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Quality in use for all

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Abstract

Designing an interactive product or service for all possible users requires consideration of more than just *physical* accessibility. Even if there is sufficient *physical* accessibility, many systems will still present major barriers to their use, in terms of *cognitive* accessibility: the functionality, terminology, information structure and interface style frequently confuse the intended user. Usually, the main emphasis in systems design is 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 problem is compounded by the difficulty that designers usually have in recognizing shortcomings or limitations in their own design. There are cost-effective procedures for dealing with this problem, which have recently been formalized in ISO 13407: Human-centred design process for interactive systems.

User-centred design provides a framework which can potentially make "Design for All" a reality. The goal is to achieve *quality in use for all*. User-centred design encompasses processes, tools and techniques which can be used to identify and document the complete range of user requirements, including special needs arising from (dis-)abilities, skills, preferences, or any other characteristic of the end user population. The tight design / evaluation loop advocated by user-centred design provides feedback to correct design deficiencies at an early stage while changes are relatively simple to make. Procedures for evaluating *quality in use* have been developed as part of approaches to usability evaluation, and now need to be extended to encompass procedures for evaluating accessibility.

In summary, "Design for All" entails both *physical* and *cognitive* accessibility. New hardware and software technologies are required to make it easier to provide *physical* accessibility. New integrated approaches to system development are required to make it easier to provide *cognitive* accessibility. Only by combining these activities can "Design for all" be achieved.

1 Introduction

The objective of "Design for all" is to provide accessible and easy to use technology both for professionals and the user population at large. It is no longer sufficient to just deliver technically excellent systems . There is increasing demand for computer systems that are widely accessible, easy to learn and use, and easy to integrate into work or leisure activities. Despite the rapid increase of computer power and the progress in the sophistication of systems development, these objectives are not being achieved: it is widely believed that the majority of computer users still cannot get their systems to do exactly what they want**.**

Currently only few interactive systems support the real needs of their users. For example: (i) most video recorders are unnecessarily complicated to use (Thimbleby, 1991); (ii) few Web pages are suitable for use by blind users with a text browser (Bartlett, 1999) (iii) most business users of computer systems are only productive for 30-40% of the time, with 60-70% of the time spent trying to understand how to use the system, or recovering from errors (Macleod et al, 1997).

These examples of poor usability are a consequence of not following a design process that is sufficiently user-centred. Many existing development processes focus exclusively on

adherence to technical and process specifications. In order to produce systems that better match user needs, it is essential to enhance current design processes to incorporate techniques for usability and accessibility through a *user-centred* approach.

Norman and Draper (1986) introduced the term "user-centred design" to refer to the design of computer systems from the user's point of view. The ISO 13407 standard (1999) describes the activities required to apply a user-centred approach to the design of interactive systems. Although this standard focuses on computer systems, the principles it contains are equally applicable to any interactive system used by humans. This chapter explains the benefits of using user-centred design principles and practices to achieve *quality in use* for *all* users of interactive products and services.

2 Quality in use: benefits and barriers

One of the major objectives of design should be to achieve *quality in use for all*, i.e., to provide tools and facilities that support people's work and leisure activities and ensure that products can be used by the widest possible range of people, to achieve their real-world tasks. This requires not only easy-to-use interfaces, but also the provision of appropriate functionality and support for computer-mediated activities.

2.1 Quality in use benefits

Increased *quality in use* would bring significant benefits to industry, end users and society:

- *Improved accessibility.* User-centred design provides methods and tools for identifying, and catering for, a wide range of user needs, thus helping define a broad range of accessibility requirements, including user interface and content accessibility, which can be accounted for in the course of subsequent design activities
- *Increased efficiency.* A system that incorporates good ergonomic design and is tailorable to the physical capabilities and preferred way of working of end users, will allow them to operate effectively and efficiently, rather than lose vital time struggling with a poorly designed user interface and badly thought-out functionality.
- *Improved productivity.* A good interface to a well-designed product will allow the user to concentrate on the task rather than the tool. If the interface is designed inappropriately, it may increase rather than reduce the time needed to perform a task, and have a deleterious effect on other aspects of user performance and the quality of task results.
- *Reduced errors.* A significant proportion of so-called "human error" can be attributed to a product with a poorly designed interface that is not closely matched to the users' task needs, or to their mental model of the task. Avoiding inconsistencies, ambiguities or other interface design faults, while adhering to user expectations in terms of task structure and sequencing, has the potential to significantly reduce user error.
- *Reduced training.* A poorly designed user interface and dialogue can be a barrier to an otherwise technically sound system. A system designed with a focus on the end-user can reinforce learning, thus reducing training time and effort.

