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USERfit - Design-for-all Methods and Tools

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What can we do as ergonomists to promote design for all (or at least design solutions that will include a greater number of people)? Perhaps the best answer we can offer comes from Rudyard Kipling:

I have six honest serving men, they taught me all I knew. Their names are
 'What', 'Why', 'When;', 'Where', 'How' and 'Who'
 (Rudyard Kipling, The Just So Stories)

Ergonomists spend much time thinking, reading, watching, asking, listening, recording, and reporting on these questions. And to help us carry out these tasks, we have various things at our disposal: methods, tools and techniques to promote user-centred design and user involvement, as well as guidelines or prescriptions to suggest how the user should interact with the product, how it should look, sound and feel. Such tools help to gather information about the user during various phases of the design process. At each stage of design and development, the process we endorse is an iterative one, ensuring that the original user requirements specification is followed and/or amended by the recommendations of users.

Table 1: User Centred Tools and Techniques

Problem Definition	Analysis / Specification	Evaluation
User mapping	Task analysis	User trials
Brainstorming	Direct observation	Direct observation
	Activity diaries	Questionnaires
	Questionnaires	Interviews
	Interviews	Group discussions
	Group discussions	Field trials
	Empathic modelling	Expert opinions

But the use of these techniques and tools are not always appropriate and easily transferrable to the assistive technology (AT) sector, in particular because of the broad range of user characteristics and requirements that need to be taken into account:

- It may be difficult to obtain a representative sample of users with different types of impairments
- It may be difficult to obtain precise and comprehensive information because the user has difficulty in communicating his or her views
- It may be difficult to obtain precise and comprehensive information because the user is too fatigued or in pain to complete the interview or experiment (or in the case of simulator testing, has possibly succumbed to simulator sickness)
- It may be necessary to use more than one technique to answer a question, thus increasing resources needed to ensure complete user involvement.
- The designer or evaluator may need specialist advice, tips or protocols (e.g. advice on carrying out testing in a driving simulator with people with mobility impairments, or how to ensure successful feedback when involving people with communication difficulties).
- It is necessary that ethical procedures are always followed, which is more difficult to ensure when some participants in the study are not able to give their consent (e.g. people with dementia).

It is also fair to say that many people put into practice a principle of least effort, which means that we will take the easiest way out of a problem. So, rather than investing large resources into understanding the users, their activities, the tools they use and the context in which they are used, we often tend to use what knowledge we have already (sometimes distorting it to make it fit). If we do not have access to that knowledge and cannot adapt what we have, we might use the nearest best thing – perhaps a book, a colleague, our own implicit theories, or as a last resort we might go to a specialist (Richardson 1998). Designers and developers are no different.

Surveys of European Commission (EC) funded projects carried out by the TIDE USER (User Requirements Elaboration in Rehabilitation and Assistive Technology) project emphasised that developers in the telematic community often lacked the skills to effectively take usability issues into account (Poulson and Richardson 1998). And as telecommunications systems and advanced technologies (like speech recognition, robotics and virtual reality) become more prevalent in the assistive technology sector, usability issues become even more

important. Some form of structured design approach and the need to document become especially important when the system being developed is a complex one and when the design team is large and multi-disciplinary. It is then that good communication becomes vital.

The USER project wanted to make human factors techniques, methods and tools more accessible and more relevant to the assistive technology sector. For the first time a structured framework was provided to promote user-centred design in AT development, as well as providing the methods and tools to ensure that this can take place. This was USERfit, developed by the HUSAT Research Institute at Loughborough University (UK), COO.S.S. Marche (IT), and SINTEF Unimed Rehab (Norway), and published by the TIDE Office of the European Commission.

The USERfit Handbook consists of:

- A guide on the subject of user centred design, usability, the principles of user involvement and the significance of user, activity and context characteristics for assistive technology.
- The *USERfit* Methodology: a set of summary tools to collate, analyse, evaluate and develop information to build a specification, along with worked examples.
- Descriptions of different specific design techniques for data capture and evaluation, illustrating when and how to use them in the AT sector.
- A collection of design prescriptions and recommendations concerning the design of assistive technology drawn from the scientific and technical literature.
- A general information section containing a bibliography and information on useful sources of design information.

