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Usability-Engineering in the Context of Product Development: Results of an Experts Focus Group

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Abstract: Effective and efficient usability engineering processes are to be aligned with requirements of the respective business and industry they are to be applied to. Nonetheless abstract, cross-industry standards are necessary and worthwhile to develop a common understanding of state of the art approaches towards user-centered product development and can serve as a guideline for process implementation. This paper presents results of an expert panel on the development of state of the art usability-engineering processes as agreed upon by usability professionals experienced in different industries.

1. INTRODUCTION

Usability engineering aims at the development of products that are efficient, effective and satisfying in their application by the user within a specific use-context (ISO 9241-11, 1999). The probably most commonly known usability engineering processes are the "Usability Engineering Lifecycle" according to Mayhew (Mayhew, D. J., 1999) as well as the "Human Centred Design Process for Interactive Systems" according to ISO 13407 (ISO 13407, 1999). Both processes outline requirements and give recommendations for the development of user-centred products. Features both processes have in common are:

- *user-involvement*

The user is at the core of user-centred product development. It is of utmost important to integrate user-requirements and -feedback as early as possible into the development process.

- *iterative improvement*

Iteration is a process of repetitive application of different actions until a certain aspiration-level is reached (Lidwell, W., Holden, K. and Butler, J., 2004). For both of the processes mentioned above usually the following steps are repeated: requirements-definition, design-solution, and evaluation of design-solution.

- *usability-thinking*

Usability as a product-quality criterion is impossible to be integrated merely at the end of the product development process. Usability-requirements have to be integrated throughout the development process of a product.

In real life the embodiment of usability engineering processes differ across companies. Effective and efficient processes need to be aligned with the respective goals, requirements and resources (i.e. time, money and labour) for each business. So does a suitable usability engineering process for the mobile phone industry, where new product versions need to be developed and released sometimes within months, significantly differ from an adequate process for the automobile industry, where product developments usually take years.

Nonetheless within this paper we pursue the ambitious aim of outlining a general usability engineering process for German industries. Results presented here are part of an implementation project conducted within the EU-Project Sino European Systems Usability Network (SESUN) comparing the practice of usability engineers in the United Kingdom, Germany and China. Within this project procedures and methods of three groups of usability engineers across the above mentioned countries were compared.

This paper presents results of a conducted expert-panel of German usability-professionals on the development of representative usability engineering processes. The focus was on the development of interactive products for the German market and on the development of products to be used in cultures different from that of the country of origin, so called 'cross-cultural usability engineering'.

The paper is organized as follows: First, the applied methodology to elicit common and best practices in terms of usability-processes and -methods for both development cases is described. Then results are briefly discussed for the case of product development for the domestic market as well as for markets abroad. From there interesting findings are highlighted and conclusions are drawn on the state of usability engineering processes in Germany.

2. METHODOLOGY

To reveal the status quo of processes for usability engineering (UE) as well as cross-cultural usability engineering (XUE) and further identify commonly applied usability methods within these processes, a focus group session was conducted with usability professionals employed in different industries (i.e. automobile, mobile phone, web-design and consulting).

After agreeing to participate, respective professionals were asked to prepare a brief overview of an UE- and possible XUE-process that either represents their perception of best practice or their company's practice. They were also asked to prepare a list of preferred methods they apply. At the session processes was to present to the other participants and therefor served as a mean to introduce each other as well as to define one's position. The follow-up discussion then was focused on the following issues:

- Of which stages a common usability engineering process is made up?
- What are the main-events of each stage?
- Who is engaged in which stage?

Constraints of the process to be developed were set as followed: The process should be

- focused on new-product development
- independent of any product class
- iterative.

The methods-list was utilized to identify a toolbox of widely used usability-methods. In order to identify most suitable and widely used methods a delphi-approach was applied building on the participants' experience. The general approach was structured as follows:

First the whole group would gather the important techniques on newsprint. Then each participant was asked in turn to contribute the most important item on their list not already on the whole group list. As they include the most important technique on their list, they must say why they think it is useful. The maximum number of items was fixed to the number of experts in each group. Other members of the group were invited to intervene in case someone feels there were different reasons why one technique is of particular importance or to provide their reasons to challenge this.