- *Improved acceptance.* This is particularly important where usage is discretionary. Users are more likely to use and trust a well-designed, accessible system, which has been designed so that information is both easy to find and is provided in a form that is easy to assimilate and use.

With all these potential benefits, why are many systems still not designed for greater usability and accessibility? There are currently a series of practical barriers to achieving *quality in use for all*.

2.2 Barriers to achieving quality in use for all

2.2.1 Incomplete requirements

The first step in user-centred design is understanding the user requirements. Software development practices have placed an increasing emphasis on achieving quality, and ensuring that the delivered products meet the stated requirements. But a recent survey (Vintner & 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. In addition, the requirements of users with special needs are frequently overlooked, partly because they usually represent only a small portion of the target user population, and partly because their needs are far from the typical experience of most design teams. Acknowledging and planning for the full range of user needs is an essential prerequisite for achieving "Design for All".

For a design process to take a user-centred approach to the identification of requirements, the process 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. This is an extension of the principles of user profiling and task analysis, which are a typical part of usability engineering (Hakos and Redish, 1998).

2.2.2 Commercial barriers

A major obstacle to the wider adoption of practices that would facilitate the goal of *quality in use for all* is the perceived additional cost resulting from the user-centred activities that are required to achieve *quality in use*, as well as with 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 (Karat 1992, Bias and Mayhew 1994, Keil & Carmel 1995), but there are several potential obstacles to extending these benefits to minority groups with special needs. These obstacles include: additional design and production costs; lack of a market which demands access for all (see also section 2.2.6, "Demand Barriers" of this chapter); and, lack of legislation requiring access for all.

There are several potential solutions to this problem, for example:

- legislation that identifies accessibility as an obligatory feature of systems developed in publicly funded projects, or acquired by public procurement;
- development of hardware and software architectures and features that reduce the costs of providing access for all;
- development and fostering of an expectation for access for all in the market, which would, in turn, progressively induce the incorporation of "Design for All" into established professional practices.

2.2.3 Practical barriers: what is "all"?

A major practical barrier for the designer is that access for "all" is impossible, if taken literally. For each product and market the potential range of "all" has to be defined, and incorporated into the design. The final definition of "all" is usually a trade-off between the requirements of potential users, and commercial and legislative constraints. However, this trade-off is rarely made explicit.

Quality in use for all needs to be supported by a clear definition of:

- who should be able to use the product and in what circumstances?
- what types of users will be excluded and why?

2.2.4 Technical barriers

Achieving wider accessibility is much easier if developers can adopt well-established general-purpose solutions. This requires:

- the availability of appropriate methods, techniques and tools that can be used to improve quality in use;
- software architectures and user interface tools that can facilitate the design and development of interactive applications adaptable, to the widest possible range of cognitive and physical requirements.

2.2.5 Development barriers

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

2.2.6 Demand barriers

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. Such a process, which is usually referred to as demand articulation, is not only important, but also necessary to raise public awareness, create incentives for the industry and, ultimately, substantiate the demand for universal accessibility and design for all.

3 Specifying *quality in use* requirements

3.1 User interface requirements

Traditional approaches to achieving quality put emphasis on meeting specified requirements that are primarily functional. Attempts have been made to broaden the perception of quality, for example in ISO/IEC 9126, which defines quality from a user perspective as functionality, reliability, usability, efficiency, maintainability and portability (Figure 1).

