

Integrating Usability Engineering in the Software Development Lifecycle Based on International Standards

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ABSTRACT

The integration of usability activities into software development lifecycles still remains to be a challenge. Most of the existing integration approaches appear to be on an operational level and cannot be transferred to other processes. Furthermore, UE standards and methods are hardly applied. How can organizations be supported in understanding and using this existing knowledge? The approach in this paper focuses on the constellation of standards to integrate UE and SE. Therefore, current development processes and standards will be analyzed and discussed to formulate recommendations for activities. In this manner, a toolset will be established to support the selection of suitable methods, the documentation and communication of intermediary results as well as the definition of competencies.

Author Keywords

Integration; usability engineering; software development; international standards; methods; competencies; recommendations; fields of activity.

ACM Classification Keywords

H.5.2 [User Interfaces]: User-centered design---integration; D.2.0 [General]: Standards

INTRODUCTION

While looking at today's industry usability has been recognized as an important quality aspect in the software development process. However, the integration of usability engineering (UE) and software engineering (SE) still remains to be a challenge in practice [13], even though implications of good usability are obvious: End-users will be able to work more effectively and efficiently with a greater satisfaction. Furthermore, usability is not an exclusive attribute of the generated product; it is also a fundamental attribute for the development process itself. Thus, a systematic human-centered design approach is needed in order to create usable products. Many large-scale

companies have this in mind and already use suitable processes and methods. Science and industry have contributed a lot to address questions and problems in such companies. Usually, such approaches focus on company's specifics and are not applicable in other companies and processes, such as small and medium-sized enterprises (SME). There is a lack of knowledge and experience regarding UE methods and UE standards [14]. Standards are helpful to define predictable and repeatable processes, to ensure a certain quality, and to communicate on a common base of knowledge. Currently, large-scaled companies use and test the added value of standard-based approaches. Current studies show that the application of UE methods in SME is up to 28 percent (sample of 2.000 participating companies), while 53 percent stated that they do not use or rarely use a method. In addition, only 15 percent of the companies indicated that they use one of the referenced standards, e.g., ISO 9241 [14]. An understanding of systematic approaches for integrating usability is not given likewise. No further studies could be found indicating why the use of UE standards and methods is low and if there is a difference between SME and larger enterprises. Hence, one hypothesis is that due to different organizational cultures the staff hierarchy is lower and more expertise as well as the quality of the results depends on a single person within a SME. Further on, there is a shortage of applicable tools regarding the manageable, efficiently and effectively use of methods and reference models for the implementation on an operational and organizational level. Thus, suitable management strategies are needed to implement the quality aspect of usability in a smooth way and to educate or help SME to use and understand UE standards and methods. Nevertheless, the research field of integrating UE is not a new one and some approaches already exist.

RELATED WORK

While looking on existing integration approaches a considerable amount can be found, which primarily take UE and SE into account. These can be organized along four general categories [11, 12]: Approaches that a) concern the concrete implementation; b) present a common specification; c) address the definition of processes and process models; and d) focuses on abstract or generic approaches.

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EICS'12, June 25–26, 2012, Copenhagen, Denmark.

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Category a - Concrete Implementations

Activities and artifacts as well as links to existing SE activities were defined in approaches concerning the concrete implementation. As an example, Ferre [5] specified a set of 51 generic UE techniques that had been reviewed by experts following some criteria, e.g. how adaptable the techniques are to software development processes, how the applicability of the techniques is in general, how much it costs to perform the techniques and how the acceptance is in the field of human-computer interaction. The concepts and the terminology of SE have been adapted in order to ensure the relation of the techniques to SE.

Category b - Common Specifications

Further on, common specifications have been elaborated in the second category of integration approaches. For example, Juristo et al. [8] developed an approach concerning the measuring and evaluation of usability topics using architectural patterns embedded in the system architecture design. Therefore, they identified several patterns of UE and adopted them to SE.

Category c - Definition of Processes and Models

A third group of integration approaches address the definition of processes and process models distinguishing between independent UE models and SE models with integrated UE activities. For example, DÜchting et al. [3] derived practice-oriented recommendations out of discussing existing agile process models (e.g., Scrum or eXtreme Programming [9]) for the implementation of UE activities.

Category d - Abstract and Generic Approaches

Other integration approaches focus on abstract or generic approaches specifying general conditions to be considered for the integration. As an example, Metzker et al. [10] present an 'Evidence-Based Computer-Aided Usability Engineering Environment (CAUSE)' for the organizational level of an organization. They developed a process meta-model supporting the selection of UE methods based on the paradigm of a situation-based decision-making.