Then a multiple-vote procedure was used to rank the items from most to least important (i.e. ranking from 1 to 5 each technique and then adding up the points so that 1st place would be 1 points, 2nd would be 2 and so on). After this each expert had the chance to state what changes she wishes to make to his/her own list in the light of the whole group list. Experts had two choices: either conform to the existing list or provide supportive evidence for including techniques that have not been included in the group list in the first round. Finally, a second voting round was to conduct to 'finalise' the session with the most important techniques.

3. DATA ANALYSIS

The focus group conducted in Germany consisted of usability professionals with various backgrounds, e.g. from the automobile industry, web-design, the mobile industry or from usability consultancies. Participants invested their free-time and were not financially rewarded in any terms.

Even though most participants were engaged in the field of usability engineering for many years already, they were lacking explicit experience in cross-cultural usability engineering. This strongly affected results obtained by the sessions.

While within the first session on UE, rich and detailed information regarding current and best practices was gathered and deeply discussed, the XUE session was a rather shallow and shortened discussion on the surface with less insightful results.

3.1 Usability Engineering Process

The, by the participants jointly developed, UE process was visually finished-up by the researcher with consistent feedback of the participants after the focus group session. The overall process consists of 14 stages with three stages being critical iterative evaluation stages and three critical decision stages.

The first stage is the *product definition* or idea, which initiates the whole process. Consequently this stage is to be seen as the first milestone within the development process. The product idea can be based on someone's inspiring spark, but usually is derived from carefully observing the market situation. Within this stage, the target market, the target users and the target price to be developed for are defined. Also the products unique selling propositions (UPS) are to be fixed. Major stakeholders of this stage are marketing and management.

Within the next stage of *requirements analysis* data about the user and the context of use are gathered. This data represents the foundation for the further product development and also serves as decision basis for upcoming evaluations. Major stakeholders here are usability analysts.

Based on the prior stage, first design propositions are developed as *conceptual drafts*. It is to point out that several drafts are developed simultaneously. The conceptual draft consists of basic functions of the product, interaction modes and applied metaphors. Designers and usability analysts are the major players within this stage.

The developed drafts then are evaluated. Consequently this stage is called *draft evaluation*, which aims at the identification of the best drafts in regard to collected requirements in stage two. Besides the collected user-requirements the expected usability-quality of the drafts are major decision criterions. Usability-tests, expert-evaluations, simple prototypes (e.g. paper-prototype) and scenarios are applicable methods here – all this with real user participation, where possible. But also technological constraints, free production capacities, technology and material availability play an important role when evaluating the drafts.

