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# International standards for HCI and usability

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Over the last 15 years, a comprehensive range of international standards has been developed to define the general principles of user-centred design and good practice in user interface design. Most of the standards specify general principles rather than the precise details of the interface. The paper briefly describes how standards are created and reviews the definitions of usability. HCI and usability standards are described in the categories: usability definitions, use in context, software interface and interaction, hardware interface, documentation, the development process and capability of the organization. The applicability of the standards is discussed.



KEYWORDS: standards; user-centred design; usability.

## 1. Introduction

The last 10 years have seen the development and publication of a comprehensive range of international standards to support user-centred design and the development of easy to use interfaces. International standards are well known for specifying hardware and software interfaces and procedures for achieving quality (e.g. ISO 9001). Very few of the HCI standards specify the interface precisely, instead defining general principles from which appropriate interfaces and procedures can be derived. This makes the standards authoritative statements of good professional practice, but makes it more difficult to demonstrate conformance.

Much of the material in these standards represents the leading edge of good practice, often in advance of what is available in published textbooks. The standards are not only a useful source of reference for more experienced practitioners but can also provide guidance to organizations that are inexperienced in user-centred design, and can give credibility to the value of introducing user-centred methods.

It is unfortunate that at a time of increasing expectations of easy access to information via the internet, international standards are expensive and difficult to obtain. This is an inevitable consequence of the way standards bodies are financed. Information on how to obtain standards can be found in Section 14.

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## 2. Types of standard for HCI and usability

Standards related to usability can be categorized as primarily concerned with the following.

(1) The use of the product (effectiveness, efficiency and satisfaction in a particular context of use).
(2) The user interface and interaction.
(3) The process used to develop the product.
(4) The capability of an organization to apply user-centred design.

Figure 1 illustrates the logical relationships: the objective is for the product to be effective, efficient and satisfying when used in the intended contexts. A prerequisite for this is an appropriate interface and interaction. This requires a user-centred design process, which to be achieved consistently requires an organizational capability to support user-centred design.

## 3. Development of ISO standards

Standards for HCI and usability are developed under the auspices of the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). ISO and IEC comprise national standards bodies from member states. The technical work takes place in Working Groups of experts, nominated by national standards committees but expected to act as independent experts.

The standards are developed over a period of several years, and in the early stages the published documents may change significantly from version to version until a consensus is reached. As the standard becomes more mature, from the Committee Draft Stage onwards, formal voting takes place by participating national member bodies and the draft documents provide a good indication of what the final standard is likely to look like.

The status of ISO and IEC documents is summarized in the title of the standard, as described in Table 1, and Table 2 shows the main stages of the development of an international standard.

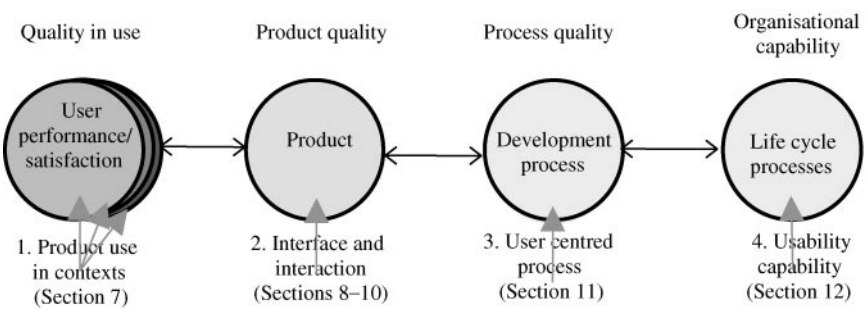


FIGURE 1. Categories of standard.

TABLE 1
*ISO and IEC document titles*†

| ISO Title | Description |
|---|---|
| ISO *nnnn* (*date*) | A standard number *nnnn* published on *date*, developed by an ISO committee. |
| ISO *nnnn-xx* (*date*) | Part xx of a standard developed by an ISO committee. |
| ISO/IEC *nnnn* (*date*) | A standard developed by JTC1: a joint technical committee of ISO and IEC. |
| ISO TS *nnnn* (*date*) | An ISO Technical Specification: a normative document that may later be revised and published as a standard. |
| ISO TR *nnnn* (*date*) | An ISO Technical Report: an informative document containing information of a different kind from that normally published in a normative standard. |
| ISO *ZZ nnnn* (*date*) | A draft standard of document type *ZZ* made available on *date*. |

†The abbreviations (e.g. TR, *ZZ*) used for the document types are described in Table 2.

