Usability is Quality of Use

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INTRODUCTION

In a paper at HCI International 1991, Bevan et al (1991) asked "What is usability?", and distinguished between broad and narrow approaches to usability. This paper builds on that distinction, identifying the broad approach to usability with the higher level quality objective of "quality of use" (Bevan, 1995a). Quality of use should be the major design objective for an interactive product: does the product enable the intended users to achieve the intended tasks? This relates usability to business objectives and elevates usability from an optional extra to the prime design goal.

The narrow approach is complementary and is concerned with the design of features of the product which are a pre-requisite for quality of use. The two different interpretations of usability lead to two approaches to the specification and evaluation of usability.

DIFFERENT INTERPRETATIONS OF USABILITY

Different people use the word usability in different ways. Even Nielsen (1993) gives two different incompatible classifications.

Usability had its academic origins in psychology, human factors and ergonomics. What makes usability different from the rest of design is that it focuses on the human issues. As a contribution to the design process it is most often interpreted by software engineers as relating to skills in interface design which complement other design objectives such as functionality, efficiency (ie execution speed) and reliability. This is a narrow product-oriented view of usability which suggests that usability can be designed into a product. In this sense usability is closely related to ease of use, which is probably the most common way the term is used. It is for instance consistent with Figure 1 in Nielsen (1993) which nests usability within usefulness, within practical acceptability, within system acceptability. It is also consistent with the limited responsibility of usability specialists in many organisations.
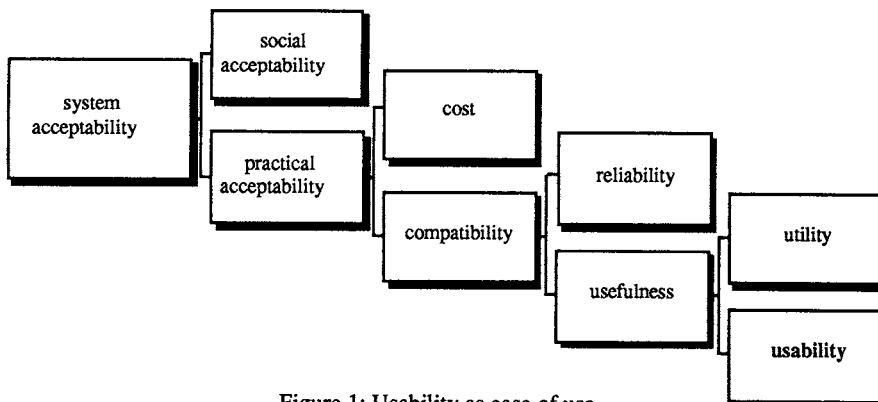

Figure 1: Usability as ease of use

In this sense one can talk about a system (with a well-designed user interface) which is usable but not useful (ie has no utility).

However, for this very reason, it is not a very good way to conceptualise usability. A system which is easy to use but useless will not sell (the product, or the reputation of the usability engineer, except in narrow domains such as computer games!).

What really counts is whether a user can achieve their intended goal when they use the product. This is also a "human" question: it immediately raises the issues of what users in what situations carrying out what tasks (not typical software engineering concerns!). Unfortunately the answer depends not only on usability as ease of use, but also utility (is the right functionality provided?), reliability (does the software crash and can you recover?) and computer efficiency (response time). In designing to enable a user to achieve their goals one needs to make a trade-off between these properties.

Usability was defined in this broad sense long ago by Whiteside, Bennett, and Holzblatt (1988). It has the advantages that:

  • it is a business-oriented view which focuses on the real objectives of design;
  • it is relatively easy to measure.

It leads to the definition of usability used in ISO 9241-11 and the MUSiC project (Bevan and Macleod, 1994):

> The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.

This broad definition of usability turns out to be synonymous with "quality of use" (Bevan 1995a), ie the higher level quality objective that not only does the product meet its specification, but also works in the real world! In software engineering, the conventional objective for quality is to build a software product which meets the specification. However, this alone is rarely sufficient to ensure quality of use – that the product can be used for its intended purpose in the real world.

