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Human-centred design processes for interactive systems

Processus de conception centrée sur l'opérateur humain pour les systèmes interactifs

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 13407 was prepared by Technical Committee ISO/TC 159, *Ergonomics*, Subcommittee SC 4, *Ergonomics of human-system interaction*.

Annexes A, B and C of this International Standard are for information only.

Introduction

Human-centred design is an approach to interactive system development that focuses specifically on making systems usable. It is a multi-disciplinary activity which incorporates human factors and ergonomics knowledge and techniques. The application of human factors and ergonomics to interactive systems design enhances effectiveness and efficiency, improves human working conditions, and counteracts possible adverse effects of use on human health, safety and performance. Applying ergonomics to the design of systems involves taking account of human capabilities, skills, limitations and needs.

Human-centred systems support users and motivate them to learn. The benefits can include increased productivity, enhanced quality of work, reductions in support and training costs, and improved user satisfaction. Although there is a substantial body of human factors and ergonomics knowledge about how such design processes can be organized and used effectively, much of this information is only well-known by specialists in these fields. This International Standard aims to help those responsible for managing hardware and software design processes to identify and plan effective and timely human-centred design activities. It complements existing design approaches and methods.

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Human-centred design processes for interactive systems

1 Scope

This International Standard provides guidance on human-centred design activities throughout the life cycle of computer-based interactive systems. It is aimed at those managing design processes and provides guidance on sources of information and standards relevant to the human-centred approach.

This International Standard is concerned with both hardware and software components of interactive systems.

NOTE Computer-based interactive systems vary in scale and complexity. Examples include off-the-shelf (shrink wrap) software products, custom office systems, plant monitoring systems, automated banking systems and consumer products.

This International Standard addresses the planning and management of human-centred design. It does not address all aspects of project management.

This International Standard provides an overview of human-centred design activities. It does not provide detailed coverage of the methods and techniques required for human-centred design, nor does it address health and safety aspects in detail.

The main users of this International Standard will be project managers. This International Standard therefore addresses technical human factors and ergonomics issues only to the extent necessary to allow managers to understand their relevance and importance in the design process as a whole. Such issues are dealt with more fully in ISO 9241 (see bibliography) which is complementary to this International Standard and is aimed at system developers, specifiers and purchasers of systems. Nonetheless, all parties involved in human-centred system development, including the end-users of systems, should find the guidance in this International Standard relevant.

2 Terms and definitions

For the purposes of this International Standard, the following terms and definitions apply.

2.1
interactive system
combination of hardware and software components that receive input from, and communicate output to, a human user in order to support his or her performance of a task

NOTE The term “system” is often used rather than “interactive system”.

2.2
prototype
representation of all or part of a product or system that, although limited in some way, can be used for evaluation

2.3
usability
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 9241-11:1998, definition 3.1]

2.4
effectiveness
accuracy and completeness with which users achieve specified goals

[ISO 9241-11:1998, definition 3.2]

2.5
efficiency
resources expended in relation to the accuracy and completeness with which users achieve goals

[ISO 9241-11:1998, definition 3.3]

2.6
satisfaction
freedom from discomfort, and positive attitudes to the use of the product

[ISO 9241-11:1998, definition 3.4]

2.7
context of use
users, tasks, equipment (hardware, software and materials), and the physical and social environments in which a product is used

[ISO 9241-11:1998, definition 3.5]

2.8
user
individual interacting with the system

[ISO 9241-10:1996, definition 2.2]

3 Structure of this International Standard

Clause 4 outlines the reasons for adopting a human-centred design process. These can be used to provide a rationale for the use of human-centred methods, or to determine priorities for resource allocation during a project.

Clause 5 gives guidance on the principles of human-centred design. Clause 6 lists the issues to be considered when planning human-centred design activities and discusses how these should relate to system design goals.

