

Investigating and promoting UX practice in industry: an experimental study

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ABSTRACT

The efforts of addressing user experience (UX) in product development keep growing, as demonstrated by the proliferation of workshops and conferences bringing together academics and practitioners, who aim at creating interactive software able to satisfy their users. This special issue focuses on "Interplay between User Experience Evaluation and Software Development", stating that the gap between human-computer interaction and software engineering with regard to usability has somewhat been narrowed. Unfortunately, our experience shows that software development organizations perform few usability engineering activities or none at all. Several authors acknowledge that, in order to understand the reasons of the limited impact of usability engineering and UX methods, and to try to modify this situation, it is fundamental to thoroughly analyze current software development practices, involving practitioners and possibly working from inside the companies. This article contributes to this research line by reporting an experimental study conducted with software companies. The study has confirmed that still too many companies either neglect usability and UX, or do not properly consider them. Interesting problems emerged. This article gives suggestions on how they may be properly addressed, since their solution is the starting point for reducing the gap between research and practice of usability and UX. It also provides further evidence on the value of the research method, called Cooperative Method Development, based on the collaboration of researchers and practitioners in carrying out empirical research; it has been used in a step of the performed study and has revealed to be instrumental for showing practitioners why to improve their development processes and how to do so.

Keywords: Software life cycle, Human-centered design, Survey, Interview, Focus group, Cooperative Method Development

1. Introduction

The proliferation of many competitive interactive systems pushes researchers to debate a lot on how to design systems that sell better, since they are capable to provide a positive UX. Designing for UX requires understanding user requirements from both a pragmatic (system functionalities and interaction) and a hedonic point of view (Väänänen-Vainio-Mattila et al. 2008). Indeed, UX extends the more traditional concept of usability, focused primarily on ease-of-use, by emphasizing

subjective attributes like aesthetics, emotions and social involvement. Human-Centered Design (HCD) is the starting point to take into account usability and UX (ISO/IEC 9241-210 2010): it prescribes to focus on users, their tasks and the context in which they operate, and to carry out iterative design by creating and evaluating prototypes of increasing complexity, possibly with users.

Unfortunately, HCD and methods addressing usability and UX are always mentioned in research papers, but very seldom applied in the current practice of software development. Today most software companies still devote a substantial amount of resources on determining the right functionality of their products. Moreover, daily experiences in working with various software artifacts (e.g. text editors, e-commerce websites) show that, despite the powerful functionality they offer, users complain about the many difficulties in using them. A user interface hard to understand and use causes many problems to users. Usability is a measure of the extent to which users are able to perform their activities in their specific context of use (ISO/IEC 9241-11 1998). A low level of usability means that users cannot work out how to use a system, no matter how elaborate its functionality is (Nielsen 1993). Today the trend is towards increasing emphasis on UX, i.e. to devote greater attention on how to motivate, attract and engage users.

Although documented benefits of usability engineering exist (Bias and Mayhew 2005), literature provides studies showing that software development organizations have limited or no usability engineering activities; examples are (e.g. (Ardito et al. 2011; Bak et al. 2008; Rosenbaum et al. 2000; Vredenburg et al. 2002)). While many authors have discussed the benefits and challenges of usability engineering in general, fewer have studied specific software development practices (e.g. (Dittrich and Lindeberg 2004; Kautz 2011; Larusdottir 2012; Rönkkö et al. 2008)). We agree with those researchers who state that, in order to optimize the impact of usability and UX on software development, it is fundamental to analyse current development practices, involving practitioners and possibly working from inside the companies (Lethbridge et al. 2005; Robinson et al. 2007).

This article provides a contribution to this research line by describing an experimental study that we have conducted with companies to investigate the use of HCD in their software development processes, and in particular to analyse how they address usability and UX of the products they create. Some obstacles were identified, which prevent the use in practice of HCD methods and possible modifications of the development processes that may lead to the creation of systems capable to provide a better UX. The research work is based on an approach that considers primarily qualitative methods by triangulating results gathered by: 1) a questionnaire-based survey, 2) interviews, 3) a focus group, and 4) an exploratory study aimed at exploring UX methods in

industrial settings, inspired by both ethnography-based research and the Cooperative Method Development (CMD) proposed by Dittrich et al. (Dittrich et al. 2008).

While in our research we wanted to understand how usability and UX are addressed in current practices, the results we got show that still today too many companies neglect these important quality factors. Other companies do not properly address them. Interesting problems emerged: some were already known, e.g. company complaining that HCD and UX methods are very much resource demanding and that no methods suitable to companies' needs exist; other problems were more surprising and challenging, such as the fact that companies are not willing to consider usability and UX requirements because they are not mentioned in the Call for Tenders published by public organizations (as it will be discussed in detail in the article). Addressing such problems is the starting point for improving the current situation. The last step of our study provided further evidence that a method like CMD has great potential to support both researchers and practitioners in identifying and improving critical aspects of software development processes. Specific hints about methods that companies could easily adopt are also given.

The article has the following organization. Section 2 reports some related work. Section 3 discusses the value of qualitative research for analyzing software engineering issues. Section 4 reports the experimental study we have conducted, by first illustrating the research methodology adopted and then describing the four steps of the study. Section 5 discusses the results of the study and provides some suggestions to reduce the gap between research and practice of UX. Section 6 concludes the article.

