# Flexible Engineering Platforms for Barrier-Free Design and Usability Testing

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# FLEXIBLE ENGINEERING PLATFORMS FOR BARRIER-FREE DESIGN AND USABILITY TESTING

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Key-problems of barrier-free design and deficiencies of traditional usability engineering approaches as well as of existing engineering platforms are analysed. Evolution of technologies that support design and production of complex interactive software-hardware systems is presented. Practical steps towards integration of pure engineering technology-driven and usability engineering driven approaches are discussed.

## 1. INTRODUCTION

Growing and frequently changing requirements towards user-centred universal products and systems along with rapid technological evolution demand to develop new generation of engineering approaches and platforms in order to manage these changes effectively and efficiently.

In general these platforms have to support user analysis, design, production, evaluation and maintenance of trustworthy systems that are compatible with humans and with environment and support user's goals and behaviour. Relevant usability engineering processes have to ensure that human needs are satisfied and individual human's resources are enhanced throughout a system's or product's entire life cycle (see Averboukh, 2000).

## 2. TRADITIONAL USABILITY ENGINEERING APPROACHES

**Early end-user participation**

Potential end-users or their adequate representatives are expected to take part in the design process from the very early stages of requirements definition, in evaluating low- and high-fidelity prototypes and final product.

Along with apparent advantages the implementation difficulties and costs of such approach are rather high and often not manageable particularly for small and medium product/system manufactures. Compromise is usually made by conducting very limited number of tests only regarding critical product functionalities with any test persons available using so-called low-cost usability testing methods (Rubin, 1994).

**User Modelling**

Information and/or patterns of human behaviour for specific user categories are acquired and/or directly measured and formalised in a form of so-called user models that are embedded into the user interface of interactive systems or products. These models may be quasi-static, i.e. do not change for an individual users during a certain period, and dynamic ones. The latter serve the purpose to adjust characteristics of user interface and information presentation to the specific user profile (Gavrilova et al, 1997).

**Model-based User Interfaces**

In order to provide off- and on-line adaptation of user interfaces to the target user categories, their goals, tasks and their average or individual capabilities (visual, audio, bio-mechanical etc.), different kinds of models, e.g., user task models, situation models, activities models, interaction models etc. are considered. These models represent relevant user-information domains and are imbedded into the user-interfaces along with traditional interface functionalities that manage dialogue and information presentation.

## 3. KEY-PROBLEMS OF BARRIER-FREE ANALYSIS, DESIGN AND EVALUATION

User-centred design have certain peculiarities and difficulties at all phases of product/system life-cycle, as exemplified in the Table 1. The criticality of these problems rises dramatically as far as universal design is considered. Traditional methods for user-knowledge elicitation, usability testing as well as user training and product maintenance etc. are practically not applicable to the „boundary user-categories“, i.e. kids, elderly, disabled etc. That means that barrier-free user requirements in general are much more ill-defined and non-homogeneous, they change with non-equal speed for different user categories under consideration, i.e. are non-stationary. More over it is much more difficult to analyse and to verify or validate both requirements and design solutions. For disabled or handicapped persons not only pure dynamic aspects, but also „synchronous“ operation of products, e.g., together with health care assistants etc. are critical for adequate usability analysis and evaluation.

Table 1

Key-Problems

| Product Life-cycle Phases | User-Oriented Design | Barrier-Free Design |
|---|---|---|
| **1.Require-ments/ Analysis** | 1.1. Users can better *express their wishes*/ preferences only looking at/ hearing/ touching etc. final product or at least high-quality prototype<br>1.2. User requirements *change* rather quickly<br>1.3. *Access* to the end-users may be difficult; requirements may be formulated by purchasing personnel, not by users | 1.1. Users *can hardly express* their wishes at all, as e.g. sensory and/or self-expression abilities are reduced or under-developed (elderly, disabled )<br>1.2.Kid's/children's requirements change extremely quick, and very slow or none changes for elderly<br>1.3. Access may be impossible (babies, disabled etc.) |
| **2. Design** | 2.1. Ergonomic *characteristics* are mostly available for working population in developed countries | 2.1. Measuring human characteristics is more demanding |
| **3. Evalua-tion** | 3.1. Difficult to find and screen representative *test persons* | 3.1. *Much more difficult* to find relevant test persons<br>3.2. Traditional „static" and/or „asynchronous" evaluation *methods* mostly *do not work* |
| **4. Sales** | 4.1. Usability is still *not a decisive factor* for purchasing personnel | 4.1.Purchase decision-maker is often unable to evaluate/predict usability |
| **5.User Training** | 5.1. Often inefficient | 5.1.Traditional training methods may be *not applicable* |
| **6.Mainte-nance** | 6.1. When usability problems occur, the amount of hot-line calls can rise significantly. Users make attempts although before they call on-line service. | 6.1. Overwhelming amount of hot-line calls particularly from elderly every time they can not *assess situation intuitively, i.e. without any effort* |

