Proceedings of HCI International 1999, 22-26 Aug, Munich

Design for usability

Nigel Bevan
Serco Usability Services, 4 Sandy Lane, Teddington,
Middlesex, TW11 0DU, UK, nbevan@usability.serco.com

1 Introduction

Making the information society accessible to all requires both *physical* accessibility and *cognitive* accessibility (Bevan 1999c). Just as physical accessibility means providing the right physical interface, so cognitive accessibility means matching the functionality, terminology, information and interface to the needs of the individual user. The emphasis in systems design has traditionally been on building systems that meet specific functional requirements, without a sufficiently detailed understanding of the cognitive and physical capabilities and expectations of the intended users, or a clear view of the context in which the system will be used.

The benefits of taking a user-centred approach to design have been long recognised (Bevan and Murray 1985, Norman and Draper 1986) and the cost benefits (Bias and Mayhew 1994) and social benefits (EC 1994) have since been widely documented. So why does most design still not have usability as a major goal?

One factor has been the gradual evolution of HCI from a field primarily concerned with the man machine interface (e.g. Bevan 1981) to a broader concern with all aspects of usability (Bevan et al. 1991), developing into a realisation that usability should be the goal of systems design (Bevan 1995), which has recently been formalised in software quality standards (Bevan 1999b).

The recognition of this strategic role for HCI and usability has profound implications for all aspects of systems specification, development and acquisition. But fundamental changes are not easy to achieve, and there are many barriers to be surmounted before design for usability becomes a reality.

This paper reviews some of the barriers, and potential solutions which have emerged from the recent work of European projects and international standards groups, some of which are now being used to promote uptake of user centred design as part of the ESPRIT TRUMP (TRUMP 1999) project.

2 Barriers to user-centred development

Many current development processes do not take a user-centred approach, and thus fail to incorporate feedback from users and identify the full range of user needs.

This was one reason for developing the ISO 13407 standard, which now provides authoritative guidance on how to achieve usability by incorporating user-centred design activities throughout the life cycle of interactive computer-based systems. It describes human-centred design as a multi-disciplinary activity, which incorporates human factors and ergonomics knowledge and techniques, with the objective of enhancing effectiveness and productivity, improving human working conditions, and counteracting the possible adverse effects of the use of computer-based systems on human health, safety and performance. INUSE has developed methods (Daly-Jones et al 1997) to support application of ISO 13407.

ISO 13407 describes the four user-centred design activities that need to take place at all stages during a project: (i) understand and specify the context of use; (ii) specify the user and organisational requirements; (iii) produce design solutions; and (iv) evaluate designs against requirements.

Recently, there has been increasing awareness of the value of user-centred design, and increasing use of RAD-based methodologies, which are compatible with user-centred design. However, many RAD methodologies do not take full advantage of user involvement, often only demonstrating new interface designs to user representatives to gain formal approval. To get the full benefits of user involvement in design means evaluating concrete artefacts, in a work context, using a process driven by business goals and risks (Curson and Bevan 1999).

3 Methodological barriers

Achieving wider usability and accessibility is much easier if developers can adopt well-established general-purpose solutions. This requires appropriate methods, techniques and tools that can be used to improve quality in use. The INUSE project developed a structured and formalised definition of the human-centred processes described in ISO 13407 (Earthy 1998). It can be used in the

specification, assessment and improvement of the human-centred processes in system development and operation.

The model consists of seven sets of activities:

(1) Ensure HCD content in system strategy;

(2) Plan and manage the HCD process;

(3) Specify the stakeholder and organisational requirements;

(4) Understand and specify the context of use;

(5) Produce design solutions;

(6) Evaluate designs against requirements; and

(7) Introduce and operate the system.

The activities provide a comprehensive checklist of what has to be done to represent and include the users of a system during the lifecycle. The model has been successfully used in a one day workshop to identify the needs of an organisation for additional user centred design activities (TRUMP 1999).

International standards for software quality provide additional authority. ISO 14598-1 (1998) and ISO 9126-1 (1999) make quality in use (synonymous with the ISO 9241-11 definition of usability) the major quality goal in systems development (Bevan 1999b). ISO 9241-11 describes how quality in use can be specified and measured, and ISO 13407 specifies the user-centred design process which is necessary to achieve the usability and quality in use goals.

4 Incomplete requirements

A survey by Vintner and Poulsen (1996) showed that the source of 80% of software defects is poor or missing requirements. Of these, only 15% are related to functionality, and of the remaining defects, 60% arise from usability errors. For a design process to take a user-centred approach to the identification of requirements, it must include activities that can capture both usability requirements derived from the capabilities of the end user groups, as well as accessibility requirements for users with special needs.

Traditional approaches to requirements engineering concentrate on identifying functional requirements and ensuring that the developed product meets these requirements. Other non-functional requirements have less importance. Yet from a user perspective, quality in use is critical to successful implementation.

The RESPECT User Centred Requirements Handbook (Maguire 1998) provides a broad framework for requirements engineering which makes meeting user

needs to achieve quality in use the overall objective of the design process. Functionality and usability (in the narrow sense of an easy to use interface) are subservient to the objective of providing a system which enables the user to meet their goals in the real world. Depending on the context of use the user's goals may be business or personal objectives.

RESPECT also introduces additional requirements of two types: detailed contextual requirements associated with scenarios of use, and high level quality in use goals (also called usability goals) for the users to be effective, efficient and satisfied when carrying out their tasks.