The quality of a product in use can be measured by the extent to which the product can be used with effectiveness, efficiency and satisfaction in a particular context. The European MUSiC project has developed tools and techniques which enable usability to be specified and measured in this way, implementing the principles of ISO 9241-11 (Bevan and Macleod, 1994).

USABILITY AND QUALITY

The purpose of designing an interactive system is to meet the needs of users: to provide quality of use (see Figure 2, adapted from the working draft of ISO/IEC 14598-1: Evaluation of Software Products). The users' needs can be expressed as a set of requirements for the behaviour of the product in use (for a software product, the behaviour of the software when it is executed). These requirements will depend on the characteristics of each part of the overall system including hardware, software and users.

The requirements should be expressed as metrics which can be measured when the system is used in its intended context, for instance by measures of effectiveness, efficiency and satisfaction. At this level, the required system characteristics could be minimum values for the effectiveness, efficiency and satisfaction with which specified users can achieve specified goals in specified environments (for more information, see ISO DIS 9241-11, Guidance on Usability, and Bevan 1995b).

The required values of these external metrics provide goals for design. To achieve these goals the internal attributes of the system can be specified as internal requirements. At this level usability requirements may be in terms of general principles (eg provide consistency, support the user's task), specific interface details (eg icons and menu design), or use of style guides. These attributes of the software can be evaluated to produce internal metrics verifying how closely the internal requirements have been met. Although these attributes contribute to achieving quality of use, users and tasks vary so much that no set of interface guidelines alone can ensure that a product will be usable.
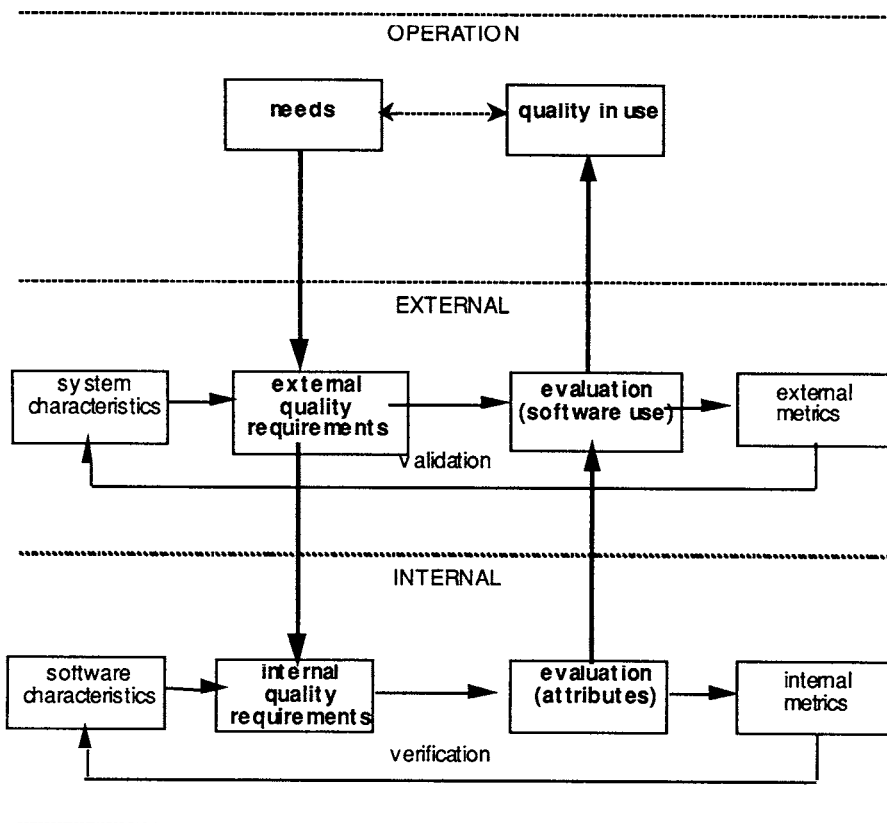
Figure 2 Quality requirements in design

EVALUATION OF USABILITY ATTRIBUTES

The usability attributes which contribute to quality of use will include the style and properties of the user interface, the dialogue structure, and the nature of the functionality. Measures of quality of use provide the criteria which determine whether the design of the attributes is successful in achieving usability.

