worked in more technical detail. A big issue discussed was the “rights”; meaning what rights different users and different administrators should have. The categories of administrators and who the administrators should be were argued, as well as the time limit for accounts, e.g. if one has a guest lecturer. It was decided that the system should have four categories of users, defined as: the reader, the writer, the sub administrator and the main administrator. The different acts conducted in the system were then identified. The acts were categorized in close to a dozen groups. The groups could then be divided between the three categories of users to determine the rights. From those categories a more detailed view of the users was gained.

For the “writer” different message places could be decided, and depending on knowledge of the user a diversity of functionality could be selected. The novice user could get a very simple set of functions while the more advanced user could get a full set of functions. The sub administrator can administrate messages, menu items and/or files. The main or full administrator can administrate everything, but can also decrease their own rights if he or she does not want them.

The system was changed and updated constantly according to the discussions in the workshops. In the iterative process the system became a beta version, which could be tested in class. In late May 2000 we had the last workshop with the users. In this large public workshop the first release candidate was presented.

2.2 A static layer-design

To reduce the complexity of all the categories described in the previous section a layered model was used. The knowledge of the different users is important to consider and they should have the possibility to learn and develop their skills within the system. By using a layered design this can be accomplished. The system can offer additional functions when the user learns new things and increase the layer complexity step by step. This method is related to what is now known as Multi-Layered Design (MLD) (Schneiderman, 2003), but is not developed to the same level and does not share the dynamic properties of MLD.

In the information system of our study a static layered design was employed. The system has five larger layers that can be turned on when the user feel ready, and several smaller steps of functionality that can be chosen. The layer model used is, as we choose to call it, static. The adaptation made when a user is ready or has knowledge enough is manual and not adaptive or automatic, the system is not intelligent enough to recognize the user behavior. When the users learn and feel the need for more rights they contact the administrator and request functionality to be added. The administrator then enables the desired level of functionality in that user’s account.
3. RESULTING SYSTEM

In June 2000 we could finally see the project evolve to the next phase of the case study, where the development phase is almost complete. Version 1.0 of the information system was implemented on a server at HTU. Around 100 accounts were handed out to the staff members and approximately 2500 students got the opportunity to take part of the new information channel. Users could reach the system from the entire world via Internet. Three main administrators were assigned and five sub administrators. The administrators were chosen depending on their knowledge and their work assignments.

The system has two parts of the user interface, one adapted for logged in users and one for not logged in users. The interface was differentiated for the users depending on the rights reserved and the chosen layer settings.

Graphical design like colors and positioning rules were adapted to HTU:s graphical profile valid during 1998 to 2001. The information system was implemented to support and take over the PowerPoint functionality. Textetten was now visible both on the TV-screens and within the information system via the Internet which gave the users an opportunity to read and/or write messages from home or anywhere in the world.

In figure 2 the first page of the system is visible, in figure 3 the two types of logged in versions are presented. A logged in writer (in the background) and a logged in main administrator (in the foreground).

The menus in figure 3 differs but could be altered in many ways depending on what level of rights a user has.

4. EVALUATION PERIOD AFTER RELEASE

The first six months after release was considered as a test period. We could now study the application in real use. The teachers were supposed to use the system within the daily education and report back to the developers how it worked. A possibility for evaluation within the information system itself was also given. Both readers and logged in users could send information, comments or questions to the developers via an e-mail form. A continuous dialog with the reference group was established. The test period was monitored and the comments on the system were collected.

4.1 Evaluation response

During these six months some bugs were detected in the system and some comments on functionality were reported. Below is a list of reported bugs and design flaws seen during the second phase of the study:
• The dynamic menu did not work as it should when using Netscape or Opera.
• If the resolution of the screen is 640x480 or less the graphics will look strange, some components will be hard to see.
• The size of the top frame on the first page varies when the graphic is turned off.
• Some pages are saved or cached so the changes made will not always be visible.
• When a file is deleted the system does not check if the file exists, so if two users simultaneously removes a file both of them will get a message that the removal was successful.
• The database only accepts five years for an educational program, which maybe should be extended.
• The format of the print out version of a message should look better.
• The creation time of a message does not need to be so precise, minutes is enough.
• The timestamp and what class the message have been posted to should be visible on the first page of the logged in users' message list.
• The number of days a message is available should give the possibility to only keep a message for the rest of the day.
• The function “Set focus” would be nice in the “log in window”.

A new version was prepared where the comments were taken into consideration. The bugs were corrected and the comments were looked over. In September 2000 a version 2.0 was released. In November the six months evaluation period was ended, and a meeting was held. The future of the system was debated and it was decided that the system was useful since the teachers were satisfied with the new information channel and the students got better information. The TV-screens were also a success since the information now was up-to-date and could be altered by the teachers themselves. The system was therefore considered to be effective and efficient. The division decided to continue to use it and it got its own link on the official web page of HTU. The project had now reached its third phase, the reality test. The application was now used for real purposes as a tool for education.