Clause 7 is the core of this International Standard. It describes each of the four essential human-centred activities which should take place during the design process. Clause 8 gives further guidance on reporting human-centred activities.

4 Rationale for adopting a human-centred design process

All work systems should follow the ergonomic principles described in ISO 6385:1981. Making interactive systems more human-centred has substantial economic and social benefits. In most countries, employers and system providers have legal obligations to protect users from risks to their health and safety. Making systems more usable means systems can contribute to these aims, meeting user and organizational needs better. They

a) are easier to understand and use, thus reducing training and support costs,

b) improve user satisfaction and reduce discomfort and stress,

c) improve the productivity of users and the operational efficiency of organizations, and

d) improve product quality, appeal to the users and can provide a competitive advantage.

The complete benefits of human-centred design can be determined by taking into account the total life-cycle costs of the system including conception, design, implementation, support, use and maintenance.

5 Principles of human-centred design

5.1 General

There are many industry and proprietary standard methods for the design of computer-based interactive systems. This International Standard does not assume any one standard design process, nor does it cover all the different activities necessary to ensure effective system design. It is complementary to existing design methods and provides a human-centred perspective that can be integrated into different forms of design process in a way that is appropriate to the particular context. All the human-centred design activities identified in clause 7 are applicable, to a greater or lesser extent, at any stage in the development of a system.

Whatever the design process and allocation of responsibilities and roles adopted, the incorporation of a human-centred approach is characterized by the following:

a) the active involvement of users and a clear understanding of user and task requirements;

b) an appropriate allocation of function between users and technology;

c) the iteration of design solutions;

d) multi-disciplinary design.

5.2 The active involvement of users and a clear understanding of user and task requirements

The involvement of users in the development process provides a valuable source of knowledge about the context of use, the tasks, and how users are likely to work with the future product or system. The effectiveness of user involvement increases as the interaction between the developers and the users increases. The nature of user involvement varies depending on the design activities which are being undertaken.

When custom-made products are being developed, the proposed users and the tasks performed can be directly linked to the development process. The organization procuring the system has the opportunity to have a direct influence on the design as it emerges, and solutions can be evaluated by those who are actually going to be working with them. Such involvement and participation also increase user acceptance and commitment.

When generic or consumer products are being developed, the user population is dispersed and is perhaps not easily accessible. It is still essential that users or appropriate representatives are involved in development, in order that the relevant user and task requirements can be identified for inclusion in the system specification, and in order to provide feedback through testing of the proposed design solutions.

5.3 An appropriate allocation of function between users and technology

One of the most important human-centred design principles concerns the appropriate allocation of function – the specification of which functions should be carried out by the users and which by the technology. These design decisions determine the extent to which a given job, task, function or responsibility is to be automated or assigned to human performance.

The decisions should be based on many factors, such as relative capabilities and limitations of humans versus technology in terms of reliability, speed, accuracy, strength, flexibility of response, financial cost, the importance of successful or timely accomplishment of tasks and user well-being. They should not simply be based on determining which functions the technology is capable of performing and then simply allocating the remaining functions topr

explicitly). Iteration allows preliminary design solutions to be tested against “real world” scenarios, with the results being fed back into progressively refined solutions.

Iteration can be incorporated in other design approaches. Even in the “waterfall” model, where there is a systematic top-down hierarchy of design decisions and the relationship between the stages generally precludes iteration between them, there can be extensive iteration within a stage.

5.5 Multi-disciplinary design

Human-centred design needs a variety of skills. A range of personnel is necessary to address the human aspects of the design. This means that multi-disciplinary teams should be involved in a user-centred design process. These can be small, dynamic and need only last the life of the project. The composition of the teams should reflect the relationship between the organization responsible for technical development and the customer. The roles can include the following

a) end-user;

b) purchaser, manager of user;

c) application domain specialist, business analyst;

d) systems analyst, systems engineer, programmer;

e) marketer, salesperson;

f) user interface designer, visual designer;

g) human factors and ergonomics expert, human-computer interaction specialist;

h) technical author, trainer and support personnel.