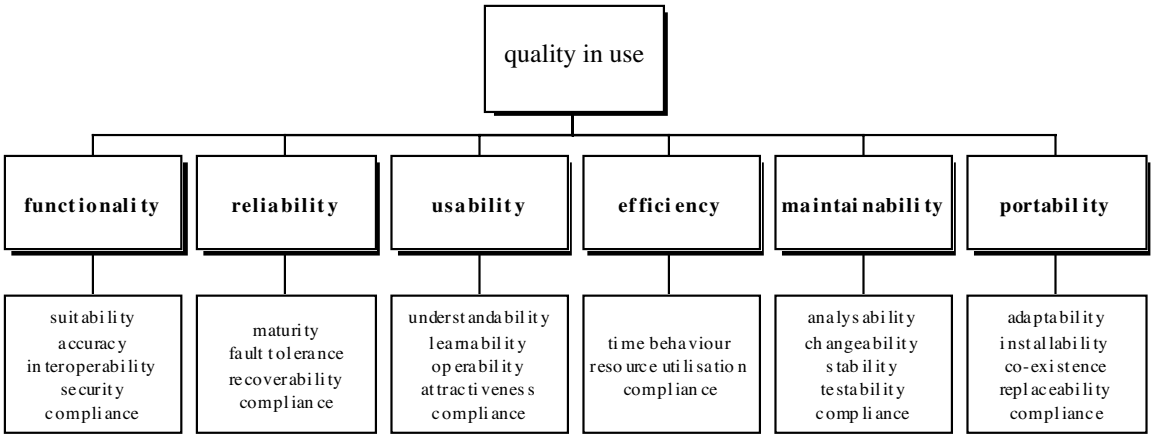

Figure 1: Software quality characteristics (ISO/IEC 9126 Quality Model).

This approach was derived from the ISO 8402 (Quality vocabulary) definition of quality:

> **Quality**: the totality of characteristics of an entity that bear on its ability to satisfy stated and implied needs.

The ISO/IEC 9126 definitions acknowledge that the objective is to meet user needs. But ISO 8402 makes it clear that quality is determined by the presence or absence of particular attributes, with the implication that these are specific attributes that can be designed into the product. Thus, when referring to software, these would be attributes of the source code. When combined with an ISO 9001 compliant quality process, the most natural interpretation is that quality should be specified and evaluated at the level of source code attributes.

For the user interface, requirements at this level of detail can be specified using style guides, or design guidance such as is contained in ISO 9241. This standard also provides a potential means to specify and evaluate usability. Schemes to do this have been developed in Germany (eg Prümper 1999, Gediga et al, 1999).

In terms of accessibility, requirements at this level would specify the interface features required to ensure access by users with special needs. This approach is very valuable in identifying and minimising low-level user interface shortcomings and defects. However, a good interface does not necessarily guarantee a system that enables users to efficiently achieve their goals and effectively complete their tasks. This requires a broad, top-down approach to design and evaluation.

3.2 Quality in use requirements

ISO/IEC 14598-1 takes this broad view, explaining that *quality in use* is the users' view of the quality of a system, and it is measured in terms of the results of using the system, rather than properties of the system itself. Thus, *quality in use* is the combined effect of the system's quality characteristics, as these are experienced by the end user. A product meets the requirements of a particular user if it enables the user to be effective, productive in terms of time and resources, and satisfied, regardless of the specific attributes the product possesses.

Quality in use in any particular system depends not only on its usability, but also on the appropriateness of the provided functionality for a given task the performance that users can achieve using the system and the reliability of the system (Bevan, 1997a). Additionally, to provide *quality in use for all*, a system will need to provide both *physical* and *cognitive*

accessibility for the intended users. *Physical* accessibility implies the provision of the physical means through which all potential users will be able to operate the system. *Cognitive* accessibility means meeting the cognitive needs of the users. The characteristics which are required to make software cognitively accessible are defined in general terms in ISO 9241-10, where it is stated that software should be: suitable for the task, self-descriptive, controllable, in conformance with user expectations, error tolerant, suitable for individualization, and suitable for learning.

In this context, *quality in use* can be viewed as a black box approach to specification and evaluation, assessing the extent to which a product or service meets the needs of users, irrespective of its specific attributes. In particular, *quality in use* depends on the circumstances in which a system is used, including such factors as the tasks, equipment (hardware, software and materials), and the physical and social environment.