2. Related work

Since the 80s, when Human-Centered Design was proposed, a considerable amount of research has been performed to define many methods that support design and evaluation of usable interactive systems. There are studies that documented the economic benefits of usability evaluation in terms of increased sales, increased user productivity, reduced training costs, and decreased needs for user support (Bias and Mayhew 2005). Nevertheless, literature provides many examples revealing that this research has had little impact on software development practice. This has been shown both in questionnaire and interview-based studies performed more than one decade ago (e.g. (Rosenbaum et al. 1999; Rosenbaum et al. 2000; Vredenburg et al. 2002)), and in more recent ones (e.g. (Ardito et al. 2011; Bak et al. 2008; Boivie et al. 2003; Cajander et al. 2006; Hudson 2008; Lallemand 2011; Nørgaard and Hornbæk 2006; Seffah et al. 2006; Venturi and Troost 2004)). Specifically, Rosenbaum et al. (2000) found that the major obstacles to the integration of HCD activities in

software development processes are related to the lack of knowledge about what usability is, to the resistance of engineers and/or managers to usability since they do not understand its value, and to the feeling that too many resources (e.g. time and costs) are necessary. Other authors remarked that different meanings are given to usability depending on the roles of the employees in the company (e.g. director, manager, head of operation management, usability designer, etc.): usability is often reduced to consistency of font and colour, simply regards performance and response times, or is used as synonym of efficiency contributing to customer satisfaction (Cajander et al. 2006). Such different interpretations of usability give further evidence to the gap between academics and practitioners (Nørgaard and Hornbæk 2006). Companies also complain that recruiting trained usability/HCD experts is difficult; indeed, in most cases such professionals are a very short of company employees (Venturi and Troost 2004).

In the last decade, researchers have also investigated the combination of HCD with agile design methodologies, like SCRUM, since both are based on similar principles, i.e. iterative design, user involvement, continuous testing and prototyping (Blomkvist 2005). Some studies have revealed that adopting some HCD technique adds value to the developed product and increases its usability (Hussain et al. 2009a; Hussain et al. 2009b). With regards to which HCD techniques are primarily used, a study conducted in 14 Swedish industries, which adopted SCRUM design methodology, indicated that practitioners mainly used very informal methods, such as blogs from users, lunch meetings, comments on prototypes and meeting with users. Only in few cases formal methods, e.g. inspection techniques, were also performed (Larusdottir 2012).

However, there are studies indicating that the combination HCD-Agile presents two important problems. The first one is related to the communication between developers and designers. A power struggle occurs between developers, more oriented to software architecture and functionality, and designers, who advocate end user needs (Chamberlain et al. 2006). In an attempt to solve this power struggle, the Personas method was applied. Unfortunately, the method appeared to be not very useful, since the precise identification of a user archetype negatively affected external clients and potential future clients (Rönkkö et al. 2004). The other important problem regards the distinction of the role of the two different actors, i.e. the *customer* and the *user*, participating in a HCD-Agile development process. Agile methodologies require the continuous customer participation in the software lifecycle in a collaborative partnership based on a daily interaction with developers (Highsmith 2002). HCD is based on a similar principle that considers user participation in the whole software development process. In an agile development process, customer and user play the same role, not distinguishing between customers, who have required the system but could not use it,

and users, who will actually use the system. Kautz carried out a study to explore a fruitful customer and user participation in an agile software development project (Kautz 2011). The customer played an informative, consultative and participative role, while the user was involved in ensuring the right flexibility of the product during the whole development process; both the project and the final product were considered a success by the customer as well as by the developing organization (Kautz 2011).

A few scattered experiences of designing and evaluating UX in practice are reported so far in literature. For example, at Nokia, which has a long history in designing for UX, the product development process includes continuous evaluation of usability and UX in different phases of the life cycle. After the release of the product in the market, feedback is gathered from the field through controlled and uncontrolled studies in order to collect information for improving successive releases (Roto et al. 2008). As it is highlighted in the motivation of this special issue, integrating such activities in software development practices is still very challenging.

3. Qualitative research in software engineering

The overall study reported in this article has been primarily based on a qualitative research approach. Qualitative research has been largely performed in fields such as psychology, social sciences, human-computer interaction, and keeps increasing in software engineering, since it is an effective way to explore the in-situ practice of software engineering (Seaman 1999). As pointed out in (Dittrich et al. 2007), “There is no ‘one way’ of doing qualitative research. The only common denominator of qualitative research is that it is based on qualitative data”. Traditionally, quantitative methods have been claimed better than qualitative ones, since they provide objective measurements and enable replication of studies, while qualitative methods build on subjective interpretation. This is not true anymore, since it has been shown that careful qualitative researchers may analyse data and present results in ways that ensure the necessary objectivity and soundness. To perform good qualitative research, it is suggested to adopt different methods, to consider different data sources, and to have different researchers cooperating in order to counterbalance possible individual or methodological biases (e.g. (Dittrich et al. 2007; Rogers et al. 2011)). Another acknowledged property of qualitative research is that the flexibility of the research design provides the possibility to involve practitioners in the process, enabling researchers to discuss and evaluate with them the possible improvements of their practices. Indeed, qualitative research is particularly suited to address software engineering as a social activity, thus emphasizing how software practitioners may incorporate new methods in their daily practices. Understanding the social side of software

engineering helps to develop, select and use methods and tools to support the engineering practices (Dittrich et al. 2007). Practitioners can actively participate in the whole research process addressing their problems and discussing them with researchers. Thus, qualitative research is very appropriate in the cooperation with industries.

In the work reported in this article, along with more traditional methods such as questionnaire-based survey, interview and focus group, we have used the qualitative research approach, called ‘Cooperative Method Development’ (CMD): it “combines qualitative social science fieldwork with problem-oriented method, technique and process improvement” (Dittrich et al. 2008). The CMD research process is an evolutionary cycle, which consists of qualitative empirical research, technical and methodological innovation defined in cooperation with the involved practitioners, and the implementation of these innovations evaluated through accompanying empirical research. CMD can be seen as a domain-specific adaptation of action research (Easterbrook 2007); it consists of three phases that can be repeatedly applied in the same context:

Phase 1 - Understand Practice: the research begins with qualitative empirical investigations into the problem domain, in order to understand existing practices based on their historical and situational context, and to identify aspects that are problematic from the involved practitioners’ point of view.