Individual team members can cover a number of different skill areas and viewpoints. Multi-disciplinary teams do not have to be large but the team should be sufficiently diverse to make appropriate design trade-off decisions.

6 Planning the human-centred design process

A plan should be developed to specify how the human-centred activities fit into the overall system development process.

The plan should identify:

a) the human-centred design process activities described in clause 7, i.e. understanding and identifying context of use, specifying user and organizational requirements, producing prototypes and evaluating designs according to user criteria;

b) procedures for integrating these activities with other system development activities, e.g. analysis, design, testing;

c) the individuals and the organization(s) responsible for the human-centred design activities and the range of skills and viewpoints they provide;

d) effective procedures for establishing feedback and communication on human-centred design activities as they affect other design activities, and methods for documenting these activities;

e) appropriate milestones for human-centred activities integrated into the overall design and development process;

f) suitable timescales to allow feedback, and possible design changes, to be incorporated into the project schedule.

This human-centred design process plan should form part of the overall system development project plan and should also be subject to the same project disciplines (e.g. responsibilities, change control) as other key activities to ensure that it is followed through and implemented effectively. The plan should be revised as requirements change and updated to reflect the status of activities.

Project planning should allow for iteration and for incorporating user feedback. Some time is also required for effective communication among design team participants and for reconciling potential conflicts and trade-offs. Projects benefit from additional creativity and ideas from the interaction of team members who, collectively have an extensive skill base. Extra communication and discussion to identify and resolve problems early on in the project can result in significant savings at later stages when changes are generally more costly.

Design organizations should incorporate human-centred design into their existing internal procedures and development standards. This can include organization procedures for prototyping, for testing, for establishing appropriate user involvement, for ensuring the right mix of skills and competence in the development team.

If the developing organization has a quality system and associated quality plans for system development, then a specific plan should be included for the human-centred design process covering both the type of development process adopted and the quality control measures.

7 Human-centred design activities

7.1 General

There are four human-centred design activities that should take place during a system development project.

These activities are

a) to understand and specify the context of use,

b) to specify the user and organizational requirements,

Relevant characteristics of the physical and social environment should also be described. These can include relevant standards, 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 and directives) and the social and cultural environment (e.g., work practices, organizational structure and attitudes).

7.2.2 The output from this activity should be a description of the relevant characteristics of the users, tasks and environment which identifies what aspects have an important impact on the system design. (See ISO 9241-11 for more information about the context of use and a sample report.)

NOTE 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.

The context of use description should

a) specify the range of intended users, tasks and environments in sufficient detail to support design activity;

b) be derived from suitable sources;

c) be confirmed by the users or if they are not available, by those representing their interests in the process;

d) be adequately documented;

e) be made available to the design team at appropriate times and in appropriate forms to support design activities.

7.3 Specify the user and organizational requirements

7.3.1 In most design processes, there is a major activity specifying the functional and other requirements for the product or system. For human-centred design, this activity should be extended to create an explicit statement of user and organizational requirements in relation to the context of use description. The following aspects should be considered in order to identify relevant requirements:

a) required performance of the new system against operational and financial objectives;

b) relevant statutory or legislative requirements, including safety and health;

c) cooperation and communication between users and other relevant parties;

d) the users’ jobs (including the allocation of tasks, users’ well-being, and motivation);

e) task performance;

f) work design and organization;

g) management of change, including training and personnel to be involved;

h) feasibility of operation and maintenance;

i) the human-computer interface and workstation design.

7.3.2

a) identify the range of relevant users and other personnel in the design,

b) provide a clear statement of the human-centred design goals,

c) set appropriate priorities for the different requirements,

d) provide measurable criteria against which the emerging design can be tested,

e) be confirmed by the users or those representing their interests in the process,

f) include any statutory or legislative requirements, and

g) be adequately documented.

