

Usability evaluation: a survey of software development organizations

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Abstract—The importance of usability engineering in software development is acknowledged by an increasing number of software organizations. This paper reports from a survey of the practical impact of usability engineering in software development organizations. The survey was conducted in Southern Italy, replicating one conducted in Northern Denmark three years earlier. The results show that the number of organizations conducting some form of usability activities is nearly the same, but there are important differences in the understanding of usability. The key advantages emphasized by the respondents are product quality, user satisfaction and competitiveness in both surveys. The main problems emphasized are developer mindset, resource demands and customer participation.

Usability engineering; software development; survey.

I. INTRODUCTION AND BACKGROUND

It is now widely acknowledged that usability engineering is a key area in software development. Since the beginning of '90 (see [1]), various methods for usability engineering have been developed and assessed; an overview is in [2]. There is also a considerable amount of research of the relevance of these methods in software development practice. Evaluating software systems for usability has been documented to be economically beneficial in terms of increased sales [3], increased user productivity [4], reduced training costs [5], and decreased needs for user support [6].

Many software organizations devote a substantial and increasing amount of resources on determining the right functionality of their products. Yet there are numerous examples of systems that fail despite having the right functionality, simply because the prospective users cannot use the system for its intended purpose [7]. A problematic or incomprehensible user interface is a typical source of such problems. Usability is a measure of the extent to which prospective users are able to apply a system in their activities [8]. A low level of usability means that users cannot work out how to use a system, no matter how elaborate its functionality is [1].

Despite the fact that documented benefits of usability engineering exist and software developers state that usability is

even more important than functionality [9], the literature provides studies that show software development organizations have limited or no usability engineering activities. Thus, it seems as if the benefits have little impact on software development practice. This has been shown not only in studies performed in the '90 (e.g. [10]), but also in more recent ones. While many authors have discussed the benefits and challenges of usability engineering in general, fewer have studied specific software development organizations in order to understand the reasons of the limited impact of usability engineering in practice. A case study of software organizations identified obstacles to increased deployment of usability engineering methods [11]. Another study found that usability is interpreted differently by different actors, depending on their formal roles, and they often experience more focus on efficiency and economy [12]. In a study of the way usability evaluations are conducted in practice, a significant gap between this practice and the literature was identified [13].

In [14], a survey has been conducted in order to identify possible obstacles that prevent organizations to actually take usability into account in their software development practices. The study involved 39 software development organizations, located in a region of Denmark. It consisted of a questionnaire survey, whose aim was to determine whether software development organizations were evaluating the usability of their software and to identify key obstacles.

A limitation of the study performed in Denmark (we refer to it as “DK-Study” in the remaining of the paper), as the authors clearly said, is that it was conducted in a limited geographical area in Northern Europe. This motivated us to replicate the study in a completely different area, namely a region in Southern Italy (we refer to it as “Ita-Study”).

The paper has the following organization Section II describes design and execution of the Ita-Study, while Section III reports its results. Section IV discusses and compares results of Ita-Study and DK-Study. Section V provides conclusions and indicates future work.

II. ITA-STUDY: DESIGN AND EXECUTION

The study described in this paper replicates the one in [14] by involving organizations located in the Apulia region in Southern Italy. It aims at investigating the current usability engineering practices in software development organizations.

A. Method

As first step in the study, we conducted an online questionnaire survey using the same questionnaire of the DK-Study. Special care has been devoted to avoid any influence of the results of the DK-Study in analysis of the collected data and in results interpretation. Then, a comparison with the results of the DK-Study has been performed.

B. Participants

In order to be consistent with the DK-Study, we considered organizations with the following characteristics: a) they develop software with a graphical user interface, (e.g. web applications, mobile applications); b) they develop for customers or for internal use; c) they are located in the Apulia region in Southern Italy (University of Bari is in this region); d) they employ more than a single person.

In order to find the organizations, we used search engines on the Web, our own knowledge of organizations, and we looked at the list of organizations of the DAISY-net consortium (www.daisy-net.com), which brings together ICT (Information and Communication Technology) companies in the Apulia region. The considered organizations have their headquarter located in Apulia, even if most of them work in the whole Italy. The product types of most organizations are distributed between web sites, Internet banking, data warehouse, mobile applications, and business management software.