Phase 2 - Deliberate Improvements: the results of the first phase are used as an input for the design of possible improvements. This is done in cooperation between researchers and the involved practitioners.

Phase 3 - Implement and Observe Improvements: the improvements are implemented. The researchers follow these method improvements as observers. The results are evaluated together with the involved practitioners.

The results of the third phase summarize concrete results for the involved companies. Moreover, they allow researchers to build the basis on which other scientists can evaluate the proposed improvements.

4. The experimental study

The aim of our work is to investigate if and how software companies consider HCD in their software development processes, how they address usability or UX of the products they create, and possibly how they can improve their development process in order to create better products. In fact, there are still very few studies carried out with the involvement of software companies that try to

understand the reasons of the large gap between what is proposed in academia - and widely published in literature - and the actual practices of software development. This section describes the experimental study we have conducted. The work has been driven by a research methodology illustrated in the following section. The successive sections describe the specific steps of the study.

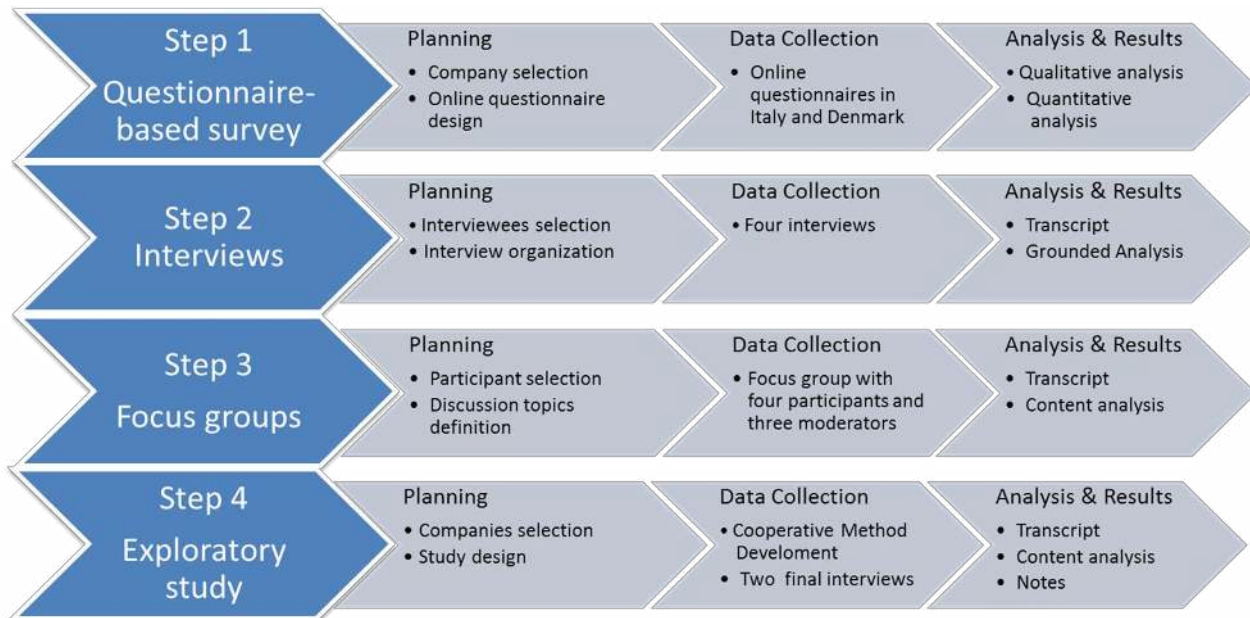


Figure 1. The research methodology.

4. 1. Research methodology

The research work presented in this article has been articulated in four steps (see Figure 1). As *first step*, we performed a survey based on an online questionnaire, since we wanted to get data from a considerable number of companies. By using a questionnaire-based survey, our research methodology actually considered some quantitative data, still remaining primarily qualitative-based. The survey results highlighted issues that we wanted to analyse in more depth. In fact, a questionnaire does not permit to discuss the meaning of questions and concepts, and to explore new opinions and views that might emerge in the respondents (Karlsson et al. 2007). Thus, we carried out the three further steps almost in parallel, as described in the following.

The *second step* consisted in semi-structured interviews that were conducted to achieve a higher degree of discussion between the interviewer and the interviewees, thus getting a better understanding of practitioners' views on the issues and the reasons of their practices to software development. Some questionnaire answers indicated that in some cases the company management is more reluctant to employ usability engineering methods. Thus, as *third step* we organized a focus group in which we involved employees of different levels in a company, in order to compare their views in addressing usability requirements and evaluations.

Our experience confirms what is already known as a limitation of interviews and focus groups in trying to get information about a certain practice (Rogers et al. 2011): in some cases, what the interviewees say is not exactly what they do, know or think. This may be due to several factors. One is that “practitioners exhibit a kind of knowing in practice, most of which is tacit” (Schön 1983), i.e. they are not able to express their knowledge in words, but it is *tacit knowledge* that they currently use in their activities, even being unaware of it. Moreover, relevant information is conveyed through documents and artefacts that they use in practice and share with colleagues; it is difficult to get this information from interviews. Finally, questionnaires, interviews and focus groups are affected by a “please the researcher” bias, namely the tendency of respondents to answer in a way that can be viewed favourably by the researcher.