7.4 Produce design solutions

7.4.1 General

Potential design solutions are produced by drawing on the established state of the art, the experience and knowledge of the participants and the results of the context of use analysis. The process therefore involves the following activities:

a) use existing knowledge to develop design proposals with multi-disciplinary input;

b) make the design solutions more concrete using simulations, models, mock-ups, etc.;

c) present the design solutions to users and allow them to perform tasks (or simulated tasks);

d) alter the design in response to the user feedback and iterate this process until the human-centred design goals are met;

e) manage the iteration of design solutions.

7.4.2 Use existing knowledge to develop design proposals with a multi-disciplinary input

There is a substantial body of scientific knowledge and theory from ergonomics, psychology, cognitive science, product design and other relevant disciplines that can indicate potential design solutions. Many organizations have internal user interface style guides, product knowledge and marketing information which can be useful in supporting the initial design, particularly when designing similar products. Generic human factors and ergonomics design guidance and standards are also available from national and international standards bodies. See annex A for relevant standards and bibliography for further sources of information.

7.4.3 Make the design solution more concrete using simulations, models, mock-ups, etc.

Using simulations, models and mock-ups or other forms of prototype allows designers to communicate more effectively with users and reduces the need and cost of reworking that can occur when products need to be revised later in the life cycle — in some cases after initial release to real customers.

The benefits are the following:

a) to make design decisions more explicit (this enables members of the design team to communicate with each other early in the process);

b) to allow designers to explore several design concepts before they settle on one;

c) to make it possible to incorporate user feedback into the design early in the development process;

d) to make it possible to evaluate several iterations of a design and alternative designs;

e) to improve the quality and completeness of the functional design specification.

Prototyping can be carried out at most stages of design, from earliest design ideas based on the context of use information (for example, using scenarios) to pre-production prototypes that are virtually complete in all details. A prototype can be as simple as a pencil and paper sketch or as complex as a computer-based simulation, barely distinguishable from the real thing.

7.4.4 Present the design solution to users and allow them to perform tasks (or simulated tasks)

Users can be involved very early in the design through the use of static, paper-based mock-ups. This could involve presenting users with sketches of screen images of what a product/system is to look like and asking them to try them out in a realistic context. Some aspects of the design (e.g., how easy it is to work with the menu hierarchies) can then be quickly and inexpensively assessed. For hardware products, three-dimensional models constructed of simple materials can yield similar benefits.

Simple prototypes are valuable at an early stage to explore alternative design solutions. Although there is benefit in making the design solutions as realistic as possible, it is important not to invest so much time, money or commitment on realistic prototypes, that there is reluctance to change the design.

In a human-centred approach, prototypes are not simply demonstrations to show users a preview of the design but are used to collect user feedback that is then used to drive the design process.

If it is impractical to show prototypes to users early in the design process (for example, for reasons of confidentiality), evaluation can be conducted by experts. Expert evaluation can be valuable and cost-effective and can complement user testing. However, for a design process to be human-centred, the final testing (at least) should take place with real users.

See 7.5 for details of design evaluation.

7.4.5 Alter the design in response to the user feedback and iterate this process until design objectives are met

The level of prototype and the degree of iteration vary depending on several factors, including the importance attached to optimizing the design. In software developments, prototyping can start with paper visualizations of screen designs and progress through several stages of iteration to interactive software with just enough functionality to support a subset of user tasks. Later in design, prototypes can be evaluated in a more realistic context. To obtain the maximum benefits, it is best to carry out several iterations with users. In order to determine whether the overall objectives have been met, more formal evaluation should be conducted in a realistic context, for example, without help or interruptions from the evaluator.