There are a number of ways of evaluating the usability attributes of a product.

- Style guides such as IBM CUA (IBM 1991a, 1991b) or Windows (Microsoft, 1992) can be used. These provide the raw material for an interface, although quality of use is dependent on the extent to which a dialogue implemented in a particular style is successful in supporting the user's task.
- Detailed attributes of the user interface can be evaluated, for instance using ISO standards (Bevan, 1995b) such as ISO 9241-14 (Menu Dialogues).
- Individual features can be assessed, such as the presence of a help system or the use of a graphical interface. These are examples of functionality which generally contribute to usability, although particular aspects may not be required in every case.
- General usability principles can be used such as the need for consistency, to be self-explanatory and to meet user expectations, such as those in ISO 9241-10 (Dialogue Principles). These are examples of useful guidelines for design, but they are difficult to use for evaluation as guidelines are imprecise, not universally applicable and may

conflict, and there is no way to weight the relative importance of the individual items for usability in any particular conditions.

There have been several attempts to use checklists as a basis for evaluating usability (eg McGinley and Hunter, 1992; Ravden and Johnson, 1989; and Reiterer, 1992). Usability guidelines and checklists are useful aids for design, and can be used to make quick expert assessments of user interface design, but they cannot provide a reliable means of assessing whether a product is usable.

THE IMPORTANCE OF CONTEXT

The quality of use is determined not only by the product, but also by the context in which it is used: the particular users, tasks and environments. The quality of use (measured as effectiveness, efficiency and satisfaction) is a result of the interaction between the user and product while carrying out a task in a technical, physical, social and organisational environment (see figure 3, from Bevan, 1995a). This means that there is no such thing as a "usable product" or "unusable product". For instance a product which is unusable by inexperienced users may be quite usable by trained users.
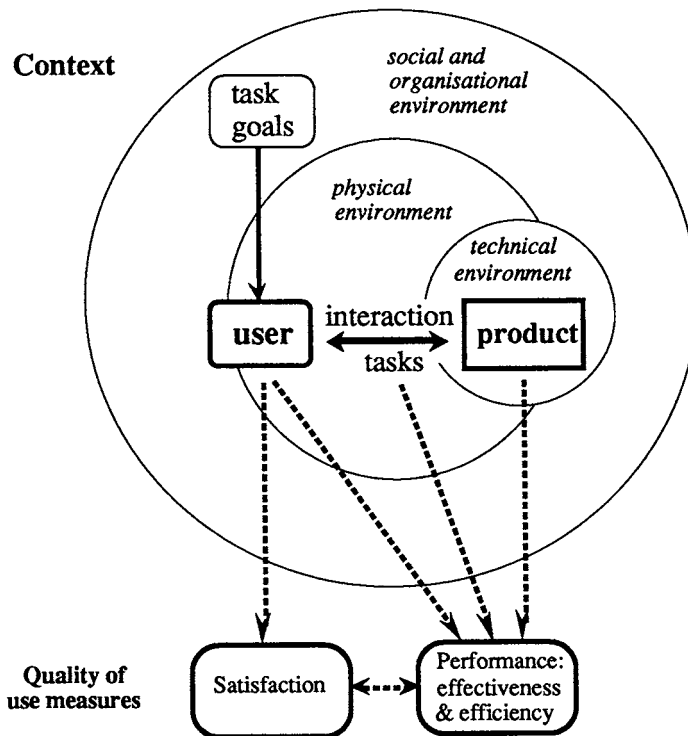

Figure 3 Quality of Use Measures Determined by the Context of Use

It is therefore essential to identify the intended context of use before carrying out any usability evaluation. In many cases it will be necessary to evaluate a product separately for different user groups carrying out different tasks. This applies both for evaluation of usability attributes and for evaluation of quality of use. For instance it may be necessary to consider different user groups when evaluating the appropriateness of the design and content of a help

system. Similarly, when evaluating quality of use by user testing, it may be necessary to decide which combinations of user and task should be selected for evaluation.