In-situ observations can fruitfully complement such methods. As pointed out in (Lethbridge et al. 2005; Robinson et al. 2007), the practice of software engineering is better understood if software practitioners are analyzed while they are engaged with their software engineering problems in real settings. Various studies performed in recent years show that ethnographically-inspired research provides very good means to get an in-depth understanding of the socio-technological realities surrounding everyday software-development practice (Dittrich et al. 2007; Sharp et al. 2010). The empirical base of these studies is collected through a combination of methods, such as observation of practice and of the used artefacts, interviews and discussions with practitioners. Actually, in classic ethnography the researchers are immersed in the area under study for a considerable amount of time (several months and even years). This is not usually possible in the case of software companies because of considerations of time or confidentiality. Thus, classical ethnography approaches have been adapted in order to conduct shorter studies (for examples, see (Robinson et al. 2007)).

We then planned, as *fourth step* of our research methodology, an exploratory study aimed at exploring HCD and UX methods from inside a company. While it could be useful to understand the company practice through the immersion of a person for a couple of months, the important objective of our study was to show to the company employees and managers that their development practice could be improved by adopting methods of HCD in order to create products of better quality. More specifically, in our study we adopted an approach inspired by the Cooperative Method Development proposed by Dittrich (Dittrich et al. 2008). In particular, we felt useful that the researchers could show to practitioners how they would apply some specific methods to collect requirements or to create a system prototype. In some other cases, it could be even better to cooperate with practitioners, so that they could appreciate the value of a certain activity. In the

performed study, two collaborators of ours participated in the development practices of a company for three months each.

4. 2. Step 1: Questionnaire-based survey

Planning

As first step of our study, we conducted a survey to investigate the practical impact of usability engineering in software development companies (Ardito et al. 2011). It consisted of a questionnaire-based survey, whose aim was to determine whether software development companies were evaluating the usability of their software, and to identify key obstacles. We wanted to address companies located in southern Italy, replicating a survey conducted in northern Denmark three years earlier (Bak et al. 2008). The questionnaire was the same used in the Danish study; being originally written in Danish, it was translated to English by its authors and then translated to Italian by the Italian researchers; eventually, it was checked by a Danish native speaker, who has lived and worked in Italy for 20 years, comparing the Italian version with the original Danish version. Special care was devoted to avoid any influence of the results of the Danish study in the analysis of the collected data and in results interpretation.

Data Collection

The survey was conducted in southern Italy in November-December 2010 using an online questionnaire. The questionnaire contained open and closed questions. The initial section aimed at acquiring information about the company (number of employees, product types, platforms, development method) and also presented questions to get the respondent's understanding of the term "usability evaluation". Then, the questions focused on experience of usability evaluation in the company and on its pros and cons.

Thirty-six companies answered to the Italian questionnaire, and thirty-nine had answered to the Danish questionnaire.

Analysis & Results

The collected data were analysed by three Italian HCI researchers. In order to avoid influence from the Danish study, they had no knowledge of that study. However, they were asked to adopt the same methodology. For the closed questions, they made a quantitative analysis. For the open questions, they followed the grounded theory approach: they individually analysed the data from each of the open questions and put codes on sentences. Then, the code for each sentence was discussed among the three of them, and a single code was agreed upon. They individually assigned codes to

categories. Again, the individual assignment of codes to categories was agreed upon in a joint session. Reliability was high (agreement over 85%) for the codes reported in this paper. This process resulted in a list of categories and codes, which was used to get a condensed overview of the results from the questionnaire. At the end, the results were compared with those of the Danish study. The detailed discussion of the obtained results is in (Ardito et al. 2011). We report here a summary.

In order to be consistent with the Danish study, we considered companies with the following characteristics: 1) they develop software with a graphical user interface (e.g. web applications, mobile applications, business management software); 2) they develop for customers or for internal use; 3) they have at least a development unit located in the Apulia region, in southern Italy, while their headquarter could be elsewhere (e.g., the IBM unit located in Bari participated); 4) they employ more than a single person. Specifically, of the 36 respondents, 5 belong to small companies (having from 2 to 15 employees in the whole company), 11 belong to medium companies (from 16 to 150 employees) and 20 belong to big companies (more than 150 employees).

The first significant result is that several companies still do not conduct any form of usability evaluation. The percentage of companies that perform usability-evaluation activities was almost the same between the two studies. In the Danish study, 39 organizations responded to the questionnaire: 29 (74%) said that they perform usability evaluation, 10 (26%) said that they do not. In the Italian study, 26 (72%) do, 10 (28%) do not. Figure 2 shows the percentage of small, medium and big companies that perform/do not perform usability-evaluation activities.

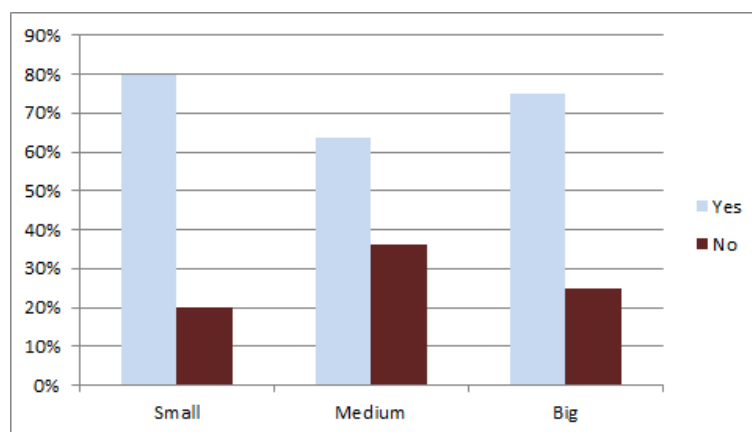


Figure 2. Percentage of small, medium and big companies that perform (Yes)/do not perform (No) usability-evaluation activities.

Looking at the first important question in the questionnaire, namely the understanding of the term “usability evaluation”, only two Italian respondents said that they do not know its meaning, while

one confused accessibility evaluation as usability evaluation. All the other thirty-three respondents either provided answers that refer to methods to evaluate usability or gave a correct definition of usability without mentioning methods to evaluate it (fifteen respondents in the latter case).