User comments, and difficulties observed when using a prototype, offer guidance on functional design changes that can improve system usability. In some cases such feedback can also help to refine the scope and purpose of an interactive system (see 7.5.1)

7.4.6 Manage the iteration of design solutions

In order to manage the progress of iterative design, the results of activities 7.4.2 to 7.4.5 should be recorded. These records can be wholly documentary or can include the design artefact itself, for example, some prototype hardware or software. They include

a) the sources of existing knowledge and standards used, with an indication of how they have been incorporated (or why they have not been followed, if appropriate),

b) the steps taken to ensure that the prototype covered key requirements and followed good practice, and

c) the nature of the problems identified and the subsequent changes to the design.

a) to provide feedback which can be used to improve design,

b) to assess whether user and organizational objectives have been achieved, and

c) to monitor long-term use of the product or system.

Early in design the emphasis is on obtaining feedback that can be used to guide design, while later when a more complete prototype is available it is possible to measure whether user and organizational objectives (see 7.3) 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 is. It is therefore important to start evaluation as early as possible.

7.5.2 Evaluation plan

An evaluation plan should be developed which identifies the relevant aspects of the following;

a) the human-centred design goals;

b) who is responsible for the evaluation;

c) what parts of the system are to be evaluated and how they are to be evaluated, for example, the use of test scenarios, mock-ups or prototypes;

d) how evaluation is to be performed and the procedures for carrying out the tests;

e) resources required for evaluation and analysis of results and access to users (as necessary);

f) scheduling of evaluation activities and their relation to the project timetable;

g) feedback and use of results in other design activities.

Evaluation techniques vary in their degree of formality, rigour and user involvement, depending on the environment in which the evaluation is conducted. The choice is determined by financial and time constraints, the stage in the development life cycle and the nature of the system under development.

7.5.3 Provide design feedback

Evaluations should take place at all stages in the system life cycle in order to influence the system to be delivered. Particular evaluation goals should reflect one or more of the objectives below:

a) to assess how well the system meets its organizational goals;

b) to diagnose potential problems and identify needs for improvements in the interface, the supporting material, the workstation environment or the training proposals;

c) to select the design option that best fits the functional and user requirements;

d) to elicit feedback and further requirements from the users.

Expert evaluation can be fast and economical and is good for identifying major problems but is not sufficient to guarantee a successful interactive system. The standards and guidelines referenced in annex A and the bibliography provide processes and criteria which can be used as a basis for this type of evaluation.

User-based evaluation can be used to provide feedback at any stage of design. In the early stages, users can be involved in the evaluation of scenarios, simple paper mock-ups or partial prototypes (see 7.4.5 for details of prototyping and iteration).

As design solutions become more developed, evaluations involving users are based on progressively more complete and concrete versions of the system. When trying to improve a prototype to meet human-centred design

objectives, cooperative evaluation can be valuable, where the evaluator discusses problems with the user as they occur. See the bibliography for sources of further information.

7.5.4 Assess whether objectives have been achieved

Evaluation can be used

a) to demonstrate that a particular design meets the human-centred requirements and

b) to assess conformity to international, national, local, corporate or statutory standards.

Further information on evaluation criteria can be found in the standards listed in annex A. To obtain valid results, the evaluation should use appropriate methods, with a representative sample of users performing realistic tasks.

The choice of evaluation criteria for human-centred goals depends on the requirements for the product and the needs of the organization setting the criteria. Objectives can relate to a primary goal (e.g. produce a letter) or a sub-goal (e.g. successfully search and replace an item) or secondary goals (e.g. maintainability). Focusing objectives on the most important user goals can mean ignoring other functions, but is normally the most practical approach. Setting objectives for specific sub-goals can permit evaluation earlier in the development process. It may be necessary to specify criteria both for the minimum acceptable levels and for the target levels to be achieved. For further information, see ISO 9241-11.

7.5.5 Field validation

The aim of field validation is to test the functioning of the final system to ensure that it meets the requirements of the users, the tasks and the environment. The main techniques which can be used include help desk data, field reports, real user feedback, performance data, reports of health impacts, design improvements, and requests for changes.

