IASDR07
INTERNATIONAL ASSOCIATION OF SOCIETIES OF DESIGN RESEARCH THE HONG KONG POLYTECHNIC UNIVERSITY 12TH TO 15TH NOVEMBER 2007

# BARRIERS AND ENABLERS FOR USABILITY IN PRODUCT DEVELOPMENT; PRELIMINARY RESULTS

## ABSTRACT:

To study how companies deal with usability in the development of electronic consumer products and to identify aspects of product development that impact usability positively (enablers) or negatively (barriers), case studies were performed among 5 international product development companies. Within each company people performing roles that impact usability were interviewed, with a total of 36 interviewees. Currently the interviews are being analyzed and preliminary results are presented on the issue of after sales feedback.

## 1. INTRODUCTION

> In my opinion, a case study approach is both the only practical way to produce a body of knowledge for applied usability, and the most effective. First, products get made all the time, and much usability work is applied to them. It makes sense to learn all we can from our own practice. Second, the development of real products is the only context sufficiently rich to produce the kind of nuanced examples that are needed to develop a differentiated and contextualized understanding of methods and techniques needed by practitioners. An accumulation of case studies might even permit meta-analyses to be conducted that would help in suggesting patterns that can be generalized across cases. (p.31, Wixon, 2005)

In the past years, the field of usability has developed considerably; both the academic world and in the product development practice. Much work has been done on defining usability (Nielsen, 1994; ISO, 1998) and developing a methodological basis (Nielsen and Mack, 1994; Kwahk and Han, 2002). In the meantime many companies have, to some extent, implemented usability engineering in their development process. Despite the increase of knowledge about usability and the increased focus of the industry, the usability of consumer electronics leaves much room for improvement. There seems to be a gap between theories on usability and the effective integration of theories into practice (Norman, 1996; Wixon, 2005).

Most of the current literature about the practice of usability engineering features self-reports (Wiklund, 1994; Böcker and Suwita, 1999) in which usability practitioners present a description of their own practices or a specific case. Very few descriptions of the usability practice provide a comparison of different companies, such as in Madsen (1999). Madsen's study allows the identification of issues that emerge across companies. Studies that do include multiple companies paint a general picture of the practice through questionnaire-based surveys (Vredenburg *et al.*, 2002; Gulliksen *et al.*, 2004; Venturi and Troost, 2004).

Although questionnaire-based surveys provide insight into the practice, they might include a certain bias because of their self-reported nature, as pointed out by Vredenburg *et al.* (2002). With regard to (self-reported) case descriptions by designers and usability specialists Lindholm *et al.* (2003), working at Nokia, make the following remark: "Reading such material from a Nokia point of view … creates ambivalence. How can they (colleagues that report the cases, ed.) keep the whole thing on track so well?" In some instances self-reported cases seem a bit 'positive'.

As a consequence the current literature does not provide a coherent insight into the practice of usability in product development. We have set up a study in which we aim to identify issues in product development that influence the usability of electronic consumer products. The focus is on electronic consumer products, as this is a product category that is featuring an increasing number of usability problems (van Kuijk *et al.*, 2006). Den Ouden (2005) points out that in the electronic consumer product industry, products are increasingly complex, the time-to-market pressure is high, the economy is increasingly global and consumers have a decreasing tolerance for quality problems. The latter makes usability an essential product quality, while the circumstances in the industry ask for the development of methods, tools and techniques that take into account the context in which they are supposed to be used.

# 2. METHOD

The goal of this study is to obtain insight into the current practice of product development of electronic consumer products, with a focus on usability issues and to identify barriers and enablers for usability in the product development process. To get this insight, we have chosen a case study approach, which is a suitable methodology to study a current, real life phenomenon in its context (Yin, 1994). In order to be able to perform an exploratory case study that offers the opportunity of cross-case comparisons, our case study was interview-based (relatively time-efficient), and performed amongst five internationally operating developers of electronic consumer products.

## 2.1 CONCEPTUAL FRAMEWORK

In order to identify the issues and actors that influence usability in product development, we performed a literature survey and conducted exploratory interviews. In the literature survey we focused on publications that provide descriptions of usability in practice: product development cases, descriptions of usability departments, questionnaire-based studies of the usability practice and usability methodology-issues that arose in practice. To supplement and verify the information found in the literature study, exploratory interviews were held with four usability experts.