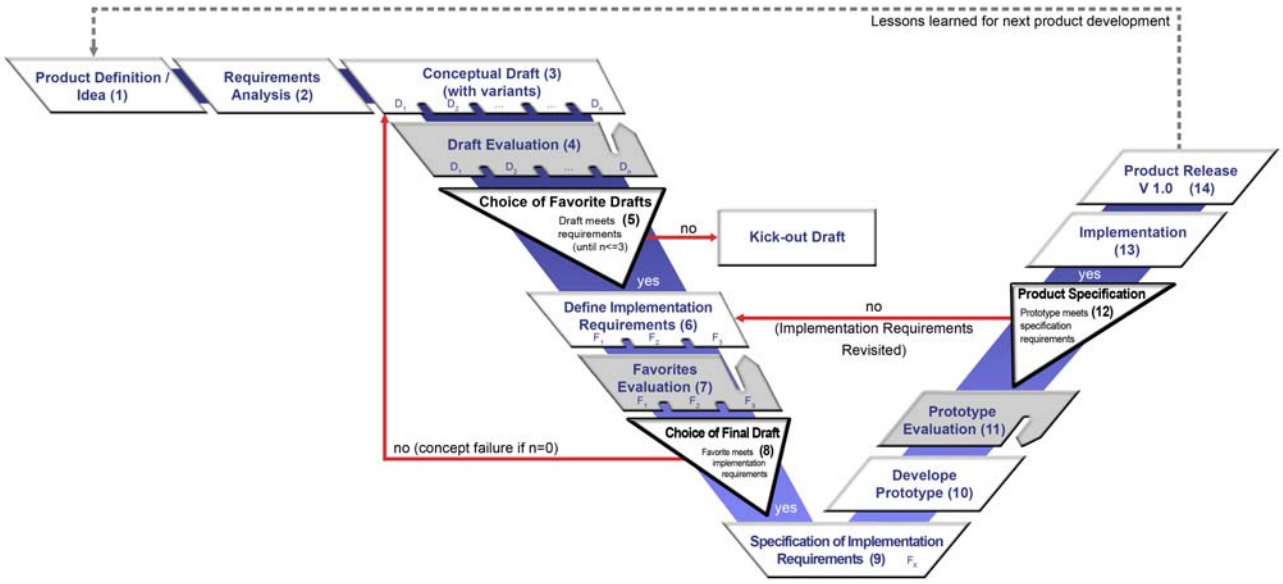

Fig. 1: UE process in Germany

The second major decision of the development process, which is consequently the second milestone of the latter, is the *choice of drafts*. Based on the conducted evaluation in stage four, the best drafts are selected for further development and are hereinafter referred to as favourites. For practical reasons and due to limited resources, the amount of favourites usually is less than four. All other conceptual drafts are not further pursued and kicked out of the process.

For the selected favourites detailed *implementation requirements* are *defined* within stage number six. These implementation requirements should include all requirements necessary for the realization of the draft. That is producibility, supplier scheduling, design-language, platform definition, laws, norms and other official regulations, etc.

Based on this detailed requirements description for each favourite, the latter are evaluated once more within stage seven - *favourite evaluation*. Here the selected drafts are further scrutinized. In the following decision stage it is decided which favourite will later be realized. Consequently out of initially three favourites only one solution will surpass this threshold. In some cases one might just realize within this stage that the product is impossible to be developed as defined within the draft. Even though this risk should be minimized through prior evaluations, in this case the draft development needs to be revisited and scrutinized to resolve identified obstacles.

The detailed product requirements of the favourite surpassing the favourite evaluation is defined in stage nine in terms of the product's *specification*. The specification represents the detailed description of user-requirements as well as the requirements of the product manufacturer.

Based on the specification more sophisticated prototypes are developed in stage ten - *prototype development*. For user-centred product development prototypes are of utmost importance as they facilitate the application of sophisticated usability tests and allow the practical and realistic engagement of the user as opposed to the rather abstract user-engagement within prior stages. Furthermore prototypes are highly required by designers and manufacturing specialists in order to test different possibilities of realization.

Consequently, the stages of prototype development and -evaluation represent a highly interwoven and iterative sub-process, which might also affect the product specification. Once a certain aspiration level that satisfies all stakeholders is reached, the *specification* is *released*. For quality control within the development process, the product specification is of utmost importance as every unit involved in the follow-up development stages is required to deliver the specified functions with the defined quality within the specified time. Naturally, this must be considered as an important milestone within the UE-process.

On this basis, the product *implementation* begins. Here all the requirements to launch the product are to be made. This includes for example the development of production-tools, the implementation of distribution channels, the development of marketing campaigns etc.

Once all this is implemented, the product is ready to go into production and can be released. Findings and lessons learned throughout the development process are documented and utilized to improve future product developments.

3.2 Applied Methods

The second objective of the conducted expert panel was to reveal applied usability engineering methods as preferred by German usability professionals. On this, usability-professionals differentiated between methods that are effective to apply and methods that are 'nice' to apply, that is methods that are elegant, fancy, popular or are fun in their application. This differentiation is an interesting finding in itself as this implies that effective methods are not necessarily the best methods. Hence this differentiation suggests that usability-professionals do not merely pursue one goal when deciding for the application of a suitable usability-method, but a whole goal-system. Hence according to this finding there seems to be a trade-off between different goals pursued. So seem most professionals perceive effectiveness and niceness as mutually exclusive as the table below shows.