TABLE 2
*Types of ISO documents and stages in development*

| Stage | Document type | | Description |
|---|---|---|---|
| 1 | AWI | Approved work item | Prior to a working draft |
| 2 | WD | Working draft | Preliminary draft for discussion by working group |
| 3 | CD | Committee Draft | Complete draft for vote and technical comment by national bodies |
| | CD TR or TS | Committee draft technical report/specification | |
| 4 | CDV | Committee draft for vote (IEC) | Final draft for vote and editorial comment by national bodies |
| | DIS | Draft international standard | |
| | FCD | Final committee draft (JTC1) | |
| | DTR or DTS | Draft technical report/specification | |
| 5 | FDIS | Final draft international standard | Intended text for publication for final approval |
| 6 | ISO | International standard | Published document |
| | ISO TR or TS | Technical report or technical specification | |

## 4. Standards described in this paper

Table 3 lists the international standards and technical reports related to HCI and usability that were published or under development in March 2001. The documents are divided into two categories: those containing general principles and recommendations, and those with detailed specifications. They are also grouped according to subject matter. All the standards are briefly described in Sections 6–13.

## 5. Approaches to HCI and usability standards

HCI and usability standards have been developed over the last 15 years. One function of the standards is to impose consistency, and some attempt has been made to do this by ISO/IEC standards for interface components such as icons, PDA scripts and cursor control (see Section 8). However, in these areas *de facto* industry standards have been more influential than ISO, and the ISO standards have not been widely adopted.

The ISO 9241 standards have had more impact (Stewart, 2000). Work on ergonomic requirements for VDT workstation hardware and the environment (ISO 9241, Parts 3–9, Section 9.1) began in 1983, and was soon followed by work on guidelines for the software interface and interaction (Parts 10–17, Section 8.1). The approach to software in ISO 9241 is based on detailed guidance and principles for design, rather than precise interface specifications, thus permitting design flexibility.

More recently usability metrics have been defined by the software engineering community. ISO/IEC 9126-4 (Section 7.1) includes detailed metrics for quality in use, expanding on the measures of usability in ISO 9241-11. ISO/IEC 9126 Parts 2 and 3 include metrics for a good interface design based on criteria for desirable interface properties, closely related to the detailed guidance in ISO 9241 Parts 10 and 12–17.

The essential user-centred design activities needed to produce usable products are described in the ergonomic standard ISO 13407 (Section 11). These principles have been refined and extended in a model of usability maturity that can be used to assess the capability of an organization to carry out user-centred design: ISO TR 18529, Section 12.

## 6. Usability definitions

### 6.1. ISO 9241-11: GUIDANCE ON USABILITY (1998)

This standard (which is part of the ISO 9241 series described in Section 8.1) provides the definition of usability that is used in subsequent related ergonomic standards:

> Usability: 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.

ISO 9241-11 explains how to identify the information that is necessary to take into account when specifying or evaluating usability in terms of measures of user performance and satisfaction. Guidance is given on how to describe the context of use of the product and the measures of usability in an explicit way. It includes an explanation of how the

usability of a product can be specified and evaluated as part of a quality system, for example one that conforms to ISO 9001.

It also explains how measures of user performance and satisfaction can be used to measure how any component of a work system affects the quality of the whole work system in use.

### 6.2. ISO/IEC 9126: SOFTWARE PRODUCT EVALUATION—QUALITY CHARACTERISTICS AND GUIDELINES FOR THEIR USE (1991)

In the software engineering community the term usability has been more narrowly associated with user interface design. ISO/IEC 9126, developed separately as a software engineering standard, defined usability as one relatively independent contribution to software quality associated with the design and evaluation of the user interface and interaction:

> Usability: a set of attributes that bear on the effort needed for use, and on the individual assessment of such use, by a stated or implied set of users.

### 6.3. ISO/IEC FDIS 9126-1: SOFTWARE ENGINEERING—PRODUCT QUALITY—PART 1: QUALITY MODEL (2000)

ISO/IEC 9126 (1991) has recently been replaced by a new four part standard that has reconciled the two approaches to usability. ISO/IEC 9126-1 describes the same six categories of software quality that are relevant during product development: functionality, reliability, usability, efficiency, maintainability and portability (Figure 2).

The definition of usability is similar.

> Usability: the capability of the software product to be understood, learned, used and attractive to the user, when used under specified conditions.

The phrase "when used under specified conditions" (equivalent to "context of use" in ISO 9241-11) was added to make it clear that a product has no intrinsic usability, only a capability to be used in a particular context.

ISO/IEC FDIS 9126-1 now recognizes that usability plays two roles (Bevan 1999): it is part of a detailed software design activity (implied by the definition of usability), and also provides the final goal that the software meets user needs (similar to the ISO 9241-11 concept of usability). ISO/IEC 9126-1 uses the term "quality in use" for this broad objective:

> Quality in use: the capability of the software product to enable specified users to achieve specified goals with effectiveness, productivity, safety and satisfaction in specified contexts of use.

Quality in use is the combined effect of the six categories of software quality when the product is in use. The objective is to achieve quality in use, both for the end-user and the support user. Functionality, reliability, efficiency and usability determine the quality in use for an end user in a particular context. The support user is concerned with the quality in the use of maintenance and portability tasks.