C. Data collection

Data from the selected organizations have been collected through an online questionnaire. The questionnaire used in the DK-Study, which was written in Danish, was translated to English by its authors. Then, the Italian researchers translated it to Italian; finally, a Danish native speaker, who has lived and worked in Italy for 20 years, checked the Italian version with the original Danish questionnaire. The questionnaire, available at "<http://tinyurl.com/questaziende>", contains open and closed questions, aiming at acquiring information about: 1) the organizations (number of employees, product types, platforms, development method); 2) their understanding of the term "usability evaluation"; 3) organization's use, experiences with and opinions about usability evaluation.

For each selected organization, we identified a contact person, who was called by phone to explain the purpose of the study and to invite her/his organization to participate in it. The contact person indicated the more appropriate person in the organization who could participate in our study.

All the forty-six contacted organizations agreed to fill in the online questionnaire. An email containing the link to the questionnaire was sent a few days later. twenty-seven filled in the questionnaire in few days; the remaining nineteen have

been solicited again. Ten organizations did not respond. At the end, we got thirty-six questionnaires.

D. Data analysis

The collected data have been analyzed by three Italian HCI researchers. In order to avoid influences from the DK-Study, they had no knowledge of that study. However, they have been asked to adopt the same methodology. For the closed questions they have made a quantitative analysis. For the open questions they have followed the grounded theory approach: they have individually analyzed the data from each of the open questions and have put codes on sentences. Then, the code for each sentence has been discussed among the three of them, and a single code has been agreed upon. They have individually assigned codes to categories. Again, the individually assignment of codes to categories has been agreed upon in a joint session. This process has resulted in a list of categories and codes, which has been used to get a condensed overview of the results from the questionnaire.

III. ITA-STUDY: RESULTS

This section reports the results obtained by the questionnaire.

A. Understanding of "usability evaluation"

The main important questions the survey addresses are whether the organizations perform usability evaluations and what possible problems and/or advantages they find. Preliminary to this, it is necessary to understand what the respondents actually mean by usability evaluation. Thus a first significant question was "describe what you understand by the concept *usability evaluation*".

The thirty-six answers have been coded in five categories: Evaluation of usability, User involvement, Usability definition, Accessibility test, Do not know. As shown in Figure 1, thirteen respondents have provided an acceptable explanation of usability evaluation. For example, one said: "Usability evaluation is a process to verify that a software product has the following features: short learning time, fast task execution, low error rate, easy to remember commands, high user satisfaction". Another said that usability evaluation "is a set of measures obtained from activities performed to evaluate effectiveness, efficiency, ease of use, etc., of the products that the company produces and/or uses". Five respondents explicitly referred to usability evaluation as a test or a process involving end users (User involvement category); an example is the following answer: "Usability evaluation is a field test, which involves end users who are the target of the system, as well as the customer". We consider this category different from the previous one since we want to highlight the fact that these respondents are not using other usability evaluation methods that do not involve end users, e.g. inspections and analytical methods. Fifteen respondents provided a more or less acceptable definition of usability, thus indicating that they are aware of what usability is, but not of how actually to evaluate it. One organization put more emphasis on accessibility than usability; this can be explained by considering that accessibility of software for public institutions is forced in Italy by a specific

law of year 2003, called “Stanca Law”, after the politician (Stanca) who proposed it. Finally, two respondents explicitly said that they do not know what usability evaluation is (“Do not know” category).

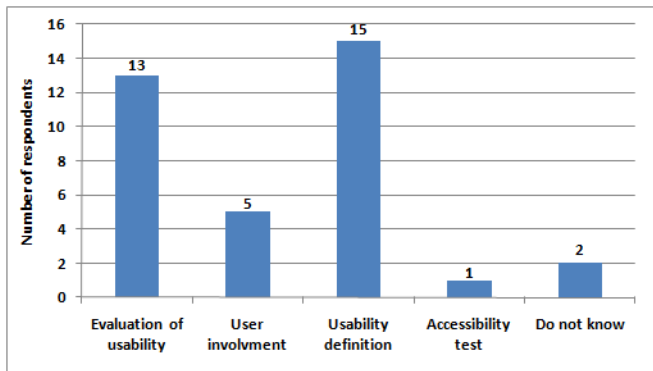


Figure 1. Respondents' understanding of “usability evaluation”.