The issues and the role of actors that were identified, were integrated in a conceptual framework, as described in Van Kuijk *et al.*, 2007. We opted for a multi-actor, integrated approach towards usability development, acting on the assumption that the usability of a product can be influenced all throughout the product development process, and by a multitude of actors. A product manager, who defines the user requirements in an early phase, can define to a large extent what type of product will be developed. An industrial designer can impact the usability of the product, because in electronic consumer products, the physical controls of the product can have a big impact on usability. And during the implementation phase, the motivation and attitude of development engineers may have a large influence on what parts of the design are actually implemented.

During the literature survey and exploratory interviews that lead to the conceptual framework, the following actors were identified as possibly influencing usability in product development.

- Product manager: coordinates product development, sets the priorities for the product.

- Marketing specialist: collects market information, defines marketing strategies
- Industrial designer: designs the physical appearance of the product
- Interaction designer: designs the user interface of the product
- Usability specialist: evaluates and improves the usability of products
- Development engineer: responsible for technological and production aspects

It should be noted that actors might be found under different names in different companies, or a single person might perform several roles. We therefore used working definitions of the roles to communicate to our primary contact within each company which actors we would want to talk to. In total 36 actors were interviewed.

## 2.2 CASE SELECTION

Because of the exploratory character of the study it was considered recommendable to include multiple cases, to be able to make a comparison of the situation in different companies. The combination of several case studies is often considered more compelling, and such a case study design is therefore regarded as being more robust (Yin (1994) quoting Heriott and Firestone (1983)). Within each case study we did not focus on the development of one particular product, but on the product development activities of the business unit or company. We studied large-scale companies, because of the complexity of these organizations. We assumed that in these organizations employees would have a distinct role in the product development team, such as usability specialist or product designer. Five development groups in Asia and Europe participated in the study, which were active in the following product categories: portable audio and video, mobile telephones, laundry care, home controls (heating, ventilation, security) and mobile navigation systems.

## 4.3 DATA COLLECTION

We conducted interviews using the general interview guide interview (Patton, 1990). In this approach the interviewer uses a list of issues or questions to verify that all the topics are covered during the interview, but the sequence of the questions is not determined in advance, nor are the questions exactly worded in advance. This allowed us to explore the subject freely with our participants.

## 4.4 DATA ANALYSIS

The interviews were recorded with audio equipment, and transcribed literally and in full. We then identified and encoded (categorized) relevant sections of the transcripts with a preliminary coding scheme, based on the conceptual framework. In addition it was marked whether an issue that was mentioned by the interviewee would have a positive (enabler) or negative influence (barrier) influence on usability or simply was a description of the situation within the company (neutral). See the sample in table 1. Barriers and enablers were identified on product and process level. A process barrier is an aspect of the development process that negatively impacts the usability, such as not performing usability tests at all. A usability enabler on product level is an aspect of the product that positively impacts the usability of the product, such as a reduction of features and options in the product.

| Original quote | Interpretation | Barrier |
|---|---|---|
| We'll as I said, I think there is a delay, it is slow, and certainly it's just too massive data and the… the data can be analyzed with more, I say more clear, you know, findings. | The data that the usability specialist receives from the customer service center is raw, massive, unanalyzed date, without clear findings. | Poor analysis and presentation/communication of customer service logs. |

**Table 1. A process level barrier for usability, containing the original fragment from the transcript (left), accompanied by the interpretation by a researcher (middle) and the underlying barriers that were identified (right).**

When all the interviews of a case have been analyzed, the barriers and enablers brought up by the interviewees from a case are clustered, to identify what issues were identified by multiple actors, which issues were only were brought up by specific actors, and to identify patterns of issues that were emerging. An overview was made, showing issues that were identified by several actors, but also stipulating where actors had made conflicting statements.

# 5. PRELIMINARY RESULTS

As we are analyzing the data, a number of themes is surfacing that will be refined and complemented by adding the information from the remaining interviews. These themes touch upon a wide range of issues, such as usability being a part of the company strategy, early user involvement, the type and range of product portfolio and the knowledge about the use phase.