TABLE 3
*Standards described in this paper*

| | Principles and recommendations | Specifications |
|---|---|---|
| Use in context | ISO/IEC 9126-1: Software Engineering—Product quality— Part 1: Quality model | ISO 20282: Usability of everyday products |
| | ISO/IEC TR 9126-4: Software Engineering—Product quality—Part 4: Quality in use metrics | |
| | ISO 9241-11: Guidance on Usability | |
| Software interface and interaction | ISO/IEC TR 9126-2: Software Engineering—Product quality—Part 2: External metrics | ISO/IEC 10741-1: Dialogue interaction—Cursor control for text editing |
| | ISO/IEC TR 9126-3: Software Engineering—Product quality—Part 3: Internal metrics | ISO/IEC 11581: Icon symbols and functions |
| | ISO 9241: Ergonomic requirements for office work with visual display terminals. Parts 10–17 | ISO/IEC 18021: Information Technology—User interface for mobile tools |
| | ISO 14915: Software ergonomics for multimedia user interfaces | |
| | IEC TR 61997: Guidelines for the user interfaces in multimedia equipment for general-purpose use | |

| | | |
|---|---|---|
| Hard-ware Interface | ISO 11064: Ergonomic design of control centres | ISO 9241: Ergonomic requirements for office work with visual display terminals. Parts 3–9 |
| | | ISO 13406: Ergonomic requirements for work with visual displays based on flat panels |
| | | ISO/IEC 14754: Pen-based interfaces—Common gestures for text editing with pen-based systems |
| | | ISO 18789: Ergonomic requirements and measurement techniques for electronic visual displays |
| Documentation | ISO/IEC 18019: Guidelines for the design and preparation of software user documentation | ISO/IEC 15910: Software user documentation process |
| Development process | ISO 13407: Human-centred design processes for interactive systems | ISO/IEC 14598: Information Technology—Evaluation of Software Products |
| | ISO TR 16982: Usability methods supporting human-centred design | |
| Usability capability | ISO TR 18529: Ergonomics of human-system interaction—Human-centred lifecycle process descriptions | |
| Other related standards | ISO 9241-1: Part 1: General Introduction | |
| | ISO 9241-2: Part 2: Guidance on task requirements | |
| | ISO 10075-1: Ergonomic principles related to mental workload—General terms and definitions | |
| | ISO DTS 16071: Guidance on accessibility for human–computer interfaces | |

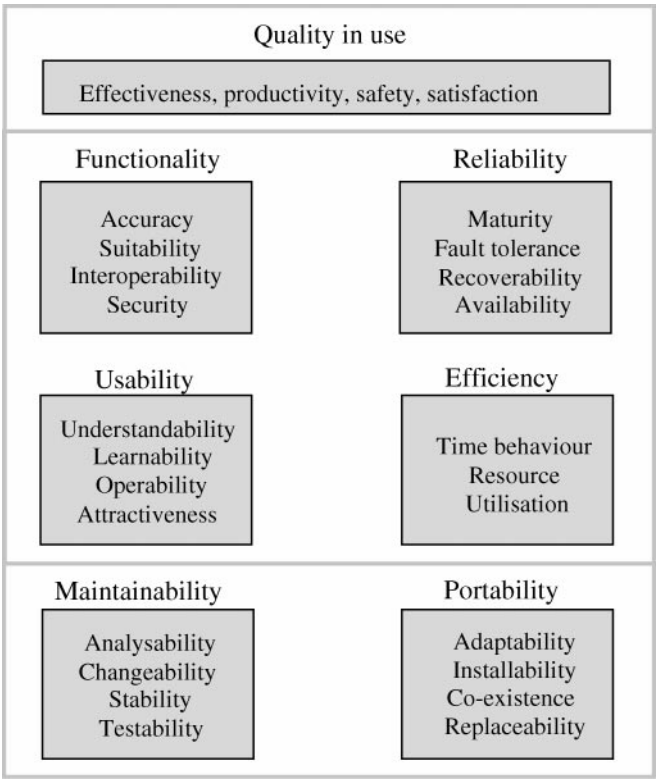


FIGURE 2. ISO/IEC FDIS 9126-1 quality model.

Other parts of ISO/IEC 9126 define metrics for usability and quality in use (see Sections 7.1 and 8.2).

### 6.4. WHY IS THERE MORE THAN ONE DEFINITION OF USABILITY?

ISO/IEC 9126-1 uses the term quality in use rather than usability, as ISO/IEC 9126 had already defined usability in a narrower way as one component of software quality. In addition, safety (personal, material and economic) is also included in the definition of quality in use. (In ergonomic standards, health and safety is treated separately.)

The two definitions of usability are complementary. The ISO 9241-11definition of usability and the definition of quality in use are in terms of measurable design objectives, that the product meets the needs of the user. As ISO 13407 makes clear, identifying these requirements has broad implications from the earliest stages of design.