B. Deployment of usability evaluation

In order to avoid misinterpretations that would compromise the possibility to compare the answers of all respondents in the following questions, the following two definitions of usability evaluation were provided: 1) the analysis of the user interface to identify interaction problems through methods performed by usability experts, with the possible involvement of users chosen from the system's target group; 2) the use of methods to check if the system (and any other possible user guidance) is: easy to learn, easy to remember, effective to use, satisfactory to use and to understand”.

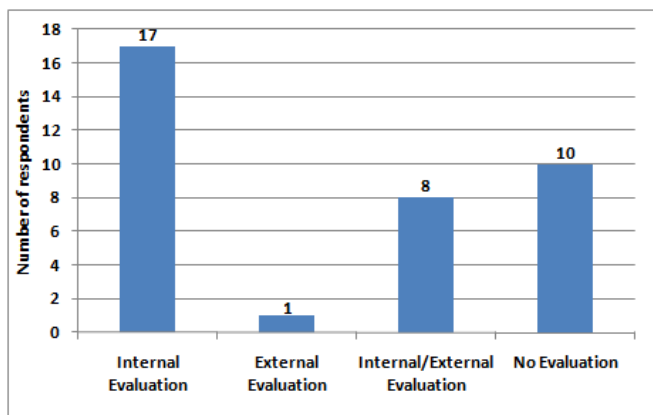


Figure 2. Type of usability evaluation performed by the respondents organizations.

With reference to these definitions, it was asked if the organization performs usability evaluations. Twenty-six respondents out of thirty-six said that their organization performs usability evaluation. As reported in Figure 2, seventeen respondents say that their organization performs usability evaluations internally (i.e. with its own personnel), one performs external evaluations (i.e. performed by external consultants), eight organizations perform both internal and external evaluations. Finally, ten organizations do not execute any usability evaluation, even if four of them say that software

developers are asked to take into account usability principles in their work.

C. Problems in usability evaluation

The twenty-six 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. Answers to this open question have been classified in the following categories, as reported in Figure 3: No suitable methods, Resource demands, User availability, Developer mindset, No problems, Do not know. Some respondents indicated more than one problem.

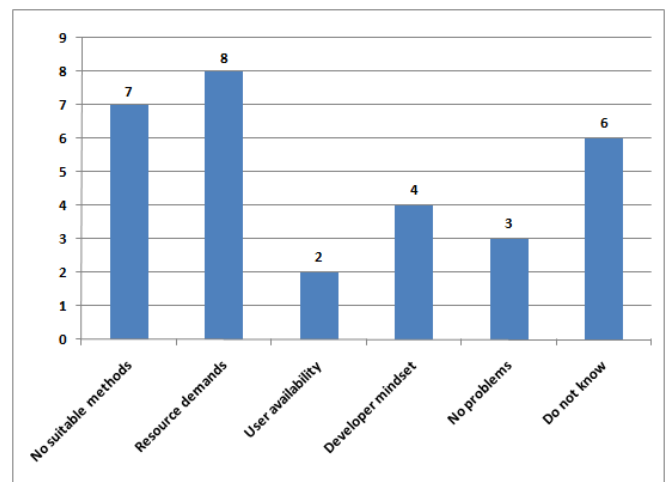


Figure 3. Problems in usability evaluations, as reported in the questionnaires.

No suitable methods. Seven respondents indicated the lack of suitable methods for usability evaluation as one of the main problems. One answer was “Lack of agile methodologies for the evaluation”. Another said: “There is no standard for usability evaluation. Each customer has his own specific reality with problems of different types, and this prevents to identify standard methods and metrics which are applicable”.

Resource demands. Eight respondents said another main obstacle to performing usability evaluations is that they require a lot of resources in terms of cost, time, and involved people. More specifically, one clearly said: “There are many problems of time and resource demands”; another said: “There is a conflict between time required by evaluations and the need of resource optimization that the organization has”. Other answers addressed the cost for designing and performing usability evaluations, and the problems to allocate time and personnel to the evaluations.

