

# Integrating the User Centered approach in the design of Command and Control systems

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## **ABSTRACT**

We conducted an enquiry on the usability practice of different industries in order to discover the most powerful strategies in implementing the User Centered Design (UCD) process. Most important factors are sharing the usability goals with the customer, considering UCD as a business strategy, using UCD in competitive analysis and communicating UCD values outside of the company. Analysing our situation we have started building up a baseline of usability requirements, specific to our task domain, which can improve the negotiation between the customer and the supplier of the systems and consequently lead to a better integration of UCD within the company.

## **Author Keywords**

Computer Human Interaction, User Centered Design, UCD Integration, Command and Control, UCD Survey, Usability Requirements.

## **INTRODUCTION**

Within Thales Naval Nederland (TNNL) UCD has been applied for 4 years as an iterative, model-based process in the design of the man-machine interface of command and control systems. The process employed is a tailored version of Usage Centered Design [1], particularly focused on the modeling of the tasks and of the interaction. The former system has been redesigned through this process and now provides a better support to the work of the operators.

Anyway, we are still not satisfied with the current UCD implementation into the company. We considered first to define and assess our process through a capability maturity model.

Capability maturity models (CMM) have been employed for more than a decade to assess the maturity of the software/system engineering process; a number of CMM have been proposed specifically for the HCD/UCD processes [2,3] as well. While these reference models are valuable for process assessment and process definition, we wanted to understand how to evolve our position within the company. What are the strategies that other UCD practitioners put into practice? What are the obstacles that they must face? We decided to design a web-based survey [4] in order to discover which are the most common

obstacles and strategies in implementing the UCD approach<sup>1</sup>.

## **SURVEYING THE UCD PRACTICE**

### **Definition of the Sample**

Research sample includes UCD practitioners in the industry, spanning from large companies and corporations (Computer, Financial, Telecommunications, etc.) to small, specialized consultancies. We gave the communication of the web survey via e-mail, to the major newsgroups and forums related to usability and UCD (ACM-SIGCHI, IDX, UK-usability, BCS-HCI among the others). 83 practitioners successfully completed the web survey in a time frame of 40 days. Most of them are human factor specialist (34%) or user interface designer (33%) and have between 5 and 13 years of UCD experience, with a minimum of 1 and a maximum of 45 years. They come from different business sectors, with most of the companies following two patterns:

1. Big companies with more than 1000 employees;
2. Small sized (<50), independent usability consultancies.

### **The first pattern**

According to the first UCD integration pattern, the concentration of UCD practitioners in a company is comparable to a drop into the ocean: on the average 2-3 practitioners over 1000, less than 1% of the total number of employees of the company. Moreover, UCD activities are still mainly funded through the R&D budget (48%), much more than bill-back by projects (36%) and annual budget (31%): this means that UCD is still seen as research, not incorporated into the mainstream processes.

How many years ago was UCD first applied? Most of the companies have started applying it since a not so short time, between 2 and 6 years ago (Figure 1): in the same timeframe in which the RUP got a grip in the software industry, UCD has barely put down its roots on it.

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<sup>1</sup> The questionnaire and the raw data are not attached due to space limitations, but they are available on request from the authors.

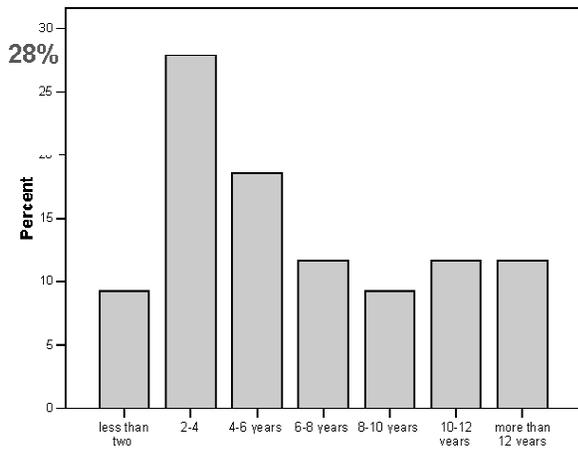


Figure 1. How many years ago was UCD first applied?

**The second pattern**

According to the second pattern, usability consultancies employ less than 50 people (100%) and have a high ratio of UCD employees instead. More than half of them are organized in teams and are funded at the project level.