But these definitions take a black box approach, and say nothing about the design characteristics of a usable product. Although measuring against final goals is strategically very important, most user interface development effort is concerned with the detailed design and diagnostic evaluation to understand why users have problems. The

TABLE 4
*Terminology for usability*

| Meaning Standard | ISO/IEC 9126-1 | ISO 9241 Parts 10 and 11 |
|---|---|---|
| Easy to use interface | "usability" | "suitable for the task, individualisation and learning, and self-descriptive, controllable, conforms with user expectations, and error tolerant" |
| Performance and satisfaction | "quality in use" | "usability" |

ISO/IEC 9126-1 definition of usability is concerned with attributes of the product that make it understandable, learnable, easy to use and attractive. The ISO/IEC 9126-1 definition is also closer to previous definitions of usability, such as Shackel (1984) and Nielsen (1993) where usability is identified with the ease of use and learning, and excludes utility (i.e. useful functionality).

By contrast, the ISO 9241-11 definition is very broad, implicitly including not only utility, but also computer efficiency and reliability.

These two approaches to usability need to be combined during the design and development process. The broad goal of quality in use is needed to support user-centred design, while detailed concern with the interface is necessary during development. Organizations that compartmentalize usability as exclusively an interface issue that can be layered onto an existing product are doomed to failure.

The different ways the terminology is used in the standards are summarized in Table 4.

## 7. Use in context

### 7.1. ISO/IEC DTR 9126-4: SOFTWARE ENGINEERING—PRODUCT QUALITY —PART 4: QUALITY IN USE METRICS (2001)

This technical report contains examples of metrics for effectiveness, productivity, safety and satisfaction. Specifying usability requirements and verifying that they have been achieved in a usability test is an important component of user-centred design (ISO 13407). ISO/IEC 9126-4 suggests metrics for effectiveness, productivity, satisfaction and safety that can be used for this purpose. The results can be documented using the Common Industry Format for usability test reports (www.nist.gov/iusr), which is included as an example in an Annex to ISO/IEC 9126-4.

### 7.2. ISO WD 20282: USABILITY OF EVERYDAY PRODUCTS (2001)

A multi-part standard is being developed to specify the information about usability that should be provided with a consumer product, so that a purchaser can judge the ease of use of the product. It will specify a test method, the characteristics of a "normal user", and how to specify the characteristics of intended users with special needs or with special skills or experience (Bevan & Schoeffel, 2001).

## 8. Software interface and interaction

These standards can be used to support user interface development in the following ways.

(1) To specify details of the appearance and behaviour of the user interface. ISO 14915 and IEC 61997 contain recommendations for multimedia interfaces. More specific guidance can be found for icons in ISO/IEC 11581, PDAs in ISO/IEC 18021 and cursor control in ISO/IEC 10741.
(2) To provide detailed guidance on the design of user interfaces (ISO 9241 Parts 12–17).
(3) To provide criteria for the evaluation of user interfaces (ISO/IEC 9126 Parts 2 and 3).

However, the attributes that a product requires for usability depend on the nature of the user, task and environment. ISO 9241-11 can be used to help understand the context in which particular attributes may be required. Usable products can be designed by incorporating product features and attributes known to benefit users in particular contexts of use.

### 8.1. ISO 9241: ERGONOMIC REQUIREMENTS FOR OFFICE WORK WITH VISUAL DISPLAY TERMINALS

ISO 9241 provides requirements and recommendations relating to the attributes of the hardware, software and environment that contribute to usability, and the ergonomic principles underlying them. Parts 10 and 12–17 deal specifically with attributes of the software. Parts 14–17 are intended to be used by both designers and evaluators of user interfaces, but the focus is primarily on the designer. (Other parts of ISO 9241 are described in Sections 9.1 and 13).

The standards provide an authoritative source of reference, but designers without usability experience have great difficulty applying these types of guidelines (de Souza & Bevan, 1990). To apply guidelines successfully, designers need to understand the design goals and benefits of each guideline, the conditions under which the guideline should be applied, the precise nature of the proposed solution, and any procedure that must be followed to apply the guideline. Parts 12–17 contain daunting 82 pages of guidelines, but even then do not provide all this information for every guideline.

Several checklists have been prepared to help assess the conformance of software to the main principles in ISO 9241 (Gediga, Hamborg & Düntsch, 1999; Oppermann & Reiterer, 1997; Prümper, 1999).

**Part 10: Dialogue principles (1996)**. This part deals with general ergonomic principles which apply to the design of dialogues between humans and information systems: suitability for the task, suitability for learning, suitability for individualization, conformity with user expectations, self descriptiveness, controllability and error tolerance.

**Part 12: Presentation of information (1998)**. This part contains recommendations for presenting and representing information on visual displays. It includes guidance on ways of representing complex information using alphanumeric and graphical/symbolic codes, screen layout and design as well as the use of windows.