User availability. As shown in Figure 1, some respondents think that usability evaluation necessarily involves users. Thus, it is not surprising that a problem in carrying out usability evaluation is user availability. Indeed, it is well known that it is not easy to involve users in the evaluations. This is one of the main reasons why methods that are not user-based, e.g. analytical methods and inspections, are often employed in usability evaluations. It is worth mentioning the following answer: “... it is difficult to get the time and resources

necessary to perform usability tests from the customer". It remarks another well known misunderstanding of people working in industry, who often refer to customers and not to real end users. Interesting is the answer of another respondent, who highlights the difficulty, as well as the importance, of involving real users, since "... user testing in a lab often does not provide reliable results".

Developer mindset. This category refers to problems due to the fact that some professional developers still have their main interest on functionality and efficiency of the code, i.e. on qualities of a software system which are of great interest for developers but have no impact on end users. The HCI researchers who analyzed the questionnaire answers proposed different names for this category. At the end we decided to call this category Developer mindset for analogy to the DK-Study. One respondent clearly said that it is difficult to consider usability among the software quality they address in their development process. He also mentioned that they do not allocate specific budget for usability evaluation: we considered this a resource demand problem. It is worth remarking that another respondent explicitly said that "usability evaluation is considered sometimes a waste of time".

No problems. Three respondents have explicitly answered that they did not find any problem. We cannot say whether this means lack of motivation in filling the questionnaire or they actually did not remember any problem.

Do not know. In this category we have grouped six respondents: four have explicitly said that they do not know about problems (one of them said that he is not the person in the company directly involved in performing evaluations); the other two did not say anything explicit about problems.

D. Advantages of usability evaluation

Next question for the respondents who said that their organization performs usability evaluations asked to report the advantages they got in performing usability evaluations. Answers to this open question have been classified in the following categories, as reported in Figure 4: Quality improvement, User satisfaction, Competitiveness, Resource saving, No advantages, Do not know. Some respondents indicated more than one advantage.

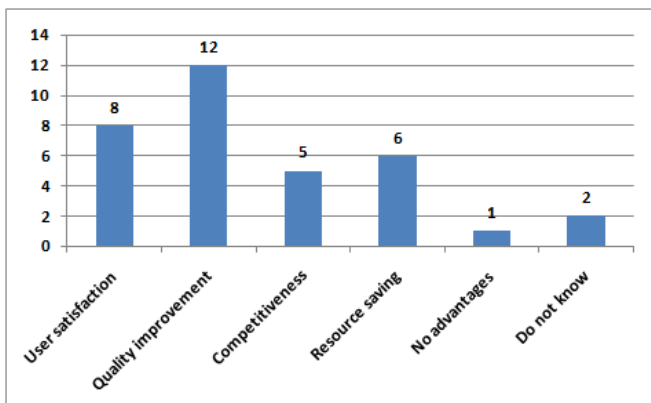


Figure 4. Advantages of usability evaluation, as reported in the questionnaires.

Quality improvement. Most answers pointed out that an advantage of usability evaluation is quality improvement of the developed products. These are some answers: "We can offer a better product to the end user"; "For sure, the product becomes closer to users' needs and expectations"; "The final product is more complete"; "[with usability evaluation] user interfaces keep improving, balancing user requirements and application complexity". A more articulated answer is: "We can increase the involvement of the end user and customer in the development process. It is a cost, since requirements are often completely modified after a usability evaluation. However, the quality of the final product improves, since the customer is active in the development process and that will produce software that is really useful and usable". As we can see, this respondent actually believes that usability evaluation will greatly improve software quality; the consideration about the cost is mainly due to the fact that, as it is well known, when usability evaluation is performed too late in the product life cycle, often it shows many problems deriving from not adequate requirements analysis, and, at this point, redesign would have a high cost.

User satisfaction. Eight respondents explicitly indicated user satisfaction as another advantage of usability evaluation. One said: "Greater satisfaction of final users, especially of regular users". This shows that the organization cares about customer fidelity and is aware that usability evaluation may help in better satisfying its customers. Other respondents indicated that usability evaluation helps ensuring that the final product better meets user needs and foster product acceptability and involvement of final users.