Universal-usability engineering and particularly usability testing approaches have to consider the above mentioned problems. Hence, new and much more methodologically and technologically advanced and flexible engineering platforms that support interdisciplinary product/system design teams are needed. Requirements to such platforms are discussed in the next sections

## 4. AVAILABLE TECHNOLOGICAL PLATFORMS AND THEIR DEFFICIENCES

Following technological platforms that are currently in industrial use for product and/or interactive systems design and evaluation, their advantages and disadvantages for barrier-free design are discussed:

- *Human Measuring Technologies* particularly for remote user monitoring.
- *„Round-Trip" Re-Engineering Technologies* that support software and/or hardware requirements analysis, modelling and simulation, as well as automatic programme code generation and reverse engineering for complex interactive systems.
  Such modelling methods as IDEF, UML etc. are used as de-facto standards in software- and/or hardware engineering industries (UML Guide, 1997).
- *Rapid Prototyping Tools* that particularly allow to simulate high quality user interface and relevant human-system interaction. These stand-alone tool usually may be linked to most popular „round-trip" engineering technologies.
- *Metamodelling Technologies* that particularly provide object-oriented description of alternative modelling methods and present and manage their structure, syntax and semantics within so-called common knowledge repositories or object-oriented data base management systems (OODBMS).

Application of metamodelling technologies allows to overcome difficulties in using different and often incompatible modelling methods and tools during different phases of the system life-cycle by diverse design team members. They provide unified platform for different and permanently changing modelling and evaluation activities along the product life-cycle, speed up the development, improve efficiency of model- and corporate knowledge maintenance and prevent loss of information etc. (Averboukh, Kovrigin &Masing, 1999).

At the same time, the above mentioned technologies are usually used by professionals with different background which hardly understand the roles, activities and professional „jargon" of each other and often use different terminology regarding the same things etc. Such miscommunications and ambiguities in task allocation between team memebers etc. undermine overall design efficiency and usability of technological platforms.

## 5. FLEXIBLE USABILITY ENGINEERING PLATFORMS: FUTURE TRENDS

Bridging current usability approaches (section 2) with available engineering and reverse engineering technologies which are currently in industrial use (section 4) from operational, system and technical points of view is discussed.

Concrete steps towards merging the approaches particularly regarding design, development and evaluation of barrier-free software and software-hardware applications are exemplified.

UML (Unified Modelling Language) is apparently becoming a de-facto standard in these rapidly growing engineering domains. The need and concrete ways of developing common glossary that unifies the terminology of usability engineering activities with standard terminology of basic (software-hardware) engineering processes are discussed.

New metaphors of barrier-free design and evaluation within joint virtual working environments for designers, developers, test persons etc. are presented. New design-team-roles such as metamodelers, domain modelers etc. and relevant changes in engineering life-cycle that lead to higher working efficiency and shorter time to the market are defined.

Market- and technology-driven evolution of design and evaluation engineering approaches and relevant industrial standards, as well as communities of engineering-related professionals within the design teams are apparently dominating over the user-driven ones. The only feasible ways to merge these two „worlds" seem via

- early adjustment and joint maintenance of usability norms, terminology and activities with the existing software or software-hardware engineering standards and technologies;
- revisiting competence development programmes in engineering as well as in human factors/ergonomics.

## 6. CONCLUSION

1. Peculiarities of barrier-free design and evaluation and relevant requirements to the team-support technological platforms are discussed.
2. Design and system engineering teams have to follow certain industrial standards and to use available engineering technological platforms that do not yet consider to a needed extent user-centred design and evaluation requirements.
3. Market and technology driven evolution of these technologies and also of engineering community is de-facto much more powerful and quick in comparison with relevant evolution of usability engineering technologies, standards and professional community.
4. Usability engineering methods and standards have to be adjusted and maintained compatible at different levels with the most advanced flexible engineering platforms such as metamodelling and so-called „round-trip" engineering technologies and norms in order to win relevant recognition in engineering circles and in the every-day industrial practice.

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