Regarding the different types of integration approaches, Nebe [12] differentiates into three levels of abstractions:

- 1) 'Standards that define the overarching framework, [...]'
- 2) '[...] process models that describe systematic and traceable approaches [...]'
- 3) '[...] and the operational level in which the models are tailored to fit the specifics of an organization.'

Shown by the variety of UE and SE integration approaches, a lot of research is going on. However, it can be said that most of the approaches for integration appear to be on an operational level, which results in very specific activities or customized methods (see category a) and b)), which focus on a lightweight integration reducing the organizational or

structural change within an organization. Thus, these approaches cannot be easily transferred to any other situation in practice. Hence, it seems to be promising to investigate in a more abstract view of integration. Approaches out of category c) focus on an interrelation with existing process models. Therefore, these approaches are more transferable than approaches on the operational level. Approaches out of category d) describe general conditions, principles and paradigms as well as meta-models. They are more abstract and meet the idea of standards. The level of standards is a basis to realize a far-reaching and transferable integration approach with both internally and externally organizational aspects. Furthermore, standards are a framework to ensure and preserve consistency and quality within and outside of an organization.

Standards in UE and SE

Looking at UE and SE, different quality- and process-oriented standards exist. Essential for the development process are the following ones:

Usability Engineering:

- ISO 9241-210: Provides requirements and recommendations for human-centered design principles and activities throughout the life cycle of computer-based interactive systems.
- ISO/TR 18529: Process description for human-centered development processes.
- ISO/TS 18152: Presents a human-systems model for use in ISO/IEC 15504-conformant assessment of the maturity of an organization in performing the processes that make a system usable, healthy and safe.

Software Engineering:

- ISO/IEC 15288: Establishes a common framework for describing the life cycle of systems created by humans.
- ISO/IEC 12207: Establishes a common framework for software life cycle processes, with well-defined terminology, that can be referenced by the software industry.
- ISO/IEC 15504: Provides overall information on the concepts of process assessment and its use in the two contexts of process improvement and process capability determination. Also known as Software Process Improvement and Capability dEtermination (SPICE).

While looking on these standards, it becomes obvious that UE and SE development processes are similar to each other and that the integration on the level of standards seems to be promising [6]. First approaches on the level of standards already exist in the technical report ISO/TR 16982. The report addresses the combination of UE and SE and supports the selection of suitable UE methods for the integration in the SE process. Nevertheless, the report only defines 12 method categories, but does not focus on selecting an adequate method. Furthermore, the report does

not take into account the correlation between methods within a development process. The awareness about the existence of UE methods is also prevented by the large amount of existing methods [7]. A good knowledge about their differences and applicability is needed. This is also necessary for the selection of suitable methods. The variety of the partially contrary guidelines for method selection [1] leads to uncertainty among the selecting persons or reduces the openness to use unknown methods. Thus, the effectiveness of SME may be inhibited according to their limited budget and low resources.

Based on the level of standards, integration approaches can be transferred onto given process models and finally onto the operational implementation. All mentioned advantages, like consistency, repeatability of processes, independence of organizations, quality, basis for communication, would remain. General applicable and comparable techniques are necessary to identify concrete lacks in a process. In addition, specific measures are needed to support the selection of suitable methods in the operational business.

According to limited human resources and smaller iterations in a process, the adaption of standards in SME hardly exists. Recommendations for activities and best practices are needed for the integration of UE and the use of standards. This leads us to the following objectives.

OBJECTIVES

According to the challenge of integrating UE and SE, one topic is not to focus only on people who are responsible for usability and software development, but to have also people in mind who are responsible for requirements engineering (RE), quality management (QM) and project management (PM). The hypothesis is that a kind of basic competence has to be continuously established in a project team focusing on results during a project. Roles have to be distributed in an appropriate way. The persons assuming the roles have to be qualified so that they are capable of how to reach a certain goal, how to create a specific result, how to suitably document the result and whom to communicate the result in order to embed it in the project. Hence, the qualification of the project members and their use of methods as well as the quality of the outcomes are necessary in order to establish a long-term added value of UE in the enterprise.

As mentioned above, international standards are not frequently used in enterprises. Nevertheless, standards are a written form of expert's consensus. Therefore, the knowledge aggregated in and the knowledge about existing standards has to be made accessible in order to enrich the integration of UE. This knowledge will be used to achieve the following objectives:

- Educate and help enterprises in using UE methods and standards, while making these more accessible
- Formulating recommendations to use a constellation of standards for the integration of UE in the software development lifecycle.

- Supporting usability specific roles in selecting appropriate methods to achieve a result.
- Supporting project roles in documenting and communicating the results among each other.
- Defining fields of competencies for the roles in software development projects to enable the team members in creating qualitative results.