Competitiveness. Five respondents addressed an important objective of organizations, namely competitiveness on the market. In their opinion, usability evaluation helps increasing organization competitiveness as well as customers' appreciation. Moreover, one respondent explicitly mentioned sales increase as an advantage. Another said: "We can improve our business performances". Other mentioned advantages are: "Software will be used by many more users"; "To ttract new customers and improve relationships with current ones".

Resource saving. Despite the fact that resource demand was considered a problem by some respondents (see Section IV C), six answers report resource saving as advantages of usability evaluation. Those people pointed out that performing usability evaluation at right time in the product life-cycle actually reduces overall costs. One respondent said: "The risk to allocate resources for developing products that will have problems in their use is reduced". Another said: "Development costs decrease, thus saving time and money". Other two respondents pointed out cost saving during maintenance and evolution phase after product release, reducing the need of revisions.

No advantages. One respondent explicitly answered that usability evaluations do not give any advantage. Again, it is impossible to say if he does not see any advantage or if he did not pay enough attention to the questionnaire.

Do not know. Two respondents explicitly said that they do not know about advantages since they are not directly involved in performing evaluations.

E. Organizations not performing usability evaluation

Six of the ten organizations that do not carry out usability evaluations have a number of employees ranging from 60 to 200, three have about 50 employees and the last one is a small company with four employees. The structure of the questionnaire was such that, when the respondent answered that his/her organization does not perform usability evaluation, four more questions were presented, the first one was an open question asking to explain the motivations for not performing usability evaluation. One respondent addressed a resource demand problem: "I think that there are not economic and temporal margins to do this type of evaluation". Several respondents reported problems that can be considered in the Developer mindset category. For example, one said: "... our current development process does not include usability evaluation and we do not have expertise for performing them". Another said: "Our company does not have personnel allocated to these activities. I do not know why". A third one mentioned: "Lack of adequate culture". Another respondent provided a more articulated answer: "... many of our products are customizations of existing systems already on the market; in such cases, our approach is to align them to the logic of use of the existing product". This answer shows a clear misunderstanding of the concept of usability and of the need of usability evaluation.

One respondent also focused on the future when saying: "Currently our need [of usability evaluation] is still in its infancy. It's very likely that in the near future metrics and measurements to assess usability during the development of a product will be available". Another respondent said: "Even if in our company there is not a team allocated to usability evaluation, people developing software and performing requirement analysis have to take into account usability principles in their work".

The final three questions for a person who said that his/her organization does not perform usability evaluation were closed questions. The first one asked: "Has it been considered to introduce usability evaluation in your organization, possibly by demanding it from external consultants?". Of the total of ten respondents, three answered Yes, two answered No, and five said Do not know. The second closed question asked: "If the problems that prevent your organization from performing usability evaluations could be minimized, would your organization be eager to perform usability evaluation?". Four respondents said Yes, six said Do not know. Finally, the third question was: "Do you think that the products of your organization could improve with usability evaluation?". Eight respondents said Yes, two said Do not know.

IV. DISCUSSION AND COMPARISON WITH DK-STUDY

Looking at the first important question in the submitted questionnaire, namely the understanding of the term "usability evaluation", only two respondents said that they do not know its meaning, and one emphasized accessibility evaluation rather than 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 (fifteen respondents) without mentioning methods to evaluate it. The

answers provided to the same question in the DK-Study, which has been performed in 2007, show that thirteen respondents actually addressed functionality tests instead of usability evaluation. This indicates that organizations are actually becoming more aware of what usability really is (our study has been conducted during November-December 2010), but either they are still reluctant to evaluate it in the software life cycle or they do not have a clear understanding of how to evaluate it.

The percentage of organizations that perform usability evaluation was also almost the same between the two studies. In the DK-Study thirty-nine organizations were considered: twenty-nine (74%) said that they perform usability evaluation, ten (26%) said that they do not; in Ita-Study, twenty-six (72%) do, ten (28%) do not.