**Part 13: User guidance (1998)**. This part provides recommendations for the design and evaluation of user guidance attributes of software user interfaces including prompts, feedback, status, on-line help and error management.

**Part 14: Menu dialogues (1997)**. This part provides recommendations for the design of menus used in user–computer dialogues. The recommendations cover menu structure, navigation, option selection and execution and menu presentation (by various techniques including windowing, panels, buttons, fields, etc.).

**Part 15: Command dialogues (1997)**. This part provides recommendations for the design of command languages used in user–computer dialogues. The recommendations cover command language structure and syntax, command representations, input and output considerations, and feedback and help.

**Part 16: Direct manipulation dialogues (1999)**. This part provides recommendations for the ergonomic design of direct manipulation dialogues, and includes the manipulation of objects, and the design of metaphors, objects and attributes. It covers those aspects of Graphical User Interfaces that are directly manipulated, and not covered by other parts of ISO 9241.

**Part 17: Form filling dialogues (1998)**. This part provides recommendations for the ergonomic design of form filling dialogues. The recommendations cover form structure and output considerations, input considerations, and form navigation.

### 8.2. ISO/IEC 9126: SOFTWARE ENGINEERING—PRODUCT QUALITY

ISO/IEC 9126-1 (described in Section 6.3) defines usability in terms of understandability, learnability, operability and attractiveness. Parts 2 and 3 include examples of metrics for these characteristics. These can be used to specify and evaluate detailed usability criteria.

**Part 2: External metrics (DTR: 2001)**. This technical report describes metrics that can be used to specify or evaluate the behaviour of the software when operated by the user. For example: how long does it take to learn to use a function, can users undo functions, do users respond appropriately to error messages?

**Part 3: Internal metrics (DTR: 2001)**. This technical report describes metrics that can be used to create requirements that describe static properties of the interface that can be evaluated by inspection without operating the software. For example: what proportion of the functions are documented, what proportion of functions can be undone, what proportion or error messages are self-explanatory?

### 8.3. ISO/IEC 11581 ICON SYMBOLS AND FUNCTIONS

**Part 1: Icons—General (2000)**. This part contains a framework for the development and design of icons, including general requirements and recommendations applicable to all icons.

**Part 2: Object icons (2000)**. This part contains requirements and recommendations for icons that represent functions by association with an object, and that can be moved and opened. It also contains specifications for the function and appearance of 20 icons.

**Part 3: Pointer icons (2000)**. This part contains requirements and recommendations for eight commonly used pointer icons that represent a pointer associated with a physical input device. It also specifies how pointer icons change appearance to provide user feedback.

**Part 4: Control icons (CD: 1999)**. This part contains requirements and recommendations for 14 commonly used control icons that enable the user to operate on windows, lists and other graphical elements.

**Part 5: Tool icons (FCD: 2000)**. This part contains requirements and recommendations for 20 commonly used icons for tools, and specifies the relationships between tool and pointer icons.

**Part 6: Action icons (1999)**. This part contains requirements and recommendations for 23 commonly used icons typically used on toolbars that represent actions by association with objects that prompt the user to recall the intended actions.

### 8.4. ISO/IEC 10741-1: DIALOGUE INTERACTION—CURSOR CONTROL FOR TEXT EDITING (1995)

This standard specifies how the cursor should move on the screen in response to the use of cursor control keys.

### 8.5. ISO/IEC FCD 18021: INFORMATION TECHNOLOGY—USER INTERFACE FOR MOBILE TOOLS (2001)

This standard contains user interface specifications for PDAs with a data interchange capability with corresponding servers.

### 8.6. ISO 14915: SOFTWARE ERGONOMICS FOR MULTIMEDIA USER INTERFACES

**Part 1: Design principles and framework (DIS: 2000)**. This part provides an overall introduction to the standard.

**Part 2: Multimedia control and navigation (CD: 2000)**. This part provides recommendations for navigation structures and aids, media controls, basic controls, media control guidelines for dynamic media and controls and navigation involving multiple media.

**Part 3: Media selection and combination (DIS: 2000)**. This part provides general guidelines for media selection and combination, media selection for information types, media combination and integration and directing users' attention.

**Part 4: Domain specific multimedia interfaces (AWI)**. This part is intended to cover computer based training, computer supported cooperative work, kiosk systems, on-line help and testing and evaluation.

### 8.7. IEC CDV TR 61997: GUIDELINES FOR THE USER INTERFACES IN MULTIMEDIA EQUIPMENT FOR GENERAL PURPOSE USE (2000)

This technical report gives general principles and detailed design guidance for media selection, and for mechanical, graphical and auditory user interfaces.