How to approach the challenge will be presented in the next section.

METHOD

To reach the specified objectives of the PhD thesis, the following approach will be considered (see Figure 1).

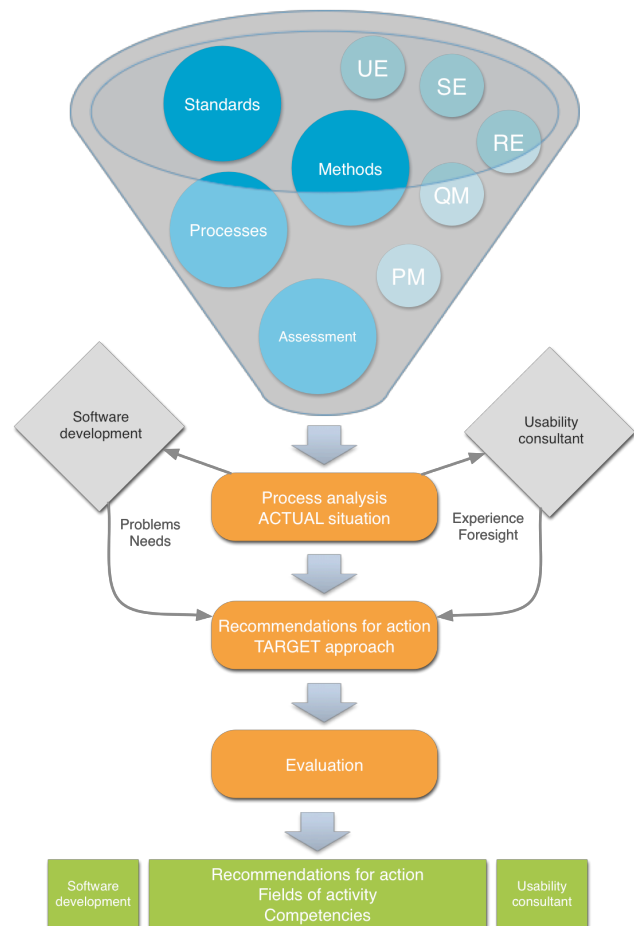


Figure 1. PhD Approach

At first, a scalable assessment method will be developed based on national and international standards (e.g. ISO 9241-210, ISO/TS 18152) as well as on different assessment approaches like the 'Usability Maturity Method: Processes (UMM-P)' [4] or the DAkKS Guidelines on Usability (DE) [2]. It will consist of activities, quality requirements and documentation guidelines. However it is still work-in-progress how this assessment will look like in detail. Using this method, the maturity of development processes out of some companies will be measured in order

to identify point of weakness, problems and needs. This will be done in analyzing the processes of software developing companies and in regarding the knowledge and experience of usability consulting companies likewise. Based on the results, a study will be carried out to identify possible barriers for the use of UE standards and methods in SME in particular. Branch-specific and unspecific aspects will be identified to see which ones support or inhibit the diffusion of integrating UE.

In the next step, recommendations for activities will be formulated. These will focus on statements about using a constellation of standards to ensure the integration of UE activities as well as the quality within the processes. At the same time, the backup of intermediate results and their communication among the project members as well as the competencies in SME will be considered. On the basis of limited resources the members of a project have to perform multiple roles. The aim would be to prevent that the quality of a project is influenced by the competence of a single person. The developed recommendations will be qualitatively evaluated within a project of a SME. They will be integrated in the existing processes. It will be investigated in which way the barriers for standards can be reduced, if recommendations based on standards can support the selection of methods and if the level of usability can be increased within the process. The evaluation protocol that will be used is still in discussion. At the same time, their application will be tested in some consulting scenarios. Thus, the integration of UE and the evaluation of the results will be prototypically implemented. Based on the gained knowledge, a range of services for usability constants and project managers will be developed. This could be a kind of an assessment catalogue to support the acquisition and allocation of resources. In this way, UE activities will be integrated likewise.

CONCLUSION

The integration approach for UE into the software development lifecycle presented in this paper focuses on the level of standards. Standards are based on expert's consensus. They enable consistency, repeatability of processes, the independence of organizations, quality, and a basis for communication. Therefore, standards seem to be promising to enrich the integration of UE. Creating a constellation of standards and linking them to processes should support usability specific roles in selecting appropriate methods, documenting and communicating their results and to define fields of competencies for the roles in software development projects in order to ensure quality.

Currently, standards in the field of usability engineering, software engineering, requirements engineering, quality management and project management are gathered, categorized and linked. Thus, a basis should be created to enable the analysis of SME processes, which will be the next step.

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