By carefully looking at the other answers provided in the Ita-Study by the twenty-six organizations who said they do usability evaluation, we did not find any indication of problems due to the used evaluation methods: none mentioned difficulties when performing a specific method, when gathering information during tests, etc. This makes us question how carefully usability evaluation is performed by such organizations. Moreover, the answers to the open question about the background of the persons performing usability evaluation indicated that they have the Italian equivalent of Master degrees in Computer Science or in Computer Engineering. In most cases, such persons, especially if they do not belong to younger generations, have very limited knowledge about human factors (HCI courses only recently have been introduced in such curricula).

The results from the DK-Study revealed that the organizations not performing usability evaluations are aware that they would improve their products, but the obstacles are greater than the expected advantages. When the ten organizations in the Ita-Study that do not perform usability evaluation, were asked if they are considering to introduce usability evaluation, only three said Yes. This pushes usability researchers and practitioners to deeply consider how to change this situation, devoting more attention on how to transfer academic work into practical value for industry. 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.

Comparing the problems in introducing and performing usability evaluation, only some category of problems were common to both studies, namely Resource demand and Developer mindset. In the DK-Study, the most frequently mentioned obstacle was "Developer mindset", i.e. many developers have their minds set more on programming aspects, technical challenges and functionality of the product than its usability. The second highest obstacle was the felt "Resource demand" of usability evaluation. Another mentioned obstacle was "Customer participation", which refers to the difficulties to get customers to participate in usability engineering activities. Overall, it emerged that many software organizations lacked practical knowledge about the way usability engineering activities should be conducted. The fact that in the DK-Study there are twelve problems in the category Developer mindset, while in the Ita-Study there are seven, is a further indication

that, as time goes by, software developers are changing their mind, becoming more aware of what usability is and of the importance of usability evaluation.

The DK-Study identified two further categories of problems, called Test participants and Customer participation; the first one refers to the difficulties in finding and motivating users to participate in usability tests; the second one refers to the difficulties to convince customers of the value of usability evaluations and getting them to participate actively in a project. In the Ita-Study, none mentioned the importance of involving customers in the project. Two respondents mentioned the difficulties in finding users to be involved in usability tests. Thus the category User involvement in the Ita-Study is equivalent to the category Test participants in the DK-Study. The last category in the DK-Study is Conducting test, which refers to problems regarding the way tests are conducted. None of the respondents mentioned similar problems in the Ita-Study; instead, another category in this latter study is No suitable methods, since the lack of methods suitable to be used in industry was indicated as a problem by seven respondents.

Considering advantages in conducting usability evaluations, in the Ita-Study "Quality improvements" was mentioned most frequently, followed by "User satisfaction". The DK-Study revealed an almost identical tendency with respect to categories and their ordering. In that study "System improvements" was mentioned by sixteen respondents followed by ten mentioning "Customer satisfaction"; five named "Marketing value", i.e. the equivalent of Competitiveness. However, the category "Resource saving" found in the Ita-Study was not found in the DK-Study.

V. CONCLUSION

This paper reports from a survey of the practical impact of usability engineering in software development organizations. The survey was conducted in Southern Italy during November-December 2010. It replicated a survey conducted in Northern Denmark three years earlier. The results show differences in the understanding of usability, where the concept is better understood by the Italian respondents. This shows that, as time goes by, software developers are becoming more aware of what usability is and of the importance of usability evaluation. The amount of organizations conducting some form of usability activities is nearly the same. The key advantages emphasized by the respondents are product quality, user satisfaction and competitiveness in both surveys. The problems emphasized differed more, with more practical problems emphasized in the DK-Study.

We are planning to complement these studies with more in-depth understanding of the advantages and problems of usability engineering as they are perceived by the individual organizations. Moreover, it would be worth focusing on software developers who are motivated to increase the usability of the products they develop. The key question to be addressed is why developers who are clearly motivated do not increase the adoption of usability engineering methods in their

development processes. Once more data will be collected, it should be useful to analyze the correlation between organization characteristics (size, sector, process in use, activities performed etc.) and the adoption of usability engineering methods. Finally, the use of ethnographic methods could provide another means to get an in-depth understanding of the socio-technological realities surrounding everyday software development practice [15], thus providing other hints on how to overcome obstacles to a wider account for usability engineering.

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