## 9. Hardware interface

These standards can be used in the design and evaluation of workplaces, screens, keyboards and other input devices. Unlike the software standards, most of these

standards contain explicit requirements. ISO 9241 and ISO 13406 contain requirements for visual display terminals in offices. These standards can be used to support adherence to European regulations for the use of display screens (Bevan, 1991). Gestures for pen-based systems are covered in ISO/IEC 14754. ISO 11064 contains ergonomic requirements for the design of control centres.

### 9.1. ISO 9241: ERGONOMIC REQUIREMENTS FOR OFFICE WORK WITH VISUAL DISPLAY TERMINALS

ISO 9241 provides requirements and recommendations relating to the attributes of the hardware, software and environment that contribute to usability, and the ergonomic principles underlying them. Parts 3–9 contain hardware design requirements and guidance.

**Part 3: Visual display requirements (1992)**. This part specifies the ergonomic requirements for display screens that ensure that they can be read comfortably, safely and efficiently to perform office tasks. Although it deals specifically with displays used in offices, it is appropriate for most applications that require general-purpose displays to be used in an office-like environment.

**Part 4: Keyboard requirements (1998)**. This part specifies the ergonomic design characteristics of an alphanumeric keyboard that may be used comfortably, safely and efficiently to perform office tasks. Keyboard layouts are dealt with separately in various parts of ISO/IEC 9995: Information processing—keyboard layouts for text and office systems (1994).

**Part 5: Workstation layout and postural requirements (1998)**. This part specifies the ergonomic requirements for a visual display terminal workplace that will allow the user to adopt a comfortable and efficient posture.

**Part 6: Guidance on the work environment (1999)**. This part provides guidance on the visual display terminal working environment (including lighting, noise, temperature, vibration and electromagnetic fields) that will provide the user with comfortable, safe and productive working conditions.

**Part 7: Requirements for display with reflections (1998)**. This part specifies the methods of measurement of glare and reflections from the surface of display screens, including those with surface treatments. It is aimed at display manufacturers who wish to ensure that anti-reflection treatments do not detract from image quality.

**Part 8: Requirements for displayed colours (1997)**. This part specifies the requirements for multicolour displays that are largely in addition to the monochrome requirements in Part 3.

**Part 9: Requirements for non-keyboard input devices (2000)**. This part specifies the ergonomic requirements for non-keyboard input devices that may be used in conjunction with a visual display terminal. It covers such devices as the mouse, trackball and other pointing devices. It also includes a performance test. It does not address voice input.

### 9.2. ISO 13406: ERGONOMIC REQUIREMENTS FOR WORK WITH VISUAL DISPLAYS BASED ON FLAT PANELS

**Part 1: Introduction (1999)**.

**Part 2: Ergonomic requirements for flat panel displays (2001)**. This standard establishes ergonomic image-quality requirements for the design and evaluation of flat panel displays and specifies methods of determining image quality.

### 9.3. ISO AWI 18789: ERGONOMIC REQUIREMENTS AND MEASUREMENT TECHNIQUES FOR ELECTRONIC VISUAL DISPLAYS (1999)

This standard is intended to revise and replace ISO 9241 Parts 3, 7 and 8 and ISO 13406.

### 9.4. ISO/IEC 14754: PEN-BASED INTERFACES—COMMON GESTURES FOR TEXT EDITING WITH PEN-BASED SYSTEMS (1999)

This standard defines a set of basic gesture commands and feedback for pen interfaces. The gestures include: select, delete, insert space, split line, move, copy, cut, paste, scroll and undo.

### 9.5. ISO 11064: ERGONOMIC DESIGN OF CONTROL CENTRES

This eight part standard contain ergonomic principles, recommendations and guidelines.

**Part 1: Principles for the design of control centres (2000)**.

**Part 2: Principles of control suite arrangement (2000)**.

**Part 3: Control room layout (1999)**.

**Part 4: Workstation layout and dimensions (CD: 2000)**.

**Part 5: Human–system interfaces (WD: 1999)**.

**Part 6: Environmental requirements for control rooms (WD: 2000)**.

**Part 7: Principles for the evaluation of control centres (WD: 2000)**.

**Part 8: Ergonomic requirements for specific applications (WD: 2000)**.

## 10. Documentation

ISO/IEC 15910 provides a detailed process for the development of user documentation (paper and on-line help), while ISO/IEC 18019 gives more guidance on how to produce documentation that meets user needs.

**ISO/IEC 15910: Software user documentation process (1999)**. This standard specifies the minimum process for creating user documentation for software that has a user interface, including printed documentation (e.g. user manuals and quick-reference cards), on-line documentation, help text and on-line documentation systems.

**ISO/IEC WD 18019: Guidelines for the design and preparation of software user documentation (2000)**. This standard describes how to establish what information users need, how to determine the way in which that information should be presented to the users, and then how to prepare the information and make it available. It covers both on-line and printed documentation and has been developed from two British Standards.

BS 7649: Guide to the design and preparation of documentation for users of application software (1993).
BS 7830: Guide to the design and preparation of on-screen documentation for users of application software (1996).