USER-CENTRED DESIGN

Although the influence of usability professionals during design is often restricted to user interface issues, usability is frequently evaluated by testing a prototype of the product with users. This leads to a number of problems. This type of user-based evaluation is often left till late in design when there is only scope to make minor changes to the user interface. If evaluation reveals deeper problems with the functionality or basic dialogue design, this may be outside the responsibility of the usability professional. The best solution to these problems is to adopt a user-centred approach to design with a continual cycle of user-based evaluation.

This is recommended in the first draft of ISO 13407 (Human Centred Design) produced by ISO TC159/SC4/WG6:

	concept	prototype	release
understand context			
specify usability			
build solution			
evaluation by users			

At each stage of design it is important to understand the intended context of use, to specify usability requirements (preferably in terms of user performance and satisfaction), and then construct design solutions which can be evaluated by users.

If usability evaluation is left until just before release, there will be no chance to make any significant changes in design to correct deficiencies. In order to achieve a usable product it is important to begin the cycle of understanding, specifying and evaluating usability by using simple mock-ups at the earliest stages of design. For most cost-effective design feedback, repeated evaluation with 3-5 users is recommended (Nielsen, 1993) rather than less frequent evaluation with more users. However, to be confident that usability objectives have been achieved, a final evaluation with 10 or more users will be required.

EVALUATION: DESIGN FEEDBACK OR MEASUREMENT

Most current usability evaluation practices focus on providing design feedback to improve usability. The most common methods for testing users involve some form of co-operative evaluation, requiring active intervention from an observer to probe usability problems with the user (eg Monk et al, 1993). The potential disadvantages of active intervention are:
- You never find out what would really have happened if the user had been left to their own devices. What appear to be minor problems may prevent the whole task being achieved. With active intervention it is difficult to estimate the extent to which task goals would be achieved with real use of the product.
- You cannot get comparable measures of task time.
- Measures of satisfaction are dependent on the amount of help or clues given in the interventions.

The inability to obtain reliable measures means that this type of evaluation cannot be used to test criteria which can form part of a statement of requirements. Specifying formal usability requirements is an important part of the design process. One of the major reasons for the lack of resources allocated to usability in design is that the acceptance criteria do not include specific usability requirements.

To obtain reliable measures, the context of evaluation must closely match the intended context of usage. This means that:
- it essential to have a complete understanding of the exact context in which the product will be used;
- it is essential to replicate the important aspects of this context for the evaluation;

• the user should work in realistic conditions without interruption from an observer, in order to accurately replicate the intended context of use.

One of the outputs of the MUSiC project is a documented procedure for identifying the context of use and the context of evaluation: the Usability Context Analysis guide (Thomas et al, 1995).

When there is no active intervention, design feedback can be obtained by closely observing the interaction (usually with the help of video) and debriefing the user after the session. The Performance Measurement Method (Macleod et al, 1995) developed by NPL as part of the MUSiC project implements this approach. It is used in conjunction with SUMI to measure user satisfaction (Kirakowski, 1995).

CONCLUSIONS

The objective of usability is to achieve quality of use. Usability requirements should be stated in terms of the effectiveness, efficiency and satisfaction required in different contexts. User-based evaluation can be used to validate achievement of these requirements.

Usability attributes provide a contribution to achieving quality of use. The presence or absence of these attributes can be verified early in design. In addition, frequent user-based evaluation of early mock-ups and prototypes is required to give feedback on the quality of use of potential solutions.

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