As answer to the same question in the Danish study, which was carried out in 2007, thirteen respondents actually addressed functionality tests instead of usability evaluation. This indicates that companies are actually becoming more aware of what usability really is. However, the results we got showed that they are still reluctant to evaluate usability in the software life cycle or they do not have a clear understanding of how to evaluate it.

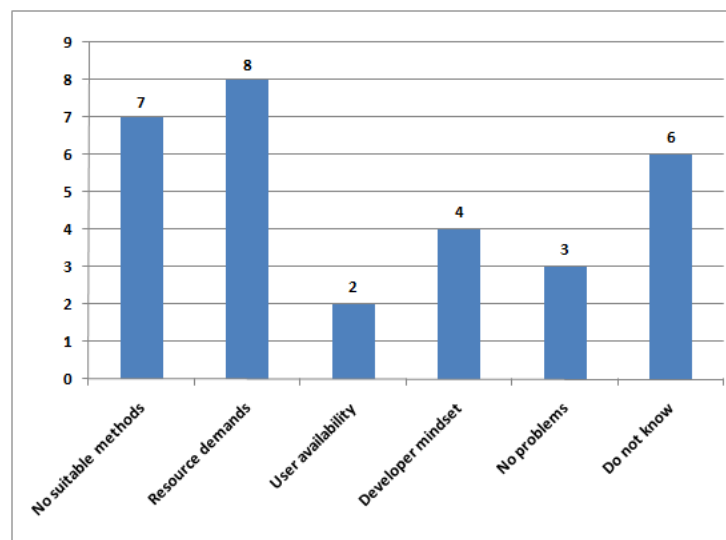


Figure 3. Problems in usability evaluations (from (Ardito et al. 2011)).

The respondents who said that their organization performs usability evaluations have been asked to report the problems they encountered in introducing and performing usability evaluations in their software life cycle, as well as the perceived advantages. *Problems* and *advantages* were two open questions. The answers to the *problems* question were classified in the following categories: No suitable methods, Resource demands, User availability, Developer mindset, No problems, Do not know. Some respondents indicated more than one problem. As shown in **Errore. L'origine riferimento non è stata trovata.**, the mostly reported problems were the lack of suitable methods for usability evaluation and the fact that they require a lot of resources in terms of cost, time and involved people. Two answers pointed out that it is not easy to involve users in the evaluation. Finally, by Developer mindset we refer to problems due to the fact that some professional developers still devote great effort on the system back-end, having their main interest on qualities such as code maintainability and reuse, and do not care too much about how the system functionalities are presented to the end users through a usable interface. The HCI researchers who

analysed the questionnaire answers proposed different names for this category. At the end, we decided to call it Developer mindset for analogy to the Danish study, which found similar categories of problems.

The answers to the *advantages* question have been classified in the following categories: Quality improvement, User satisfaction, Competitiveness, Resource saving, No advantages, Do not know. Some respondents indicated more than one advantage. As shown in Figure 4, most answers pointed out that advantages of usability evaluation are quality improvement of the developed products as well as the fact that users get more satisfied. Five answers pointed out that usability evaluation helps increasing company competitiveness. Despite the fact that resource demand was considered a problem by some respondents, six answers reported resource saving as advantages of usability evaluation. Those people appeared convinced that performing usability evaluation at the right time of the product life cycle actually reduces overall costs.

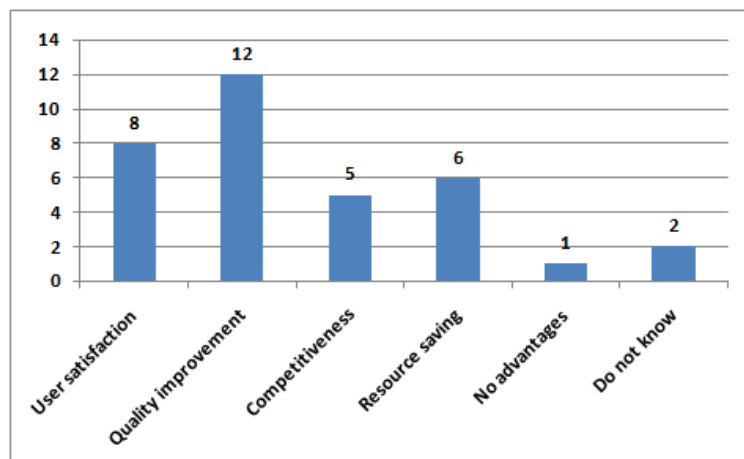


Figure 4. Advantages of usability evaluation (from (Ardito et al. 2011)).

In order to get a more in-depth understanding of the topics addressed in the questionnaire, and in particular for better discussing advantages and problems of usability engineering as they are perceived by the individual companies, the second step in the research methodology consisted in interviews performed with managers of some companies.

4. 3. Step 2: Interviews

Planning

We decided to interview representatives of those companies that, based on their answers in the returned questionnaire, appeared to be motivated to improve the usability of the products they develop. Four persons, of four different companies, were contacted.

A semi-structured interview was designed in order to understand in depth the socio-technological realities surrounding everyday software development practices and why their companies are not pushing for the adoption of usability engineering methods in their development processes.

Data Collection

Two or three researchers were involved in each of the four interviews: one was the interviewer; the other(s) assisted by taking notes. The interviews were audio-recorded. Each interview was transcribed before analysis.

Analysis & Results

The grounded theory approach for analysing the survey open questions was also adopted for analysing the data collected in the interviews and in the focus group (Step 3). According to this approach, two researchers independently examined the interview transcripts. This analysis led to an iterative refining of the identified categories and a new category emerged. Reliability was high (agreement over 90%).