Effectiveness

Method	Points
Experte evaluation	6
Context analysis	6
Scenario	11
Eye Tracking	15

'Niceness'

Method	Points
Scenario	8
Eye Tracking	9
Context analyse	9
Experte evaluation	11

Tab. 1: Favourite Methods (less points equals higher rating)

The most effective methods, as perceived by the participants, were expert evaluation and context analysis followed by scenarios and eye tracking. From nicest to less nice methods participants ranked scenarios higher than eye tracking and context analysis which seemed nicer to them than expert evaluations.

3.2 Cross-Cultural Usability Engineering Process

Regarding the cross-cultural usability engineering process participants were somewhat troubled to agree upon one state of the art definition. One reason for this probably can be seen in the focus group composition and current best practice in this field. Most multinational companies developing for international markets – and most participants were employed by multinationals – utilize facilitators within the target market for analysing requirements of the user, the context and the task. Hence, participants had little to no experience in the early stages of the development process.

They pointed out, however, that except the stage of requirements analysis other stages of the development process differed only marginally from the UE-process as described above. The difference in analysing requirements for cross-cultural usability engineering thus is that this is done by local usability experts within the target-market. This implies also that in the follow-up stages the end-user of the target culture is virtually not involved.

For the same reasons usability professionals could not agree on particular methods that are more suitable in cross-cultural context.

4. DISCUSSION

Despite the limitations inherent in this study findings, provide interesting insights into current approaches to usability engineering in Germany. The diverse composition of the expert-panel provided additional insights. So do consultants perceive the process developed as a clear-cut separate unit while the in-house usability-experts' understanding of the usability-engineering process as far more interwoven with other business activities. For the latter the usability-engineering process is not a clearly embodied one, but happens rather parallel to existing processes as a virtual process.

It is to point out that the usability-engineering processes described here needs to be understood as an ideal that in reality probably does not exist in exactly this embodiment. However, the process described represents what usability-professionals consider as best practice. It thus provides support for companies striving to establish a state of the art process.

Furthermore, as this is what German professionals perceive as best practice, it allows the comparison with usability-processes as established in other countries. So do findings of the conducted SESUN implementation study suggest a more matured process of usability engineering in Europe than in China what, however, should not come as a surprise recalling the rather brief history of the usability-profession there. Mainly, this more mature process is manifested by the stronger emphasis on iterations of the UK and the German process. Different levels of process maturity are also supported by the fact that the UK as well as the German processes seem to be more embedded throughout a 'real-life' development process, whereas findings regarding Chinese processes can rather be described as standard text-book approaches.

In terms of usability methods, the further investigation of the professionals' goal-system for method-application seems worthwhile. A clear understanding of what professionals actually expect from a method seems a prerequisite to further

develop existing methods. On top of this the perceived mutual exclusion of effectiveness and niceness of methods as mentioned above should encourage usability professionals and researchers to develop new methods that serve the broader goal-vector of practitioners and in which niceness and effectiveness reinforce each other.

This research also points out significant short comings of usability-engineering endeavours for markets abroad. Not just that no clear process seems to be established to account for cross-cultural product development, methodological practices seem to be in their infancies also. However, the universal and reliable application of 'standard' usability methods across cultures seems doubtful for exactly the same reasons that require the localization of interactive systems in the first place (Clemmensen, T. and Goyal, S., 2005) (Yeo, A., 1998) (Dicks, R. S., 2002) (Nielsen, J., Clemmensen, T. and Yssing, C., 2002) (Del Galdo, E. M. and Nielsen, J., 1996) (Chavan, A. L., 2005). Also seems the commonly agreed upon application of theories and model of cross-cultural psychology and intercultural communication (Gould, E. W., 2005) prone to conceptual and theoretical misconceptions (Fiske, A. P., 2002) (Ratner, C. and Hui, L., 2003). Consequently the whole field of cross-cultural usability-engineering seems worthwhile investigating in terms of theoretical foundations and methodological applications.