Consequently, *quality in use* is broader in scope than the usability of the interface. However, the term usability has several interpretations, and in some ergonomic standards (e.g. ISO 9241-11 and ISO 13407) the terms *usability* and *quality in use* are used synonymously. In this chapter, the term usability is used in the ISO/IEC 9126-1 sense, of understandability, learnability and operability.

4 Evaluation of quality in use

Evaluation of quality in use should take place as part of a user-centred design process that starts with the specification of the requirements for quality in use, in specific contexts of use. The MUSiC Performance Measurement Method (Macleod et al 1997), based on ISO 9241-11, documents all the necessary procedures one has to follow to evaluate quality in use, from deciding what and how to evaluate, to producing the final usability report. The steps involved are:

(i) **Define the product to be tested.** The first step is to define which version and which components of a product or system are to be evaluated.

(ii) **Define the context of use.** The next step is to clarify the intended context of use of the product: what are the intended user groups, what skills and what cognitive and physical capabilities will the intended users have, what task goals can be achieved with the product, and what physical and social conditions will the product be used in?

(iii) **Specify the quality in use requirements.** Quality in use is measured in specific contexts of use. Measures of quality in use have three essential components:

- Effectiveness: can users complete their tasks correctly and completely?
- Productivity: are tasks completed in an acceptable length of time?
- Satisfaction: are users satisfied with the interaction?

Quality in use requirements are often set by comparison with alternative means of achieving a task. For instance, a new communication aid for the disabled should enable users to communicate more effectively, in a shorter time and with more satisfaction than when using existing solutions.

(iv) **Specify the context of evaluation,** so that the evaluation can be carried out in conditions as close as possible to those in which the product will be used. It is important that:

- users are representative of the population of users who will use the product;
- tasks are representative of the ones which the system is intended to support;
- conditions are representative of the normal conditions in which the product is to be used.

(v) **Design an evaluation** to meet the specified context of evaluation. In designing the evaluation, one should keep in mind that it should measure the performance and satisfaction of users as they perform set tasks within this context. Satisfaction can be measured with a validated questionnaire such as SUMI (Kirakowski, 1996).

(vi) **Perform the user tests and collect data.** When assessing quality in use it is important that the users work unaided, only having access to forms of assistance that would be available under normal conditions of use. In addition to measuring effectiveness, efficiency and satisfaction, it is usual to document the problems users encounter, and to obtain clarification by discussing those problems with the users at the end of the session. It is often useful to record the evaluation on video, which permits more detailed analysis. It is also easier for users to work undisturbed, if they are monitored remotely by video.

(vii) **Analyse and interpret the data.** The data is used to calculate metrics for effectiveness, efficiency, and satisfaction. There is only limited experience in using these metrics to assess *quality in use for all*, and additional metrics are a topic for further research (Stephanidis, 1999).

(viii) **Produce a usability report.** This should give a description of the measures obtained for the system under test, and could be used to compare the system with initial requirements, with similar systems, or with the same system as it evolves over time.

From the above, it follows that the evaluation of quality in use should take place as part of a user-centred design process that starts with the specification of the requirements for *quality in use* in specific contexts of use. Thus, if accessibility is to be integrated within the evaluation of quality in use, it should first be introduced within user-centred design. The next section provides a brief summary of the phases of user-centred design, and the extensions needed.

5 User-centred design and design for all

5.1 ISO 13407

ISO 13407 provides guidance on achieving quality in use by incorporating user-centred design activities throughout the life cycle of interactive computer-based systems. It describes user-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.

There are four user-centred design activities that need to take place at all stages during a project. These are to:

- understand and specify the context of use;
- specify the user and organizational requirements;
- produce design solutions; and,
- evaluate designs against requirements.

The iterative nature of these activities is illustrated in Figure 2. The process involves iterating until the objectives are satisfied.