Since we used a semi-structured interview approach, it is logical that some themes appear more prominently than others, as we probed our interviewees on certain themes such as communication of usability test results, or the feedback they received after use. It should be noted that even though the interviewees were asked questions about a certain subject or theme, the questions were quite open, offering the interviewees the possibility to express their concerns on the matter. Thus, we encountered topics both inside and outside of the subjects we probed the participants for.

We will go in-depth on one of the themes that are emerging, as an illustration of the information that the study is generating. As the analysis is ongoing we can expect more evidence to surface about usability as a source of after sales feedback. This might widen or tighten our scope, and deepen our understanding of the subject.

## 5.1 AFTER SALES FEEDBACK

After sales feedback is the information that a product development team receives once a product is on the market. We expected that after sales feedback might be important for the product developers, because it would allow them to learn from their actions. This indeed proved to be the case, but the answer to the question what information they received, and would like to receive after product launch, spawned an interesting range of issues beyond the subject of 'learning from your mistakes'. In the literature on the user-centered design practice and usability methods the focus usually lies on the development of the product and not on what happens in practice, and what information can be collected once the product is sold and used (Borgholm and Madsen, 1999; Vredenburg *et al.*, 2002; Gulliksen *et al.*, 2004),.

### 5.1.2 LIMITED KNOWLEDGE ABOUT USAGE

Knowledge about the product usage is considered a critical enabler for usability by several interviewees. When probed on what information they would like to have after product launch, interviewees indicate that they have limited insight into how users handle their products in real life, as illustrated in the following quotes:

Usability Specialist — *You give a task. And by doing that, I mean, it's an artificial need, then they have to come up, yeah. Of course, in the real world there is also more ways to use a product. If you're on a sole particular task there are, you know, you could use different combinations. […] You know, there are lots of different ways of doing it, whilst in a lab, it tends to kind of focus it on, one application, one way of doing it.*

Requirements manager *…it would be very much that usage information, which I'll be interested in seeing, […] what will people really use this box [product, ed.] for? We have a good idea what people can use this box for and we give a lot of different capabilities to the box so that people can use it in various situations. […] But the real feedback that we are very interested in, from a, from a design perspective, would be to say; ok, well… first of all from a functional point of view, what do people do with this box the most? At the moment, there really isn't any way to retrieve this kind of information from the products themselves, you know.*

Most usability evaluation methodologies are aimed at assessing the usability of a particular function, but do not provide an overview of what functions or how often the user will access this function. Knowing what functions users access most frequently provides product developers with an indication what functions should receive more attention during product development, as these are the most important functions in the product. In addition, if a function is not used this might be an indication that the user doesn't know it's there or it's poorly implemented. But, in contrast to websites (and in some cases software) electronic consumer products do not allow for online monitoring of product use. However, one of the participating companies offered a number of services through its product, that made use of a server, which caused the development team to be alerted of a usability problem:

Usability Specialist *The reason to perform that user test was the dramatically low uptake of that particular service, people simply did not subscribe to it, and we got a lot of questions in customer support on how to use this service.*

Manager Software Dev. *Well we really only notice that if it's a live service, such as [X] or [Y], something that we can measure on the server. There we can see how many people connect to it. And we know how many devices we sell, so you can work out in a percentage whether it is used or not and how it is used. […] It can also be that people say like: "I don't understand this feature." And if that's just one person, than we don't really… but if that's a large group, we'll take a second look.*

By monitoring the server logs it was found that one particular service was only a limited number of people that paid for the service were actually using it. In addition, the customer service department received a large amount of calls about how to install that particular service, which also triggered the company to investigate the issue.

In the cases we observed, the time pressure on development projects was high, usability departments were generally understaffed, and the product range could be quite extensive. Under these circumstances it was not possible to evaluate the usability for every product or function. They had to prioritize. Thus it becomes important to know which products have urgent usability issues. In the incident described above, the data from the servers and the customer support was what sparked an in-depth usability study of the service. If the company would not have been conscious of the problem, it would not have set up the usability evaluation and improved its product.