The standard is intended to compliment ISO/IEC 9127—User documentation and cover information for software packages, and ISO/IEC 15910 Software user documentation process.

## 11. The development process

ISO 13407 explains the activities required for a user-centred design, and ISO DTR 16982 outlines the types of methods that can be used. ISO/IEC 14598 give a general framework for the evaluation of software products using the model in ISO/IEC 9126-1.

**ISO 13407: Human-centred design processes for interactive systems (1999)**. This standard provides guidance on human-centred design (HCD) activities throughout the life cycle of interactive computer-based systems. It is a tool for those managing design processes and provides guidance on sources of information and standards relevant to the human-centred approach. It describes human-centred design as a multidisciplinary activity, which incorporates human factors and ergonomics knowledge and techniques with the objective of enhancing effectiveness and efficiency, improving human working conditions, and counteracting possible adverse effects of use on human health, safety and performance. See Earthy, Sherwood Jones and Bevan (2001) for a fuller treatment of ISO 13407.

The EU-funded INUSE project has developed a more detailed procedure and a set of criteria that can be used to assess how closely a development process has followed the principles of ISO 13407 (Bevan, Claridge, Earthy & Kirakowski, 1998). The TRUMP project recommended specific methods for user-centred design based on ISO 13407 (Bevan, 2000).

**ISO DTR 16982: Usability methods supporting human-centred design (2001)**. This technical report outlines the different types of usability methods that can be used to support user-centred design.

**ISO/IEC 14598: Information technology—Evaluation of software products (1998–2000)**. This multi-part standard specifies the process to be used to evaluate software products. The first part included the original definition of quality in use.

## 12. Usability capability of the organization

The usability maturity model in ISO TR 18529 contains a structured set of processes derived from ISO 13407 and a survey of good practice. It can be used to assess the extent to which an organization is capable of carrying out a user-centred design. Each human-centred design (HCD) process (such as "specify the user and organizational requirements") can be rated on the ISO 15504 Software Process Assessment scale: Incomplete, Performed, Managed, Established, Predictable or Optimizing (Earthy *et al.*, 2001).

**ISO TR 18529: Ergonomics of human–system interaction—Human-centred lifecycle process descriptions (2000)**. This Technical Report contains a structured and formalized list of human-centred processes.

```
HCD.1 Ensure HCD content in system strategy.
HCD.2 Plan and manage the HCD process.
HCD.3 Specify the user and organizational requirements.
HCD.4 Understand and specify the context of use.
HCD.5 Produce design solutions.
HCD.6 Evaluate designs against requirements.
HCD.7 Introduce and operate the system.
```

The Usability Maturity Model in ISO TR 18529 is based on the model developed by the INUSE project (Earthy, 1999). For more information see Earthy *et al.* (2001).

## 13. Other related standards

**ISO 9241-1: Ergonomic requirements for office work with visual display terminals (VDTs)—Part 1: General Introduction (1997)**. This part introduces the multi-part standard ISO 9241 for the ergonomic requirements for the use of visual display terminals for office tasks and explains some of the basic underlying principles. It provides some guidance on how to use the standard and describes how conformance to parts of ISO 9241 should be reported.

**ISO 9241-2: Part 2: Guidance on task requirements (1992)**. This part deals with the design of tasks and jobs involving work with visual display terminals. It provides guidance on how task requirements may be identified and specified within individual organizations and how task requirements can be incorporated into the system design and implementation process.

**ISO 10075-1: Ergonomic principles related to mental workload—General terms and definitions (1994)**. This part of ISO 10075 explains the terminology and provides definitions in the area of mental workload.

**ISO DTS 16071: Guidance on accessibility for human–computer interfaces (2000)**. This technical specification (derived from ANSI HFS 200) provides guidelines and recommendations for the design of systems and software that will enable users with disabilities greater accessibility to computer systems (with or without assistive technology). It includes low vision users, hearing impaired users, deaf users, users with physical and cognitive impairments, and the elderly.

## 14. Where to get international standards

ISO standards have to be purchased. They can be obtained directly from ISO (see address in reference list), or from a national standards body (Table 5). NSSN: A national

TABLE 5
*Sources of standards and further information*

| Information | URL |
|---|---|
| Published ISO standards, and the status of standards under development. | www.iso.ch/projects/programme.html |
| ISO national member bodies | www.iso.ch/addresse/membodies.html |
| Secretariats for draft standards | www.iso.ch/projects/programme.html |
| BSI: British Standards Institute | www.bsi.org.uk |
| ANSI: American National Standards Institute | www.ansi.org |
| NSSN: A National Resource for Global Standards | www.nssn.org |
| TRUMP list of HCI and usability standards | www.usability.serco.com/trump/resources/standards.htm |
| IBM list of ISO and ANSI HCI standards | www-3.ibm.com/ibm/easy/eou_ext.nsf/Publish/583 |

resource for global standards also has a comprehensive list of standards, some of which can be obtained electronically. In principle, draft standards can also be purchased; but, while the FDIS and DIS documents published by ISO are easy to obtain, the individual secretariats have to be approached to obtain earlier drafts (e.g. FCD, CD or DTR). While these early drafts may give a good indication of the likely content of the final standard, they are often subject to major changes, and in some cases may never be published.