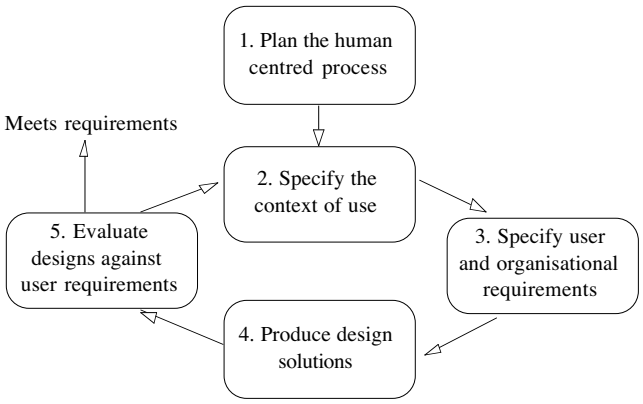

Figure 2: The interdependence of user-centred design activities.

The sequence in which the activities are performed and the level of effort and detail that is appropriate vary depending on the design environment and the stage of the design process.

5.1.1 Understand and specify the context of use

The characteristics of the users, tasks and the organizational 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.

The context in which the product is to be used should be identified, in terms of:

(i) The characteristics of the intended users. Relevant characteristics of the users can include knowledge, skills, experience, education, training, age and physical abilities. If necessary, define the characteristics of different categories of users, for example having different levels of experience, different roles, or different levels of cognitive capabilities.

(ii) The tasks the users are to perform. The description should include the overall goals of use of the system. The characteristics of tasks that can influence quality in use in typical usage scenarios should be described, e.g., the frequency and the duration of task performance for a specific task. Tasks should not be described solely in terms of the functions, or features provided by a product or system. Instead, the description should include the allocation of activities and operational steps between human and technological resources.

(iii) The environment in which the users are to use the product. The associated hardware, software and materials can either be identified as specific products, or can be described in terms of their attributes or performance characteristics. Relevant characteristics of the physical and social environment also need to be described. For example, aspects which may need to be described include attributes of: the wider technical environment (e.g., a local area network); the physical environment (e.g., workplace, furniture); the ambient environment (e.g., temperature, humidity); the legislative environment (e.g., laws, ordinances, directives and standards); and the social and cultural environment (e.g., work practices, organizational structure and attitudes).

An effective way to collect and document the necessary information is to use an annotated checklist of user, task and environmental characteristics, such as the one found in the Usability Context Analysis Guide (Thomas and Bevan 1996). Such a "general-case" checklist would need to be used in combination with one intended to capture the special needs of end users (e.g. Maguire et al 1998).

The output of this activity should be a description of the relevant characteristics of the users, tasks and environment, which identifies what aspects of the overall context of use have significant impact on the system design. This description is unlikely to be a single output that is issued once. It is more often a "working document" that is first produced in outline terms and is then reviewed, maintained, extended and updated during the design and development process.

5.1.2 Specify the user and organizational requirements

In most design processes, there is a major activity dealing with the specification of the functional and other requirements for the product or system. For user-centred design, it is essential to extend this activity to include an explicit statement of user and organizational requirements, in relation to the context of use description, in terms of the usability and accessibility of the human-computer interface and the overall quality in use.

Objectives can be set, with appropriate trade-offs identified between different requirements. The requirements should be stated in a form that permits subsequent testing.

Including accessibility as a non-functional requirement implies a commitment on behalf of the stakeholders to invest the required resources to meet the requirements of users with special needs.

5.1.3 Produce design solutions

The next stage is to create potential design solutions by drawing on the established state of the art and the experience and knowledge of the participants. The process therefore involves:

- using existing knowledge to develop proposed multi-disciplinary design solutions;
- making those design solutions more concrete (using simulations, models, mock-ups etc.);
- presenting the solutions to users and allowing them to perform tasks (or simulated tasks);
- using feedback from the users to improve the designs;
- iterating this process until the user-centred design goals are met.

Though rapid prototyping techniques and tools have substantially improved the outcome of this stage, there is still much to be expected to facilitate accessibility. This is due to the fact that tools for accessible design are largely missing. In the recent past, with initiatives such as Microsoft's Active Accessibility[1] and Sun's Java Accessibility[2] the situation has been slightly improved. However, unless tools that facilitate edit-evaluate-modify prototyping cycles become available, accessibility will remain a loosely addressed target. To justify this account, one can draw parallels with Graphical User Interfaces (GUIs) over the past two decades, or, more recently, Java. Specifically, it was not until tools for building GUIs became available, that graphical interaction took off. Similarly, the primary constraint of Java's diffusion is the lack of suitable tools to facilitate the development of Java applications (Reagan, 1998).