5 Practical barriers: undefined context of use

The characteristics of the users, tasks and the organisational and physical environment define the context in which the product is used. It is important to understand and identify the details of this context, in order to guide early design decisions, and to provide a basis for evaluation. This activity is missing from conventional development processes.

An effective way to collect and document the necessary information is to use an annotated checklist of user, task and environmental characteristics, such as, e.g., the Usability Context Analysis Guide (Thomas and Bevan 1996). The RESPECT special needs document (Maguire et al. 1998) gives information on some of the basic requirements of young, old and disabled people and explains in detail how to design systems to take account of their needs.

6 Commercial barriers

A major obstacle to design for usability is the perceived additional cost resulting from the user-centred activities, as well as from the additional hardware and software features that are required to provide wide accessibility. The economic benefits of using user-centred design to improve quality in use for major user groups is now well established (Bias and Mayhew 1994), but there is still widespread resistance to making the investment in skills and methods needed to adopt user-centred design.

Usability will only be taken seriously when it is part of the acceptance criteria for a product, and this requires a means to specify usability goals and assess their achievement. A Common Industry Format for usability test reports is currently being agreed between major American software suppliers and purchasers in an initiative supported by NIST (the US National Institute of Standards and Technology), and in co-operation with ACM SIGCHI (Bevan 1999a). The objective is to raise the profile of usability in the procurement

process, and to demonstrate the consequent benefits of acquiring products with increased usability.

In making purchase decisions, companies and organisations have traditionally had little indication of how usable a product would be, how productive its users will be, or how much training and support its users would need. The situation has made it difficult to compare products, to plan for support, or estimate total cost of ownership. NIST will be collecting data from consumer organisations using the CIF format, to provide evidence of the benefits of improved usability.

This is measured as quality in use: effectiveness, efficiency and satisfaction. This is the approach taken in ISO 9241-11, and operationalised in the MUSiC methods (Bevan and Macleod 1994, Macleod et al. 1997).

7 Conclusions

Surmounting all these barriers needs a cultural change in the expectations and demands of purchasers and users, and a change in priorities in development from meeting technical specifications to meeting the widest possible range of user needs. The ESPRIT TRUMP project is contributing to this objective by demonstrating the value of applying INUSE and RESPECT methods, and making supporting material available on the TRUMP web site (TRUMP 1999).

8 References

[Note: papers and deliverables by the author and associated EC projects are available from http://www.usability.serco.com]

Bevan, N. (1981). Is there an optimum speed for presenting text on a VDU? *International Journal Of Man-Machine Studie*s, 14, 59-76.

Bevan, N., Kirakowski, J., & Maissel, J. (1991). What is usability? *In: Bullinger HJ) Proc. 4th International Conference on HCI, Stuttgart, Sep 1991*. Elsevier.

Bevan, N. (1995). Measuring usability as quality of use. *Journal of Software Quality*, 4, 115-130.

Bevan, N. (1999a). Common industry format usability tests. In: *Proc. Usability Professionals Association Conference* (Scottsdale, Arizona, May 1999).

Bevan, N. (1999b). Quality in use: meeting user needs for Quality. In: *Journal of System and Software* (in press).

Bevan, N. (1999c). Quality in use for all. In Stephanidis, C. (ed.) *User Interfaces for All*, Lawrence Erlbaum (in press).

Bevan, N. & Macleod, M. (1994). Usability measurement in context. *Behaviour and Information Technology*, 13, 132-145

Bevan, N. & Murray, D. (1985). *Man/Machine Integration - The Coming of Age Infotech State-of-the-Art Report*. Pergamon Infotech.

Bias, G. & Mayhew, D. (Eds.) (1994). *Cost-Justifying Usability*. Academic Press.

Curson, I. & Bevan, N. *Guidelines for effective RAD*. Available at: www.usability.serco.com.

Daly-Jones, O., Thomas, C. & Bevan, N. (1997). *Handbook of user-centred design*. Serco Usability services, Teddington, Middx, UK.

Earthy, J. (1998). *Usability Maturity Model: Processes*. INUSE D.5.1., 4 p.

European Commission (1994). The Bangeman Report, Brussels. Belgium.

INUSE and RESPECT (1999) see http://www.lboro.ac.uk/eusc

ISO/IEC FCD 9126-1 (1998). *Software product quality - Part 1: Quality model*.

ISO 9241-11 (1998). *Ergonomic requirements for office work with visual display terminals (VDT)s - Part 11 Guidance on usability*.

ISO 13407 (1999). *User-centred design process for interactive systems*.

ISO/IEC 14598-1 (1998). *Evaluation of Software Products - Part 1 General guide*.

Macleod, M., Bowden, R., Bevan, N. & Curson, I. (1997). The MUSiC Performance Measurement Method. *Behaviour and Information Technology,* 16.

Maguire, M. (1998). RESPECT User-Centred Requirements Handbook. RESPECT Deliverable D 5.3. HUSAT Research Centre, Loughborough.

Maguire, M., Heim, J., Endestad, T., Skjetne, J. & Vereker, N. (1998). *Requirements specification and evaluation for user groups with special needs*. RESPECT D6.2.

Norman, D. & Draper, S. (1986). *User centred system design*. Lawrence Erlbaum,.

Thomas, C. & Bevan, N. (eds.) (1996). Usability Context Analysis: A practical guide, Version 4. Serco Usability Services, Teddington, UK

TRUMP (1999). Trial Application Usability Maturity Project, ESPRIT 28015. Available at: http://www.usability.serco.com/trump

Vintner, O. & Poulsen, P.M. (1996). Experience driven software process improvement, *Software Process Improvement '96*, December, 1996, Brighton.