Educational workshops and help sessions were held with the students and the staff members. All new staff members got a short help file with instructions and personal help if wanted. In the system all parts had specialized help and if wanted a summarized help file could be used as well.

5. LONG TERM OUTCOME

Autumn of 2004, the outcome of the information system project has been monitored for five years. In the study we wanted to be able to compare the user involved design process, to development projects where users had not been involved. Therefore we monitored other information systems in the same context during this time period. Disco and the HTU-Intranet were two of them, and the e-mail system another. Both Disco and the Intranet were created without user involvement and the e-mail system was bought without a supported and accepted decision from the users that were going to work with it. By monitoring systems that have the same users and is used in the same context we could compare the usability and the robustness of the different systems. Updates, maintenance, user support and redesign issues could also be compared.

During phase three of the information system, no updates or redesign issues have been necessary to address. The system has been running constantly and is used by the whole campus and by all educational programs. Disco and the HTU-Intranet have both been updated several times and they have been through at least one major redesign of the interface. The e-mail system has been updated and finally exchanged for another, new system.

There are at least twenty messages in the system every day. Some educational programs have been using it more and some less. One of the departments had less time in their workshop and the teachers from that department do therefore not feel as involved as the other teachers do. The use of the released system correlates to the user involvement during the development process. In the departments with very active
reference persons the usage also has been higher. In the department with low use new workshops have been held lately to try to convince more users to work with the system.

The maintenance has been quite low for the information system; only the hardware has been exchanged once. The three monitored systems have a high maintenance and both the software and the hardware have been changed. The user support is also much higher at the three other systems with one to several issues per month while the user involved project only had one or two support issues per every third month.

5.1 Status of information channels 2004

In year 2003 a new information system was planed for, a web-portal that would collect all important student information on the same webpage. Due to good results with user involvement they choose to create the new system with good support in the organization and let the users be involved in the development process. The original information system is to be included and rebuilt to fit the new portal and to fit the new organization of HTU. The five year old system will continue to function within a different context and with new users.

6. RESULTS AND DISCUSSION

Five years later, in 2004, the information system of this study is still running, and to answer the question we asked in the beginning of this study: yes the result of the study indicates very well that early user involvement is very effective. The final product seem to be more robust then the other systems used in the same context and by the same users. By the use of less hours of support time and less time for updates and redesigning parts of the system the program will be more cost effective. The development process is more expensive and takes longer time then development methods without users would have done. But the extra time spent on the development is repaid in fewer hours for support and updates. Our study also show that the time saved in the beginning of the project by excluding the users will generate a loss of hours in the end when the users have more difficulties and are less motivated to use the application. They will use something they recognize and can say they have contributed to, and the higher degree of usage increases the value of the system at hand after deployment. Another advantage with a method where the users decide the functionality and interface requirements in an early stage of the development less time on remaking components will be needed. It is also easier to test the prototypes early and the cost for changes will then be smaller (Sommerville, 2001).

One problem with user involvement is as Kujala and Kaupinen (2004) conclude that the users are very hard to predict and it is difficult to select representative users for the development process. Even in this study we could see a difference between the test group using the application and the result of the real-world usage. There were several matters that had to be changed and debugged when the application was released, to finally get to version 2.0. On the other hand would, most likely, the differences be even larger if the users had not been involved at all (Kujala, Kauppinen, 2004). The developer in contrast have in most cases more knowledge about technical solutions and should therefore cooperate with the users to find intelligent solutions that would support the tasks performed by the users. We could therefore conclude that early user involvement is very important but the application must also be tested in real situations. There will always be user categories that will be missed or not prioritized, the important thing that we have found is to try to get as large representation as possible and try to involve the users early to get all the varieties of requirements into the process in an early state. Without the user-center design it would probably have been much harder to get the system released and accepted. The requirements came from within the organization, and the users had a need for the new system. The deployment will then be much easier then if the demands for a system would have came from the administration or executives.

7. CONCLUSION

To work with a user centered design have been useful and in our opinion very effective. We have concluded that the user involvement influences the effectiveness and the efficiency in the end-system design in a good
way as expected, but that it also clearly surpass the effort put in at the early design stages. This information system would never have been accepted if we not had gained approval of it by the users. We could clearly see that the involvement influences the usage rate when the system is released, those departments that have been active in the development are also active users. These two factors correlated very well.

It has also been concluded that the different system rights were correctly divided. There have been no problems with exceeded rights. And the users that got administrative right have handled that very well. There have been no incidents.

The static layer design seem to be working, users can get small parts of rights and then add rights when they need them. There have been a number of users selecting one type of rights from the beginning and then when they have learned asked for extended rights.

The system is still in use despite competition from new types of information software and despite that the design has not been updated since 2000. In the new Intranet of HTU it has also been suggested that the system should be included in the web-portal, as well as extended to work for all three campuses at the University.

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