The interviewees mainly pointed out the lack of suitable usability-evaluation methods with a high benefits-costs ratio. They said that, since time and other resources are limited, during their product development process companies focus only on the requirements established for that particular project. In general, such requirements do not include usability and UX. Why should companies bother about ensuring usability and an engaging UX if this is not explicitly required? This is mainly true when considering public tenders. Indeed, it often happens that companies develop software systems commissioned by public organizations, which specify the system requirements in a Call for Tender (CfT). It is evident that the companies' interest is to satisfy all and only the requirements specified in the CfT. For example, an interviewee clearly said: *"I do not burden myself with anything not explicitly required in the Call for Tender"*. Thus, in addition to the categories of problems identified in the survey, a new category emerged, that we call "CfT problem".

On the contrary, companies' interest in software accessibility was explicitly stated. The interviews confirmed that companies, especially those working for the public administration, have to produce accessible products, since accessibility is one of the requirements in the CfT. In the questionnaire returned by the company in which one of the interviewee works, an answer reported that the company produces usable products since the Web Content Accessibility Guidelines (WCAG) are followed. The interviewee also said: *"Accessibility contains usability!... We use automatic tools to validate our products"*. He was referring to tools for assessing accessibility, like, for example, AChecker (AChecker). During the interview, a short discussion was devoted to clarify this issue. It

is worth mentioning that in Italy companies are often requested to comply with the Stanca law about accessibility, which was approved by the Italian Parliament in 2003. Thanks to this law, which clearly indicates the different types of accessibility levels, it is easy to specify accessibility requirements in the Call for Tenders.

4. 4. Step 3: Focus group

Planning

The aim of the focus group was to invite employees of different levels in a company (managers, leaders and developers) to debate on issues related to performing HCD activities in their work. Four employees of a company that participated in the survey in Step 1 were selected: one company manager, two project leaders and one User Interface (UI) developer. We expected that conflicts about advantages and problems in applying HCD methods would have aroused from employees performing different activities and having different responsibilities in the software life cycle. The location was a meeting room at the company.

Data Collection

One of the three researchers participating in the focus group started the meeting with a brief introduction of the research goals. Then, he facilitated the discussion by asking some questions to clarify the answers that a representative of their company gave in the survey, in particular to obtain more details about number and competences of people working on product usability. Participants were also asked about the company development process and the formal or informal meetings they have with other employees to discuss their work. The two other researchers participated in the meeting taking notes and in a few occasions asking about further details. The focus group was audio-recorded and later transcribed.

Analysis & Results

The notes the researchers took during the focus group and the transcription of the audio-recording were analysed by using the same methods of the interview analysis. The gathered data provided information about the company, the type of projects it develops and its development process.

The company has 15 employees including managers, project leaders and developers. They develop products commissioned by privates (50% of their work), as well as by public administrations (30%). For the remaining 20%, they work on research projects funded by regional or national government. Two persons take care of the UI aspects of the interactive systems they develop: a

graphic designer and a developer, called UI developer, who has some HCI competences acquired during his recent university studies.

The company adopts an Agile development methodology. Being a small company, the managers are also involved in critical phases of the overall design and development process. Initially, they participate in an informal meeting with the project leaders and a customer representative to identify the high-level needs and expectations of the customer. The collected information becomes a guideline for system requirements definition. At this point, the specific application domain is studied and competitor systems are analysed. Managers and project leaders, whose expertise is primarily in Software Engineering (SE) and very low in HCI, sketch and discuss among them some paper mock-ups. Once they agree, these mock-ups are delivered to the graphic designer who, based on his experience and creativity, develops prototypes of the UI by using drawing tools, such as Adobe Photoshop[®]. Then, the UI developer implements an evolving prototype using tools such as Pencil, Artisteer, etc. At this point, the software developers create a Beta version of the system, which implements the core functionality. This version is shown and discussed in a review meeting, in which customer representatives are also observed while interacting with the system to perform the main tasks. After the meeting, the detected criticalities are solved by the project team and the updated Beta version is released to the customer to be tested by a restricted number of users, while the company developers go on implementing other functions.

Participants in the focus group were asked why they do not involve end users. They explained that during the requirement specification *“users are considered a waste of time”*, because *“they are not aware of their needs”*, or *“they ask the impossible”*, or *“they change idea too many times”*. Moreover, the company does not perform user tests because *“users, aware of being observed, feel awkward and are not able to perform even simple tasks”*. They said that no useful indications come from end users. The researchers decided to further investigate this point. It emerged that this company usually develops software systems commissioned by small or medium enterprises; these systems will be used by the enterprise employees. When they interviewed such end users for requirement analysis, they did not get any useful information. Specifically, they often interviewed some technology fanatics, who emphasized the technological appeal over the system functionality; being convinced to be expert of technology, they tended to dictate their ideas about the system. In other cases, they interviewed employees that consider their role as an opportunity for showing their capabilities to their bosses. As a consequence, they tended to ask for much more functions than really needed.

The researchers explained that interviews are not the only method to involve end users in requirement analysis, just because situations like those described by the participants may happen. They mentioned other methods that can be triangulated with interviews (e.g. user observation) and they agreed with practitioners to meet again to show how they could be properly applied.

The focus group also confirmed what already emerged in the previous interviews, that is the Call for Tender is one of the main reasons for not addressing usability engineering. All participants, including the UI developer, said that they do not care about designing for usability and UX since in the requirements they get from their customers, in the private as well as in the public sector, there is no reference to usability; sometimes, it is only very generally mentioned that the system has to be “easy to use”. Participants also said that their main objective, besides permitting to use the system with no help of an operating manual, is to guarantee compliance with the Italian law on accessibility, since this is usually explicitly required.