### 5.1.3 CUSTOMER SERVICE FEEDBACK

As can be seen in the quotes above, customer feedback can be a way for product developers to be alerted about usability problems in the product. However, within the same company, another interviewee indicated the following about usability issues in customer service feedback:

Manager Test Team *You really don't hear that much about it. It's more that users probably are starting to get annoyed, but not so annoyed that they will start reporting about it.*

According to the interviewee, relying on users to call customer service to report usability problems might not be a very good way to assess the level of usability of your products. It just provides an alert if usability issues get out of hand, as users only start reporting problems when these are very serious. No report of usability issues in customer service calls does not necessarily mean that no usability problems exist in the product.

For the information from customer support to be of any use to the product development team, the information needs to be communicated by the customer service department to the development team in an appropriate way. Den Ouden (2005) points out that customer service departments might not be equipped to process usability issues, as their classification system of complaints mostly focuses on technical errors. Even if usage problems are documented correctly, attention needs to be paid to how the information is communicated to product developers. The usability specialist quoted below, who monthly received an unfiltered overview of customer contacts, illustrates this:

Usability Specialist *I think it is just too massive, the data, it is just so much that once you see it you're just scared away by all this data, and you know someone should really make use of the data right. […] I think there is a delay, it is slow, and certainly it's just too massive data and the data can be analyzed with more clear findings.*

One of the companies we studied had a customer support department at the same location where the product development team is housed.

Product manager *During the lifecycle of the product, there will be a formal contact with customer support at least once every two weeks. Then we review and make reports that indicate what product aspects produce a lot of calls. But if there is something important, we just stand at each other's desk. And that's one of the reasons why we don't outsource our support team. They're in this building, a few floors down. I have very regular contact with the people that are getting the qualitative feedback, such as "Hey, my product is not working because… or this and that doesn't work." […] But customers also make suggestions, which is one of the reasons why we really want our customer support department in-house.*

The quality of the information that is stored, as well as the informal contact and cooperation between the customer service department and the product development team seems to be stimulated by having an in-house customer support department, and housing it in the same location as product development.

Being housed in the same location allows this company to have a representative from the customer support department as part of the development team:

Product Manager *We have someone from the customer service department in the development team. He will indicate very early-on that a certain choice will lead to a large number of support calls, because the customer will be insecure about this, or doesn't have enough information about that.*

Thus the company uses the information and experience of the customer service department pro-actively in the development process. It is a measure that provides the development team with information that can lead to a better design, without having to perform one single test. This is an example of a way of working that, according to Wixon (2005) is typical for the approach towards usability in an environment where the goal is "to produce, in the quickest time, a successful product that meets specifications with the fewest resources, while minimizing risk." (p.31)

Strangely within this company, that pays so much attention to the communication between customer support and the development team (through the product manager), the communication from customer support to the usability specialist (who is not in the product development team) appears to get less attention:

Usability Specialist *Actually, not much information is supplied… so if I would not know anything, I would have to gather that information myself. That is one my goals […] to monitor more what is being said about us.*

Apparently, the usability department is not considered a target group for the information that customer service collects.

### 5.1.4 CUSTOMER SURVEYS

Maguire (2001) mentions customer surveys as a way to 'capture the subjective impressions formed by users, based on their experiences with a deployed system or new prototype' (p.618). Within the companies we studied they consist of (usually internet-based) questionnaires that are filled out by people that have registered for a newsletter, or that have bought a product and signed up for support or a membership club.

Usability Specialist *Basically consumers who bought a product have the right to register online and then we got the data and we can send a questionnaire to them to ask them what they think about the product after you used it. So that sort thing helps us to understand the real actual experience of the consumer after they bought the product. […] Are there any critical issues that you experience that you can tell us, that you can share with us?*

The feedback of course is self-reported, and there is some concern, among product developers, that simply asking users what they think of the product might not be a reliable source of information.

Requirements Manager *And it's not the kind of thing that you can ask a user, because the, the information is so specific. And also I think that there is a… I think if you ask a user whether they can use the product they bought, they'll tell you they can, uhm.. and don't… tend in their minds to overlook the fact that they struggled to find this specific menu option, because it makes them feel a little bit stupid, because it didn't work out, you know.*

However, this or similar concerns were only expressed by a small number of interviewees.

In the companies we studied, information that was collected through customer surveys seemed primarily aimed at assessing customer satisfaction in general, rather than at identifying usability issues specifically. Although, as indicated, users are given the opportunity to comment on the usability of the product or suggest improvements. In contrast, the satisfaction questionnaires mentioned by Maguire (2001) are almost completely devoted to assessing the quality of the interaction.