The second pattern shows globally a very well integrated approach; this is not a surprise since UCD is their main business activity.

**Manager commitment**

What about the commitment of the managers? Here we got apparently contradicting figures: while 61 percent of them thinks UCD to be part of their business strategy, they usually do not set usability goals (only 25% do), nor do they usually compare the usability of their products to that

of their competitors through competitive analysis (again, only about 40%).

It seems that, when applied, UCD is mostly considered as a selling proposition, without seriously incorporating it into the business of the company. As a result, when we face an economy downturn, usability funding is cut, as if it was “unnecessary luxury”.

**Most used methods**

In the survey we asked also what kind of methods and techniques have been employed in a chosen, representative project.

Prototyping is obviously the most used approach during the design phase (Figure 2), in its low-fidelity and high-fidelity variants. An interesting trend is the substantial similarity between the two figures of the low-fidelity and the high-fidelity approach: the low-fi prototyping is more used in the analysis phase, while the high-fi in the design phase. Some years ago the low-fi variant scored much higher [4], which is due probably to the improvement and/or the release of new prototyping tools. Prototyping is quite often coupled with formative, qualitative usability testing (about 60%).

In the evaluation phase (Figure 3), observation and formative usability evaluation still score quite high, while summative, quantitative usability evaluation scores only 27%.

Expert and heuristic evaluations are much less used today (38% during design and 33% during test) than some years ago [6], where they were used by about 70% of the practitioners.

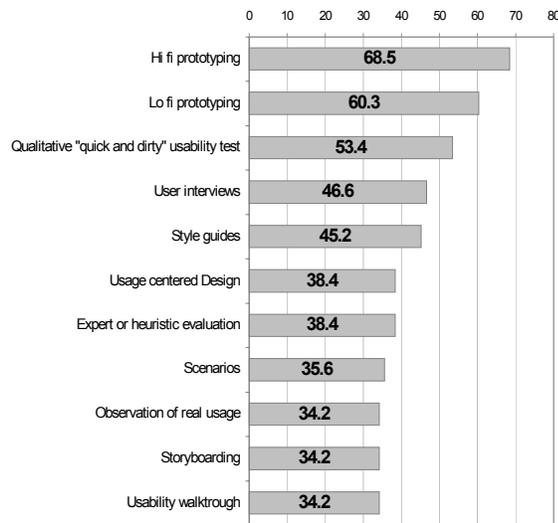


Figure 2. Methods most frequently used during the design phase

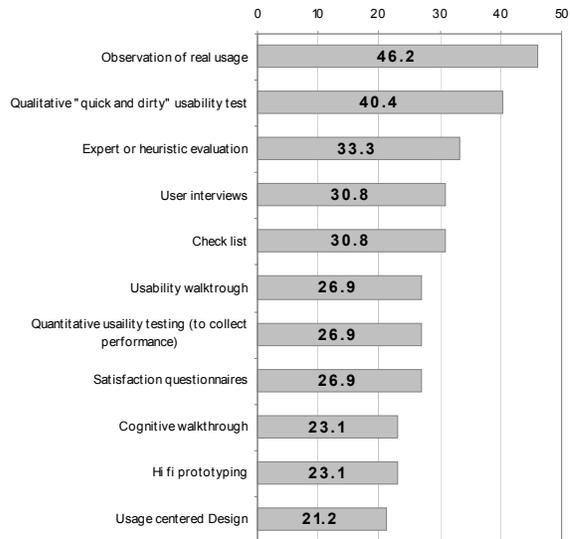


Figure 3. Methods most frequently used during the test phase

Overall, the “user interview” is the most frequently used method over the whole lifecycle, since about 80% of the surveyed UCD practitioners used it at least once.

**The importance of UCD integration**

In our study [4] the descriptive analysis shows a cluster of companies that are achieving success in the implementation of UCD. We applied therefore other types of analysis (ANOVA, factorial) in order to select the most relevant factors. The most relevant set is made by “sharing the usability goals with the customer”, “UCD as business strategy”, “UCD in competitive analysis” and “Outbound communication”. All of those factors are significantly related to the number of practitioners in the company and the budget spent in UCD activities.

