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USABILITY IN PRODUCT DEVELOPMENT: A CONCEPTUAL FRAMEWORK

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The development of a conceptual framework for case study research on usability in the product development is described. In order to focus the case study, issues and actors that impact usability were identified through a literature study and exploratory interviews. These issues and actors are presented in the conceptual framework, of which the constituent elements are discussed, as well as the use of the framework in the case study.

Introduction

In the past years, the field of usability has matured considerably in 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 generally paint a more general picture of the practice through questionnaire-based surveys (Vredenburg *et al.*, 2002; Gulliksen *et al.*, 2004; Venturi and Troost, 2004).

Though 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. (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 (Kuijk *et al.*, 2006).

A practice-oriented, multi-actor approach

To get an insight into the practice of usability in product development, 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 to be interview-based (relatively time-efficient) amongst five internationally operating developers of electronic consumer products. In order to identify issues and actors that influence usability in product development, we did 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 crosscheck the information found in the literature study, exploratory interviews were held with four usability experts.

Developing a conceptual framework

A broad spectrum of issues was found, ranging from 'core' usability issues, such as the recruitment of test participants, to more general issues such as top-management support. This led us to adopt a case-study setup in which we would not just focus on usability departments, but would study how usability is integrated in the whole product development process (Kuijk *et al.*, 2006). This meant interviewing people from different disciplines and probing whether and how they influence usability and what their attitude towards the issue was. After having clustered the issues that emerged by theme, we arranged them in a conceptual framework, of which a (somewhat) simplified version is given in figure 1. The framework constitutes of the following issues:

Product development

- **Product development process:** the organisation of the product development process forms the primary 'axis' of the framework. In our case we have chosen the milestones and phases from the Delft Innovation Model (Buijs, 2003; Ouden, 2005).
- **User Involvement:** in what stages of the product development, to what extent and in what form product developers involve users in the product development process. Is information collected to determine user needs? Do designers work with users during the design process? Are user tests performed to evaluate the usability of the products?
- **Other considerations:** factors (apart from the user perspective) that may influence decision-making in the product development process, such as business and technology considerations.
- **Product development context:** the environment in which product development takes

place, which is considered at different levels: project team, department, company, or market level. What is the company culture? Is usability an important product property in the market the company operates in? What is the scope and width of the company's product portfolio?

- **Product development activities:** how actors deal with the tasks stemming from the product development process. What processes and tools do they use? For example, a cognitive walkthrough, performed by the usability specialist.
- **After sales process:** how a company organizes the activities that are required after a product has been sold. This includes monitoring product use, giving customer support, providing users with a service through a product (i.e., a mobile phone subscription), and improving the product based on customer feedback.
- **After sales activities:** how actors deal with the tasks from the after sales process. How is information collected at the helpdesk? What studies are done on product use?
- **Communication and documentation:** how communication takes place within and between project teams (including briefings and reports). For example, how are the results from a usability test communicated to the product development team?
- **Feedback:** the information product developers get about their products once these are on the market, and how they get the information, i.e., from reviews, forums or customer support.