4. 5. Step 4: Exploratory study

Planning

The study was performed in a company of medium-high size located in southern Italy and was inspired by both ethnography-based research and the Cooperative Method Development (CMD) (Dittrich et al. 2008). Referring to the two objectives of the overall study, we aimed to view, capture and understand the company’s work practice and to integrate in key points of the software development life cycle some activities for addressing usability and UX, such as interviews to real users and usage scenarios during the requirement analysis, prototype development and evaluation during early phases of the system life cycle. According to the CMD, company employees were involved in order to identify with them the possible improvements to be implemented in the company software development practice.

The company participating in the study develops products in different domains, primarily public administration and banking. The company is organized in three different Business Units (BUs): Public Administration, Finance and Research. The latter is mainly involved in research projects. Each BU could be considered as a separate small company, with its own personnel for carrying out all the activities in the software life cycle: BU managers, project leaders, analysts, designers, developers, etc. All BUs adopt a traditional waterfall life-cycle model for several reasons, including managers’ background and project constraints, as it will be explained later.

A research group of four HCI senior researchers and two HCI junior researchers was formed. It was agreed with the company that the two junior researchers would have worked in the company, each

one for sixty working days (twelve weeks). According to the CMD three phases (see Section 3), the two junior researchers investigated the existing company practices in order to identify those aspects that were problematic (Phase 1). Every two weeks short meetings were held, in which the two researchers reported what happened in the company and evaluated the performed work with the other members of the research group and the company representatives. In the meetings, possible improvements were designed (Phase 2). Then, the two junior researchers implemented them in the company software practices and collected the results to be evaluated in the next meeting (Phase 3).

Data collection

The study was carried out in the Public Administration and Research BUs. Specifically, Rossana, a female researcher, was assigned to a project of the Public Administration BU, whose aim was to create an application for tourists visiting a certain town, running on a mobile device; it was commissioned by the municipality of that town. Diego, the male researcher working in the Research BU, was assigned to a research project, whose aim was to develop hardware and software to provide services to various people, from oceanography researchers to skippers, and others.

Data about current practice were gathered by: observations of practice reported in researchers' diaries; observation of artifacts of practice; in-situ formal and informal interviews with practitioners, BU managers and Project managers; informal discussions with BU employees. As soon as critical aspects were identified, informal meetings among the researcher and practitioners were carried out, where the researcher illustrated some methods that could be introduced in order to improve these critical aspects of the development process. The methods were proposed by the researchers on the basis of their academic knowledge, but the discussion about which method should be selected and how it should be applied involved the practitioners very much. In some cases, the researchers autonomously applied a method and then showed the results to practitioners. Further discussions and interviews were conducted in order to evaluate the improvements.

The study ended with two interviews to each BU manager, performed about a month after the exploratory study to get their opinions about Rossana's and Diego's work.

Analysis & Results

From the observation of the design and development processes in the company, Rossana and Diego realized that the point of view of users was very much neglected in the requirement analysis. Thus, they worked a lot to try to demonstrate the benefits of including a detailed specification of the user requirements. They also performed some interviews to validate such requirements with other stakeholders. Diego was working on a quite complex system, addressing very different types of

users; so, he insisted on involving real users, pointing out how different final users are from other stakeholders in terms of needs and expectations; however, this was not possible.

Both Rossana and Diego used paper prototypes a lot, discussing them in participatory meetings with other stakeholders, i.e. the other project partners in the case of Diego's research project, while Rossana organized short meetings with the design team. Such participatory meetings were themselves a new activity with respect to the traditional process, and they were very much appreciated by the practitioners, who realized how much useful information about the project was provided by the different stakeholders expressing their own point of view. Because Rossana was designing an application devoted to people visiting a certain town, she involved a few other persons in the company (secretaries and staff members), who acted like tourists interacting with the prototypes. Even if the approach might appear a bit naive, HCI researchers know well how useful these "quick and dirty" methods might be (Rogers et al. 2011). As further example, to test a running prototype with real users, Diego contacted two friends of his, who are professional skippers, and performed thinking-aloud tests. The tests indicated some various problems and in particular showed that a certain feature was not as useful as analysts had considered.

After an analysis of various tools for rapid prototyping, Diego selected Justinmind Prototyper (Justinmind Prototyper) and used it for creating several successive prototypes. Rossana and Diego also performed several heuristic evaluations of the prototypes. Thus, they used methods that are very cost effective in order to demonstrate that such methods require limited resources and little training of company employees who could apply them.

The study of the work practice showed one of the reasons why the company is still adopting a waterfall model that neglects formative evaluation during software development. In fact, in some cases the company develops systems whose requirement analysis and specification of the system user interfaces are performed by other companies. Therefore, the company has only to make sure that its development complies with the requirements they get from another company.

About one month after the end of Rossana's and Diego's work in the company, three researchers interviewed the BU managers in two separate interviews. They said that they actually understood how fruitful the new activities performed by the two researchers were and how meeting other stakeholders helped resolving several concerns. The Research BU manager appreciated a lot the fact that, in the requirement analysis, Diego insisted very much on including a detailed specification of user requirements. Both managers highlighted that they are now convinced of the value of the early prototyping activities and are enthusiastic of the prototyping tools used. In particular, they are planning to get the tool used by Diego and to use it in the early design phase of their projects. They

are still far from carrying out systematic usability and UX evaluations, but it seems that the feedback they got from this experience was very valuable to make them reconsider their development process.

5. Discussion and suggestions

The results of the questionnaire-based survey conducted as first step of our research methodology were discussed in details in (Ardito et al. 2011), where they were also compared with a similar study carried out in a very different geographical region, northern Denmark. Both surveys (in Italy and Denmark) showed that the number of organizations conducting some form of usability activities is rather low. Even if software developers are becoming more aware of usability and of its importance in order to improve their products, one of the main problems still remains what we call “Developer mindset”: many developers have their minds set mainly on programming aspects, technical challenges and functionality of the product rather than on its usability. Still too many of them do not know well what usability is and they know even less about UX. Another main obstacle they reported is the lack of suitable methods that could be integrated in their work practices without demanding a lot of resources.