This research was intended to shed light into current practices of state of the art usability and cross-cultural usability processes as perceived by Germany usability professionals. Findings presented here can only be understood as qualitative descriptions of what a small subset of professionals perceives as best practice. Limitations of this study are the small number of participating experts as well as their lack in the field of cross-cultural usability engineering. Nonetheless presented insights for the domestic market product development can be justified by fact that these represent consensual state of the art approaches agreed upon by experts experienced in different industries. However, further research needs to verify these findings with quantitative data. Hence, each single stage of the development process and especially each sage's interface to other processes, detailed method-application and key-roles in each stage seem worthwhile to further scrutinize in order to develop a rich genral usability-engineering profile that serves companies and practitioners as a guideline and benchmark for user-centred product development efforts in Germany.

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REFERENCES

Chavan, A. L. (2005), *Another culture, another method*, Proceedings of the 11th International Conference on Human-Computer Interaction (HCII 2005), CD-ROM, 22-27 July 2005, Las Vegas, Nevada, USA, Mahwah, New Jersey [et al.]: Lawrence Erlbaum Associates, Publisher.

Clemmensen, T. and Goyal, S. (2005), *Cross-cultural usability testing: The relationship between evaluator and test user,* Discussion-Paper, Department of Informatics, Copenhagen Business School.

Del Galdo, E. M. and Nielsen, J. (1996), *International user interfaces*, Wiley, New York [et al.].

Dicks, R. S. (2002), *Mis-usability: on the uses and misuses of usability testing*, SIGDOC '02: Proceedings of the 20th annual international conference on Computer documentation, New York, NY, USA: ACM Press, p. 26-30.

Fiske, A. P. (2002), *Using Individualism and Collectivism to Compare Cultures—A Critique of the Validity and Measurement of the Constructs: Comment on Oyserman et al. (2002)*, Psychological Bulletin, vol. 128, no. 1, p. 78-88.

Gould, E. W. (2005). *Synthesizing the literature on cultural values,* Aykin, N. (Ed.), Usability and internationalization of information technology, Mahwah, New Jersey [et al.]:Lawrence Erlbaum Associates, Publisher, p. 79-121.

ISO 13407 (1999), *Human-centred design processes for interactive systems*, Beuth, Berlin.

ISO 9241-11 (1999), *Anforderungen an die Gebrauchstauglichkeit*, Beuth, Berlin.

Lidwell, W., Holden, K. and Butler, J. (2004), *Design. die 100 Prinzipien für erfolgreiche Gestaltung,* Stiebner, München.

Mayhew, D. J. (1999), *The usability engineering lifecycle*, Morgan Kaufmann, New York.

Nielsen, J., Clemensen, T. and Yssing, C. (2002), *Getting access to what goes on on people's heads? - Reflections on the think-aloud technique,* Proceedings of NordCHI 2002, Arthus, Denmark, 19-23 October 2002, New York: ACM Press, p. 101-110.

Ratner, C. and Hui, L. (2003), *Theoretical and methodological problems in cross-cultural psychology*, Journal for the Theory of Social Behavior, vol. 33, p. 67-94.

Röse, K.; Miao, M.; Braun, B. (2007): *Integration von Usability-Engineering in die Produktentwicklung: Ergebnisse einer Expertenfokusgruppe.* In: Röse, K.; Brau, H. (Hrsg.)(2007): *Usability Professionals 2007*. Berichtband des 5. Workshops des German Chapters der Usability Professionals Association e.V., 02.-05.09.2007, Weimar, Germany, S. 131-134.

Yeo, A. (1998), *Cultural effects in usability assessment*, CHI 98 conference summary on Human factors in computing systems. Los Angeles, California, United States, 19-23 April 1998, New York: ACM Press, p. 74-75.