The USERfit methodology is structured in the following way (Poulson et al., 1996):

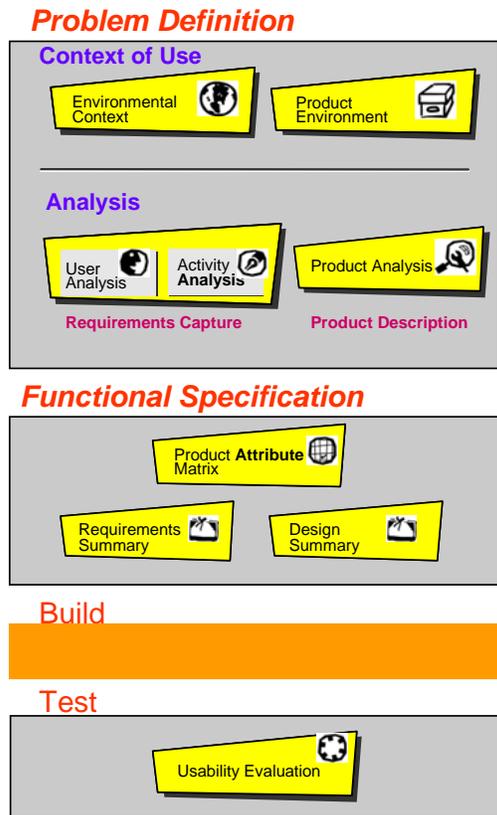


Figure 1: Overview of the USERfit Methodology

A key aspect of this methodology is that it forces design issues to be made explicit. It makes designers, especially those who work in multi-disciplinary teams, ask the right questions and justify and document any design assumptions or decisions they have made, either about the technology or its users (Poulson and Richardson, 1998). However, the methodology is designed to be modular, and can be dipped into where and when needed.

The tools making up USERfit are briefly described below, although for more detailed information on the elements, I refer the reader to the USERfit Handbook itself (Poulson, et al. 1996), or to a summary in Poulson and Richardson (1998).

Table 2: Elements of the USERfit methodology

USERfit tool	Objectives
Environmental context	Provides a high level summary of the product, covering such issues as the initial justification for it, who its users are likely to be, who will purchase it.
Product environment	Summarises what is known about the support environment for the product (including likely training, documentation, installation, maintenance and user support).
User analysis	Identifies the range of people who should be considered in the development of the product, and describes in detail their attributes.
Activity analysis	Identifies and describes the range of activities that people will engage in when using the product and the implications that these will have for product design.
Product analysis	Summarises the functional aspects of the product as they are understood and lists these as operational features.
Product attribute matrix	Summarises the match between emerging functional specifications and product attributes inferred from user and activity analysis.
Requirements summary	Summarises the design features identified through user and activity analysis and their degree of match to user requirements.
Design summary	Summarises in more detail the functional specification for the product and its operational details.
Usability evaluation	Summarises plans for evaluation along with objectives, methods to be used and evaluation criteria. Also documents the degree of match between evaluation criteria and the results of evaluation activities.

(from Poulson and Richardson, 1998)

It is clear that the Handbook can be used by all designers to ensure that they ask the right questions at each stage of the design process, so coming closer to a design that will be usable by more people. This concept was emphasised by a final year student in our new Module at Loughborough University - Ergonomics, Ageing and Disability.

I thank Nessa Thomas, Final year Psychology/Ergonomics student in the Human Sciences Department, for the use of this anecdote from her recently submitted coursework (Thomas, 1999). The case study illustrates an approach to design that could benefit from some reminders to include the needs of all users.