## 15. How to contribute

ISO and IEC comprise national standards bodies from member states. The technical work takes place in working groups of experts, nominated by national standards committees but expected to act as independent experts.

Most standards bodies welcome the participation of individuals with suitable technical expertise. Participation is possible at two levels: national or international. Although some international standards are based on national drafts, most technical work takes place in the international groups. The drafts are circulated to participating national member bodies for comment.

Despite the importance of standards, the technical work is carried out by volunteers. There are few sources of funding for the development of international standards, and most participants are supported by their employer. Contact your national standards organization if you would like to volunteer to the following.

- Provide written comments on draft standards.
- Participate in national meetings to produce national standards and contribute to national comments and policy on international standards.
- Participate in international meetings.

The difficulties of developing ergonomic standards are discussed by Stewart (2000).

## 16. Applicability of the standards

The international standards described in this paper avoid many of the potential disadvantages of user interface standards. They support good design, can be used to support legal requirements and can be cited in contracts to help assure the usability of products.

### 16.1. DISADVANTAGES OF USER INTERFACE STANDARDS

Possible objections to the use of standards include the following.

*Standards for HCI and usability will be an unnecessary constraint on design and stifle innovation.* Consistency is important in user interface design, but in practice this level of detail has been left to industry style guides (e.g. Microsoft Corporation, 1999). An attempt by the IEEE to develop a standard for "drivability" of user interfaces (IEEE, 1993) failed to achieve consensus.

*These standards often describe principles, not useful solutions.* To avoid constraining the design, most of the international standards for the software user interface described in this paper specify the principles to be used, rather than the specific implementation. Moreover standards on specific details of the user interface can quickly go out of date. Many of the ergonomic standards contain a single requirement specifying what kind of information shall be provided to demonstrate that the relevant recommendations in the standard have been identified and followed. This approach is inevitable given that so many recommendations are context-specific.
*User interface standards can quickly become out of date.* All international standards are reviewed at least once every 5 years. A majority of the participating countries decides whether the standards should be confirmed, revised or withdrawn.

## 16.2. SUPPORT FOR LEGISLATION

The European Display Screen Equipment Directive (EEC, 1990) specifies minimum ergonomic requirements for workstation equipment and the environment. These can be achieved by conforming to ISO 9241 Parts 3–9. The Directive also requires that the "principles of software ergonomics" are applied in designing the user interface. ISO 9241 Part 10 contains appropriate principles. The other requirements for the ease of use of software can be met by conforming to ISO 9241 Parts 12–17.

The Machinery Directive (EC, 1998) requires suppliers to provide machinery that meets essential health and safety requirements, one of which is that the interactive software is "user-friendly".

The Supplier's Directive (EEC, 1993) requires that the technical specifications used for procurement by public bodies must make reference to relevant standards adopted by the European standards body (CEN). These could include ergonomic and user interface standards, provided that they have explicit conformance requirements.

European Union countries have national legislation to implement these Directives (eg. HSE, 1992).

## 16.3. USE IN CONTRACTS

Technical specifications in contracts could make use of the following types of standards.

*Usage in context.* Requirements for effectiveness, efficiency and satisfaction in a particular context of use can be specified using ISO 9241-11 and ISO/IEC TR 9126-4.
*User interface design.* Office systems can be required to conform to the user interface guidelines in ISO 9241.
*User-centred design.* The design and development process can be required to conform to ISO 13407.
*Organizational capability.* The usability maturity of organizations developing the software can be assessed (ISO TR 18529).

These are potentially complementary approaches to the assurance of usability. Usability of the developed product can be tested against effectiveness, efficiency and satisfaction criteria, but this only establishes usability for a particular combination of user group and tasks. Use of ISO 9241 (in combination with a style guide) is useful for a detailed design,

but does not in itself ensure usability. Requiring that a user-centred design process conforming to ISO 13407 be used should ensure that all necessary user-centred activities take place. An organization can demonstrate this capability in advance by having its usability maturity assessed against ISO TR 18529.

### 16.4. GOOD PRACTICE IN USER-CENTRED DESIGN

The standards that define organizational capability and the requirements for a user-centred design process provide the framework for how user-centred design should be practised, and could potentially have a significant impact on the practice of HCI and usability. Earthy *et al.* (2001) assert that software engineers, system engineers and usability professionals have a professional responsibility to adopt the definition of good practice in ISO 13407 and ISO TR 18529 as their baseline. These standards provide a broad framework for the future definition of good practice in usability and HCI.

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