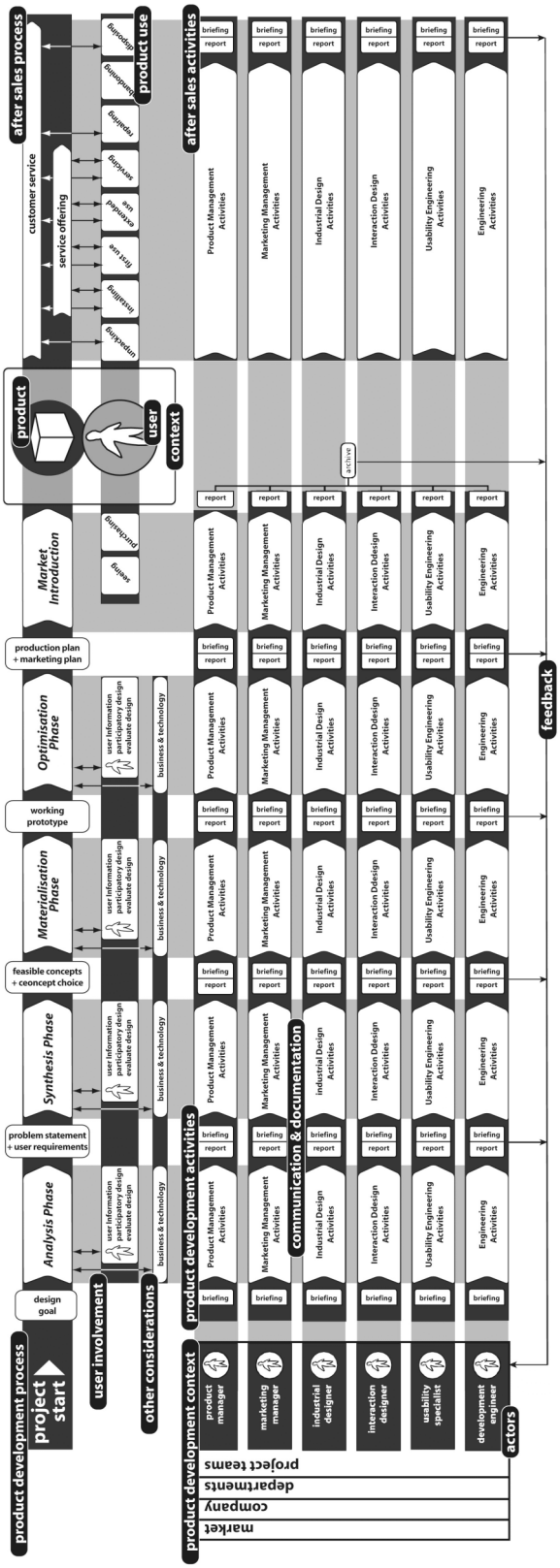

Figure 1. The conceptual framework

Human-product interaction

The usability of the product is not just determined by how well it was developed. Some products are simply more complex (i.e., have more functions) than others, and are therefore harder to use. The 'theoretical maximum' of usability that could be achieved for a product is determined by a number of issues, as articulated in the interaction framework by Shackel (1991). This theoretical maximum could be achieved if product development was performed in an ideal fashion.

- **Product:** The properties of the product that is developed. What and how many functions does it offer (ie., a mobile phone with alarm clock, camera, internet access, etc.) is there a service offered through the product (purchasing songs wirelessly on an mp3-player)?
- **User:** The characteristics and the capacities of the user group (note: not target group) the product will be used by? What are their physical and cognitive skills? Is the user group diverse or focused? What goals do they have and what are their expectations?
- **Context:** in what type of context (i.e. physical, social) will the product be used? For example, will the product be used on the move or at home? Do people use the product individually or in groups?
- **Product use:** what phases of product use can we distinguish and what usability issues can we expect for the different phases? For example in the installation phase, we might find different usability issues than in the extended-use phase (Jordan, 1994).

Actors

The following actors were identified as possibly influencing usability in product development. It should be noted that actors might be found under different names in different companies.

- **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

Use of the Framework

When setting up the case study, the framework was helpful in documenting the issues and actors we would focus on. This in turn was helpful when detailing the setup of the case study. For example, it served as a basis for setting up the topics guide for the interviews with the actors. Conceptualising our frame of reference allowed us to have a better overview of the subject and proved a useful tool in discussions about the study. The visual presentation of the issues allowed us to identify the relations between the issues and actors involved, instead of just clustering them by theme.

The framework is not a static entity; it was continually tweaked to represent the evolving insights of the researchers. It should also be noted that the framework is not a representation of reality; it is a tool to document our frame of reference for the case studies. For example, the product development departments we visit do not necessarily use the product development process as described by Buijs (2003), which is a generic description of product development.

We have currently finished the semi-structured interviews at five product development groups for washing machines, mobile telephones, navigational devices, home control equipment, and personal entertainment devices in Europe and Asia. This resulted in a total of

36 interviews that are currently being processed and analyzed. During the analysis of the cases the framework will be used in two ways. Firstly, when analyzing the cases the framework will be used to present the findings from an individual case, replacing the generic product development process with the process as followed by the company involved. Thus we move from a generic framework to a specific case representation. Secondly, the results of the cross-case analysis will be documented using the framework, to show the differences and communalities we have found with regard to usability at our five cases.

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