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[1] For more information please refer to chapter 16 ("Microsoft Efforts to Increase Software Accessibility") of this book, or to: http://www.microsoft.com/enable/msaa/default.htm.

[2] For more information please refer to chapter 17 ("Accessibility in the Java Platform") of this book, or to: http://java.sun.com/products/jfc/accessibility/doc/.

5.1.4 Evaluate designs against requirements

Evaluation is an essential step in user-centred design and should take place at all stages in the system life cycle. Evaluation can be used to:

- provide feedback which can be used to improve design;
- assess whether user and organizational objectives have been achieved;
- monitor long term use of the product or system.

Early on in the design process the emphasis is on obtaining feedback that can be used to guide design, while later, when a realistic prototype is available, it is possible to measure whether user and organizational objectives have been achieved.

In the early stages of the development and design process, changes are relatively inexpensive. The longer the process has progressed and the more fully the system is defined, the more expensive the introduction of changes becomes. It is therefore important to start evaluation as early as possible.

In the recent past, there have been substantial developments in the area of techniques and tools for evaluation. Many of those can be used either directly or with slight modifications, to assess the degree to which designs meet specified accessibility requirements. It should be mentioned, however, that the primary use of these techniques is in formative evaluation (i.e., provide feedback that can be used to improve design). Techniques for summative evaluation of the accessibility of an interactive product are still pending, as they would require an operational definition of accessibility to derive appropriate measures (see also chapter 21, "User Interface Adaptation: Evaluation perspectives" of this book).

5.2. Relationship between User-Centred Design and "Design for All"

The objective of "Design for All" in the context of the emerging Information Society is 'the conscious and systematic effort to proactively apply principles, methods and tools, in order to develop IT&T products and services which are accessible and usable by *all* citizens, thus avoiding the need for a posteriori adaptations or specialized design' (Stephanidis et al., 1998). This means that products and services should have *quality in use* for all citizens in all the relevant contexts of use.

As discussed in the previous sections, user-centred design can be extended to provide the framework for a design process within which this can be achieved; however, one shortcoming of current approaches to user centred design is that (as in ISO 13407) there is no explicit mention of accessibility. Moreover, due to its commercial orientation, user-centred design typically emphasizes the need to identify the intended users, rather than exploring how access can be provided for *all* users. However, with the advent of the Information Society and the introduction of novel contexts of use, the concept of the "intended user" needs to be expanded, to include occasional, or "unforeseen" users. One of the important steps that need to be made in this direction is that requirements for accessibility should properly be considered as part of a user-centred design process. Formal integration of accessibility with user-centred design to achieve user-centred design for all is a matter for further research and development (Stephanidis et al., 1999). It should also be noted that design for all is a more ambitious objective than quality in use for all, which may currently be achieved to some degree using a posteriori adaptations or specialized design.

6 Example of user-centred design

To illustrate the approach, consider a hypothetical example of how user-centred activities could contribute to the design of a Web site that provides a database of the results of recent publicly funded research. The example will be used to demonstrate some of the concepts

put forward in the previous sections, both in terms of the process followed in the development of an interactive system, and in the focus of various activities within that process.

The first step is to identify the expected context of use. Analysis of existing users of technology research results identifies the main users of the Web site as professionals seeking information on new technology; they would be likely to access the site in two circumstances:

- while visiting technology information centers;
- while at their normal place of work.

Technology information centers are approached to provide information on the typical goals of their clients, and a profile of their range of clients. The profile includes people with poor eyesight and other physical disabilities.

Discussions with information center clients and other potential users leads to agreement on the goals for quality in use. This is a black box approach. Rather than specifying the presence or absence of interface features, criteria are established for users' effectiveness, productivity and satisfaction when using the product:

- at least 90% success when looking for information contained in the system;
- the average time to find information should not exceed 10 minutes;
- the user satisfaction with the Web site should be at least as great as with other sites providing similar services.