An anecdote on design

Derek the Designer had just received his first promotion for a home products company and was enthusiastic to make his mark in industry. He was also a keen cook, and having just re-designed his own kitchen he foresaw a need for an oven, or cooker, which was more in keeping with the design of his own kitchen and requirements. He often fondly recounted his mother's special dinners for family and friends, although these had lately become less frequent. But then, back at work, Derek designed his cooker, complementing the design with a number of up-beat colours. He incorporated a larger cooking space by lowering the cooker floor and had come up with a control panel so attractive that it would not have been out of place in the most futuristic of movies.

The design was presented to the Board. During the meeting, Derek was asked if he had considered the elderly and disabled user, but he thought of an elderly person sitting in an armchair or wheelchair in a residential home, and quickly dismissed the idea by saying "that the cooker was not targeting that kind of user." The design was passed, and the cooker went into production.

The first cooker from the production line was packaged and dispatched as a well-deserved gift to Derek's mother. However, Derek had not stopped to notice lately that his mother had slowly begun to become frail, her eyesight was failing and due to some confusion over a cooking time and temperature, she had recently ruined some special dinners. She had been too proud to tell anyone of her mistake and since then had completely lost her confidence for entertaining.

The arrival of the cooker reminded her that her children would expect her to cook for them and she could neither stoop to reach into the new oven or twiddle the tiny knobs with her slightly swollen arthritic fingers. The designer had, in fact, forgotten his own mother, and many other important people like her, in his design. It doesn't matter if this is a real story or not. As a good parable, it is still true.

Designers often neglect to collect suitable information on user needs due to a misconception that users are all like themselves. Or, taking the 'principle of least effort', perhaps they think they can predict without needing to spend resources on detailed information gathering. Even when we think we are using the right tools, though, we still need reminding. I made that mistake in a project investigating the use of technology for tracking people with dementia who wander. We interviewed many careworkers and academic experts working in the field of dementia. We spoke to some family members and sent short questionnaires to many others, but we didn't ask the person with dementia, whose views even though garbled, have something important to say. Resources were scarce, the funding ran out, and so trade-offs had to take place.

Maybe something like USERfit can provide the necessary methods, tools and techniques which will help designers to learn more about actual users by asking questions like 'What', 'Why', 'When', 'Where', 'How' and 'Who', and providing a framework to document and discuss the answers.

USERfit - present and future

Since publication in 1996 approximately 2400 copies of USERfit have been distributed. It is also possible to download much of the USERfit handbook from a WWW site supported by the EU funded INCLUDE project (<http://www.stakes.fi/include>), found in the section on user-centred design methods. A number of EC funded projects have applied parts of the methodology in their work (e.g. the ACTION project, which has developed a multi-media system to provide information and support for informal family carers of people who are elderly or disabled – see <http://www.hb.se/action/>). However, to our knowledge no one has used the entire methodology, and the descriptions of the various tools have been reported as the most useful part. Since it is a modular framework, however, this type of use was anticipated and welcomed.

The Handbook has been used very successfully in training ergonomics and design students at Loughborough University, e.g. in our new Ergonomics, Ageing and Disability module mentioned earlier. A number of student research projects have also assessed its usefulness not only in product design (e.g. Whitlock, 1998) but also in relation to design of services (Goffee, 1996). This latter study evaluated the effectiveness of the USERfit methodology in helping to produce a set of requirements for the providers of a tele-marketing service set up by the Enham Trust, a charity providing training and employment for people with disabilities in Andover in the UK. Even though USERfit was aimed at product development and not services, it raised a number of key issues and stimulated debate, for example, with regard to software design and the wide range of training needs of the employees. This again emphasises the value of a structured framework which encourages questioning and communication.

Evidence suggests that, even though USERfit is full of useful information, and a 'first' of its kind, there are some limitations to its use, for example:

- It is too big and unwieldy, making navigation difficult
- It has too many paper-based forms and should be an on-line tool
- More guidance is needed on evaluation methods and protocols

However, we needed to start somewhere, and we feel that the present USERfit Handbook is a step in the right direction towards promoting the concept of user centred design and user involvement in the assistive technology sector. Now we are seeking opportunities to improve the Handbook so that it will not only be more useful to designers in promoting 'design for all', but will also be more usable in itself.

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