## 5.1.5 FIELD STUDIES

The lack of knowledge about product usage can be solved by performing field studies. In surveys of usability practice, field studies are reported to be a popular method (Gulliksen *et al.*, 2004), that is often applied by usability practitioners (Venturi and Troost, 2004). Our data seems to support the fact that usability practitioners appreciate field studies as a method.

Usability Specialist A *Last year I went to the US to see how people use the device and experience it. Whether that was different than in Europe. The interaction in itself wasn't that different, it's just that the [behaviour of consumers] was different, which does affect our products.*

Usability Specialist B *…sometimes to do field, field studies, where we actually take products or prototypes and give them to people and they have them for a, for a while. […] You get passed learnability and look at other things […] So, I mean, that's quite a nice one, where you, where you can have them, doing their stuff in the real world, and coming back in […]*

Although field studies are considered worthwhile, because they generate valuable insights, they are also considered time-consuming, complex and expensive, which seems to limit how often they are applied.

Usability Specialist A *As soon as you go out of the lab, it's much harder, and costly to observe exactly what people are doing.*

Usability Specialist B *What's a pity is that it is a pretty tough procedure. You'll be with them for days. But I think we're not doing these studies often enough.*

The usability departments we studied quite often suffered from a lack of staff and the time pressure that was on the projects they were engaged in:

Usability Specialist B *Well, we're trying to do it regularly, but performing tests is quite labor intensive; preparing and executing a test can take two weeks, easily. We really don't have that time at the moment. I hope that once we expand the team, that it will come back.*

We observed that because of high time pressure and shortage on staff, usability specialists seem revert to methods that are easier to execute and cost less time. One usability department routinely used expert reviews as the only method of usability evaluation. This contrasts with the findings of Venturi and Troost (2004).

However, their survey of the user-centered design practice was primarily aimed at the field of Human Computer Interaction, which might explain the different outcomes.

## 6. CONCLUSION

Product developers of electronic consumer products seem to have a limited insight into the real-world use of their products. After sales feedback can provide the product development team with an indication of the level of usability of the product they made (how are we doing?) and they may get an indication of usability problems that users encounter in the product. These problems can then be investigated further, and fixed in the current or a next version of the product. In our case study product developers got after sales feedback on product use from a variety of sources, such as the customer service department, service server logs, field studies, product reviews on websites and in the media, and customer surveys. From our case study it becomes evident that collecting knowledge about the usability and usage of a product can go well beyond the product launch date. However, attention must be paid to the fact that some after sales feedback methods, such as customer service calls provide more of an indication that there are problems, than what the problems are exactly. The company that was alerted by monitoring server logs and customer service calls of the presence of a usability problem subsequently had to execute usability tests to study the nature of the problem. The fact that most after sales feedback is based on self-reports by the users might reduce the quality of the information.

## 7. DISCUSSION

Literature pays relatively little attention to methods for collecting usability-related information from after sales feedback. This case study shows that, from a usability point of view, this phase can be a very valuable cycle in the development process. In addition to the information that is collected we see a number of advantages of collecting usability information through after sales feedback. Firstly, as after sales feedback is collected when the product is already on the market, it does not take precious development time. In addition, the collection of after sales information is part of the normal procedure for many companies, so no special studies need to be set up. However, attention needs to be paid that the information on usability issues is collected, stored and communicated correctly. Finally, after sales feedback seems especially valuable in the field of electronic consumer products, as the sector moves in short development cycles (Brombacher, 2005). So, much of the information that is collected can be re-used in a next version of the product. For example, in overviews of user-centered design methods, field studies are usually classified as a method to be used as a start of a product development project. Because of the fast and cyclic nature of the electronic consumer products

industry, evaluative field studies into one product can become the informative field study for the next product generation.

## 8. NEXT STEPS

When all of the interviews have been analyzed an analysis per case will be made Within each of the participating companies a workshop will be held with the interviewees, in order to perform a member check of the descriptions and conclusions in the case analysis. When the analyses of the individual cases have been presented and discussed with the parties involved, an overall case analysis will be performed to identify similarities and differences between the individual cases.