The design team maps out the potential structure of the site using self-adhesive notes for each intended page, and discusses the structure with potential users. A rough sketch of each page is then produced on a series of cards, which are presented to users in sequence, and users are asked to step though a series of tasks by selecting an option on each card. The feedback from these tests is used to refine the site structure until it meets the expectations of users.

Special consideration is given to the information and navigation requirements of users with poor eyesight and other physical disabilities, who will access the site with specialized browsers and adapted physical interfaces. Two design options are considered:

a) to produce an alternative version (or alternative versions) of the site for users with special needs (e.g., optimized for aural rather than visual presentation);
b) to follow Web accessibility guidelines to produce pages that cater for a large range of special requirements of different end user categories.

The decision whether to invest in alternative versions is based on the extent to which a generic site is expected to have negative effects on the quality in use for different user groups, and the degree of priority given to providing optimal access for all.

Parts of the site are then mocked up as Web pages. Color prints of these pages are again presented to physically- and cognitively-able users to find out whether they can successfully navigate the site. Users with special needs are also involved in the process using appropriate interface mockup techniques. A trial implementation is then made of part of the site with sample contents in the database.

The success of the user-centred design process can be evaluated by comparing the quality of the product in specific contexts of use, with the original quality in use goals. This type of validation can be quite expensive to perform, so it is generally necessary to concentrate on key user groups and tasks. Based on the expected context of use, the site should be evaluated by users with and without access to assistance from an information center, as well as with and without disabilities.

Representative categories of users are selected: information center clients without disabilities, information center clients with specific types of disability, and researchers from companies producing innovative technology. Typical task scenarios are defined, and a minimum of eight users from each category are given a series of tasks to perform using the types of PCs and Internet access that are typically found in their working environment. To establish whether the initial quality in use goals have been met, measures are taken of the task time, the degree of success in achieving the tasks, and the rated satisfaction in using the Web site. For more information on a user-centred approach to design see for example Bevan (1997) for web site design guidelines, Bevan and Curson (1998) and Daly-Jones et al (1997) for information on methods for user-centred design, and Bevan (1995) and Macleod et all (1997) for quality in use measurement.

7 Conclusions

Many systems are designed to be accessible only by users with specific physical abilities and skills. Similarly, many systems are designed to be usable only by users with specific cognitive abilities and skills. Currently, there are two separate professional communities concerned with improving product accessibility and product usability. Both of them share the objective of meeting user needs in order to achieve *quality in use*. However, while usability has been primarily concerned with the range of "typical", or "average" users (by implication able-bodied), accessibility is concerned with extending design to incorporate users with physical and cognitive disabilities. User-centred design can provide a common framework for enhancing current design practice, in order to meet the real needs of both these majority and minority user groups.

One of the most frequent failures of current design processes is a lack of understanding of real user needs. User-centred design requires a detailed understanding and specification of user requirements, and the active participation of users in an iterative process of evaluating whether proposed design solutions meet user needs.

Current requirements engineering and specification processes need to be enhanced to explicitly incorporate *quality in use* requirements related to the capabilities of the users who are expected to use the system, and the requirements for effectiveness, productivity and satisfaction resulting from the system's use.

Many design teams lack the necessary skills to carry out user-centred design activities, particularly in smaller organizations. Large IT suppliers are making substantial investments in usability and accessibility, particularly in the competitive office systems market. Much remains to be done to create the same demand for usable and accessible systems in other markets, which currently tolerate unacceptably poor *quality in use* for the end user.

It is a common failing to provide new technology without understanding how it will support user needs. Procurement specifications need to demand *quality in use for all*, and evaluation of *quality in use* should be an essential part of the acceptance testing process.

A first step in this direction is a recent initiative by the US IT industry to make usability more visible in the procurement process (Blanchard 1998, Bevan 1999). Producers have agreed to make Industry Standard Usability Test Reports available to potential corporate purchasers. It is to be hoped that this will be an influential step towards establishing *quality in use* in its rightful place as the prime goal of systems design.

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