The importance of integration is therefore very high in the achievement of UCD benefits. While the process model and the UCD skills and knowledge are often available, like in our case, the factors related to the management, the infrastructure and the communication of usability are otherwise underestimated.

**DISCUSSION**

The findings of this study cast under a different light our current implementation of UCD. While we employ experienced professionals and an up-to-date process models, our approach is still lacking from the point of view of integration: the number of UCD practitioners is low, usability requirements, if defined at all, are a source of conflict with the customer, UCD is not part of the business strategy, UCD is not used in competitive analysis and outbound communication is barely carried out. Our integration level is therefore low; we can predict that on a Usability CMM assessment we would score for most of the practices at the first or second maturity level (“initial” or “managed”).

Some of those problems, like lack of competitive analysis cannot be solved in our domain, because it is difficult to compare our command and control systems with those of different companies, while the communication can be easily addressed putting more resources into it. Improving the sharing of the usability goals with the customer, instead, requires more effort to be solved.

**The open issues**

Started in the innovation department, the UCD approach got progressively positive feedbacks from the programs management and at the moment it is more funded by programs than by R&D budget.

Anyway, there are three open issues to be solved yet:

**P1.** In projects there is often hardly any involvement of the customer in the domain modelling; the context of use is seldom used as guidance for the design and, as a consequence, it is impossible to define the usability requirements for the interface.

**P2.** It is very difficult or impossible to get feedback from the user after the product is deployed, unless the program clearly specifies it: usability tests are seldom employed in most of the military programs in Europe.

**P3.** The Usage-centered approach was accepted because it is fitting quite well in the whole Rational Unified Process and because it is founded on a structured analytical design process (Domain → Task → Interaction → Implementation) and therefore culturally close to the traditional engineering culture. Anyway, it does not really impact, as intended, the degree of user involvement in the design process.

**Setting up a baseline for usability requirements**

Through a number of internal interviews we found out that most of the suspicion towards usability is grounded in practical problems, common with other industries, especially those that design and build safety/mission critical systems.

In our domain requirements are specified through a formal process, which involves the customer, the supplier, procurement agencies and research institutes. Specifying usability requirements can be tricky especially because requirements are later used in acceptance tests, and usability involves not only the capabilities of the system but also those of the team involved.

Requirements have a legal value and they specify the features of the system being delivered. But what if the system includes also the user? As suppliers, how can we avoid the risk of being rejected for the results of a usability test, which may go wrong because the team was not properly manned or trained?

Usability requirements bring different degrees of risk to the customer and to the supplier [7]: while performance measures (“*Expert user shall perform task Q and R in 5 minutes*”) push the risk on the supplier, other requirements, at the design level (“*Systems shall use screen pictures in app xx, buttons work as app yy*”), as well as development

Usability requirements	Risk	
	Supplier	Customer
<b>Problem counts</b> R1: At most 1 of 5 novices shall encounter critical problems during task Q and R. At most 5 medium problems on the list		
<b>Task time</b> R2: <u>Novice users</u> shall perform task Q and R in 5 minutes. <u>Experienced users</u> shall complete tasks Q and R in 1 minute.		
<b>Keystroke counts</b> R3: Assigning a track shall be possible with 5 keystrokes/(or within 30 seconds for an expert users)		
<b>Opinion poll</b> R4: 80% of users shall find system easy to use. 60% will find it pleasant to use.		
<b>Product-level requirements</b> R5: For all of the code fields, user shall be able to select from a drop-down list		
<b>Development process requirements</b> Three prototype versions shall be made and each of them will be tested with users.		

**Figure 4. A baseline for usability requirements**

process requirements (“*Three prototype versions shall be made and usability tested during design*”) bring more risk to the customer, because they do not necessarily imply that a usable system is provided.

We started therefore to build up a solid baseline of usability requirements (examples in Figure 4) for our domain that can minimize the risk for the supplier and the customer and that can be used as a reference for future and existing programs.

### **CONCLUSIONS**

We carried out a web enquiry in order to discover the obstacles and the most successful strategies in the implementation of the UCD approach. We found out that the integration factors are relevant in the achievement of a significant impact on the company business. In our company the integration of UCD is still modest: negotiation and definition of usability requirements was a critical point in the establishment of the UCD practice and it has been addressed first.

### **ACKNOWLEDGMENTS**

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