But still. One of our interviewees indicated that if you ask users whether they are able to use a product they bought, they might tell you something different than what is actually happening; maybe not even consciously. And we have to admit, the same goes for this study: it is based on what people say, not on what people do. Even though there were good reasons to do so – in a relatively short time we were able to sample a considerable number of companies and actors – in subsequent studies we will aim for supplementary sources of information, such as observation or documentation, to triangulate information from the interviews with other sources of data.

## 9. REFERENCES


Böcker, M. and A. Suwita (1999). Evaluating the Siemens C10 mobile phone: going beyond "quick and dirty" usability testing. Human Factors in Telecommunication 1999, Copenhagen, Denmark.

Borgholm, T. and K. H. Madsen (1999). "Cooperative usability practices." Communications of the ACM 42(5): 91-97.

Brombacher, A. C. (2005). "Reliability in strongly innovative products; a threat or a challenge?" Reliability Engineering & System Safety 88(2): 125-125.

Buijs, J. (2003). "Modelling Product Innovation Processes, from Linear Logic to Circular Chaos." Creativity and Innovation Management 12(2): 76.

Gulliksen, J., I. Boivie, et al. (2004). Making a difference: a survey of the usability profession in Sweden. Third Nordic conference on Human-computer interaction, Tampere, Finland, ACM Press.

ISO (1998). ISO 9241-11 Ergonomic requirements for office work with visual display terminals (VDTs) - Part 11: Guidance on usability. Geneva, Switzerland, International Organization for Standardization.

Kuijk, J. I. v., H. C. C. M. Christiaans, et al. (2006). Usability in the Development of Consumer Electronics: Issues and Actors. IEA 2006, 16th world congres on ergonomics, Maastricht, The Netherlands.

Kuijk, J. I. v., H. C. C. M. Christiaans, et al. (2007). Usability in Product Development; A Conceptual Framework. Concemporary Ergonomics 2007, Proceedings of the English Ergonomics Society Annual Conference 2007, Nottingham, UK, Taylor & Francis.

Kwahk, J. and S. H. Han (2002). "A methodology for evaluating the usability of audiovisual consumer electronic products." Applied Ergonomics 33(5): 419-431.

Lindholm, C., T. Keinonen, et al., Eds. (2003). Mobile Usability: how Nokia changed the face of mobile phones, McGraw-Hill.

Madsen, K. H. (1999). "The diversity of usability practices." Communications of the ACM 42(5): 60-62.

Maguire, M. (2001). "Methods to support human-centred design." International Journal of Human-Computer Studies 55(4): 587-634.

Miles, M. B. and A. M. Huberman (1994). Chapter 4; Early Steps in Analysis. Qualitative Data Analysis; An Expanded Sourcebook. Thousand Oaks, Sage Publications: 50-89.

Nielsen, J. (1994). Usability Engineering, Morgan Kaufmann.

Nielsen, J. and R. L. Mack (1994). Usability inspection methods. New York, Wiley.

Norman, D. (1996). Design as Practiced. Bringing Design to Software. T. Winograd. New York, USA, ACM Press.

Ouden, E. d. (2005). Development of a Design Analysis Model for Consumer Complaints. Department of Technology Management, Section Product and Process Quality. Eindhoven, Eindhoven Technical University. PhD: 165.

Patton, M. Q. (1990). Qualitative Interviewing. Qualitative Evaluation & Research Methods. M. Q. Patton. London, UK, Sage Publications.

Venturi, G. and J. Troost (2004). Survey on the UCD integration in the industry Third Nordic conference on Human-computer interaction Tampere, Finland, ACM publishers.

Vredenburg, K., S. Isensee, et al. (2002). User-Centered Design; An Integrated Approach. New Jersey, USA, Prentice-Hall.

Vredenburg, K., J.-Y. Mao, et al. (2002). A survey of user-centered design practice. SIGCHI 2002 conference on Human factors in computing systems: Changing our world, changing ourselves Minneapolis, Minnesota, USA.

Wiklund, M. E., Ed. (1994). Usability in Practice; How companies develop user-friendly products. Cambridge, AP Professional.

Wixon, D. (2005). "Evaluating usability methods - why the current literature fails the practitioner." Interactions(July + August 2005): 28 - 34.

Yin, R. K. (1994). Case Study Research; Design and Methods. London, Sage Publications.