Interviews and focus group were conducted in order to investigate more in depth the issues raised in the survey. In particular, the focus group aimed at understanding whether employees of different levels in a company, e.g. developers, project leaders, managers, possibly had different views about advantages and disadvantages of performing HCD activities. Both interviews and focus group confirmed the main results of the survey; however, they were instrumental to: a) better highlight some problems, or b) show new problems. Indeed, more problems on user involvement emerged. It was evident that most practitioners are reluctant to involve end users in participatory design activities as well as in evaluation. In the focus group, they clearly expressed that it is a waste of time to involve end users since they are unable to explain their needs and expectations or provide useful indications during the evaluation. Again, it was remarked that involving users is very demanding in terms of costs and time, therefore it is not feasible to perform user testing. The work of the research team in Step 4 had the great value to demonstrate that in many cases valid user-based evaluation can be performed by using the so-called discounted methods, like thinking aloud (Nielsen 1993); in order to get useful feedback, company employees or friends may be involved, if they have characteristics similar to the actual end users of the application under development.

A new and interesting finding of interviews and focus group indicated that another reason why companies neglect usability and UX is that they are not requirements considered in public tenders.

In most cases, companies develop software systems commissioned by public organizations, which specify the system requirements in Call for Tenders. Companies do not address usability and UX since they are not required in these Calls. Thus, another suggestion for changing the current situation is to convince such public organizations of the need of explicitly mentioning usability and UX requirements in their Calls for Tenders. In order to do so, we are already in touch with people working at the office of the Apulia region (the region where our University is located), which has been publishing in the last years several Call for Tenders about ICT systems, and we are discussing such issues. While trying to convince them to address UX, we are facing another critical issue, namely the lack of usability and UX requirements that are objectively verifiable; consequently, it is not easy to specify them in the Calls. HCI researchers are urged to find proper solutions to this problem and to invest research work in order to define more significant metrics for usability and UX. It is worth remarking that companies focus a lot on accessibility since in Italy there is a specific law illustrating different types of accessibility levels, thus the Call for Tenders easily specify the accessibility requirements the software systems have to comply with.

The study performed as Step 4 of our research work confirmed the value of ethnographically inspired research in order to get an in-depth understanding of the socio-technological realities surrounding everyday software development practice (Dittrich et al. 2007; Sharp et al. 2010). The CMD proved to be a method able to address the following questions (Dittrich et al. 2008): How do software development practitioners carry out their daily work? What are the methods they use to address software quality? What is their view about different ways of involving users in the software life cycle? Which methods, if any exist, could be easily integrated in their software development process to address the problems that practitioners experience? What are the improvements we get by integrating a specific method? These questions help researchers and practitioners identifying, managing and improving critical aspects of a company development process.

The study confirmed how it is important to develop paper prototypes and to discuss them with other stakeholders, including end users. This is another important suggestion for companies. It might appear that it is not a new finding, because it is obvious within the research community, whereas the actual problem is to transfer the use of iterative prototyping in the practice of companies. The company got also evidence of the advantages of informal meetings in which several stakeholders, including end users, analyse prototypes starting from those on papers. This study and other previous experiences of ours on HCD in practice (e.g. (Ardito et al. 2010)), as well as other relevant work in literature (Wagner and Piccoli 2007), provide another important suggestion: running prototypes have to be evaluated with samples of their end users *in a real context of use*, since “end users can

raise significant issues about system usability only when they get down to using the system, or even a running prototype, in their real activity settings”. Only then, they are able to provide the right indications about what is working well and what is not. If this is true for usability, it is further true for UX, both because usability is part of UX and because the subjective aspects that UX impacts can be really assessed only by end users in real contexts of use.

6. Conclusion

This article has presented an experimental study conducted with software companies to investigate and promote usability engineering and UX methods. It has followed a research methodology that triangulated different methods. It started with a survey conducted in southern Italy, whose aim is to inspect the usability engineering practices in software development companies. It replicated a similar survey performed three years earlier in northern Denmark. These surveys highlighted some issues, which required a more in-depth analysis. Specifically, the goal was to understand why developers, who appeared clearly motivated to increase the usability of their products, did not actually adopt usability-engineering methods in their development processes. Thus, three further steps were carried out: they consisted in semi-structured interviews of project leaders of software companies, a focus group with employees of different levels in a company, and a study conducted to explore UX practices in industrial context by collaborating with practitioners.

The article has discussed the results of the study and provided suggestions on methods that companies can easily integrate in their software development practices. An interesting issue that emerged in the study, on which both HCI and SE researchers have devote attention in order to change the current situation, is to convince public organizations that they have to explicitly mention usability and UX requirements in the Calls for Tenders for ICT products. This way, companies will be obliged to consider these requirements. To make it possible, usability and UX requirements that are objectively verifiable have to be defined, so that they can be clearly specified in the Calls. The study has also provided more evidence on the fact that usability researchers have to be more careful in transferring academic work into practical value for industry. As we said in (Ardito et al. 2011), we believe “it is responsibility of academics to translate scientific articles, which formally describe evaluation methods, into something that makes sense for companies and it is ready to be applied”.

As a further contribution, this article confirms the value of the research method, called Cooperative Method Development (Dittrich et al. 2008). This method involves the cooperation between researchers and practitioners to carry out qualitative empirical research, identify critical aspects and possible improvements of their development process, and, finally, implement and evaluate such

improvements. The active involvement of the practitioners in the overall CMD process, along with the feedback they get from evaluating the obtained improvement, were instrumental in persuading them about the urgency and necessity to address usability and UX in their development processes.

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