7.5.6 Long-term monitoring

There should be a plan and a process for long-term monitoring of the use of the product or system. Systematic collection of user input is needed as part of the design and evaluation activities in a human-centred design process. Long-term monitoring means collecting user input in different ways, over a period of time. There is an important difference between short-term evaluation and long-term evaluation. Some effects of working with an interactive system are not recognizable until the system has been used for a period of time or there may be effects which result from external factors, for example, unforeseen changes in working practices.

Performance criteria and company health reports can provide assessment parameters for the long-term evaluation process. Attention to human-centred design principles during the design phase can identify those parameters most important to assess. Performance criteria can be quite straightforward: does the system achieve its productivity goals? Information can be gained from standard economic and marketing studies, analyses of support costs, modification requests and other data.

Criteria and measurements should be sensitive enough to identify system failure, or system problems, at an early stage.

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c) there were valid testing and data collection methods,

d) there was an appropriate treatment of test results, and

e) the conditions of testing were appropriate.

There are three types of evaluation reporting that can be useful during the design process, depending on whether the purpose of the evaluation is to feedback to design, to test against specific standards or to provide evidence of achieving human-centred goals, for example, in terms of usability or user health and safety.

7.5.7.2 Reporting of feedback to design should

— take place at an appropriate time in the development process,

— be based on appropriate sources of evaluation e.g. users, design reviews,

— provide design feedback in a form which supports design decisions, and

— result in demonstrable changes in the system, where applicable.

7.5.7.3 Reporting on tests of the design against specific standards should

— identify relevant standards and provide a rationale for their use,

— provide evidence that the assessment was conducted by a competent person using appropriate procedures,

— provide evidence that sufficient parts of the system were tested to give meaningful results for the system as a whole,

— report how non-conformities were dealt with in the design, and

— justify any deviations from applicable standards.

7.5.7.4 Reporting on user testing should

— define the context of use which was used for evaluation,

— provide information on the user and organizational requirements,

— describe the product tested and its status, e.g. production prototype,

— describe the measurements undertaken, users and methods used,

— contain results with relevant statistical analysis, and

— indicate a pass/fail decision in relation to the requirements.

8 Conformance

If a development process is claimed to have met the recommendations in this International Standard, the procedures used, the information collected and the use made of the results shall be specified. The level of specification of the procedure and the level of detail for reporting the information collected are a matter of negotiation between the involved parties.

Users of this International Standard can either utilize the procedure and forms provided in annex C or develop another procedure tailored to their particular development and/or environment.

Annex A
(informative)

Guidance on other relevant standards

A.1 General

Standards related to human-centred design fall into two categories:

— process-oriented: these specify procedures and processes to be followed;

— product-oriented: these specify required attributes of the user interface.

Some product-oriented standards specify the requirements in terms of performance rather than product attributes. These standards describe the users, tasks, and context of use and assess usability in terms of user performance and satisfaction to be achieved.

A.2 Process-oriented

ISO 6385:1981, *Ergonomic principles in the design of work systems.*

ISO 6385 sets out the ergonomic principles which should be applied to the design of work systems. This International Standard is based on these principles, and on the description of the aims and objectives of ergonomics which are contained therein.

ISO 9241-1:1997, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 1: General introduction*.

ISO 9241-5 specifies the ergonomic requirements for a visual display terminal workplace which will allow the user to adopt a comfortable and efficient posture.

ISO 9241-6:—[1)], *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 6: Guidance on the work environment.*

ISO 9241-6 specifies the ergonomic requirements for the visual display terminal working environment which will provide the user with comfortable, safe and productive working conditions.

ISO 9241-7:1998, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 7: Requirements for display with reflections.*

ISO 9241-7 specifies 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.

ISO 9241-8:1997, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 8: Requirements for displayed colours.*

ISO 9241-8 specifies the requirements for multi-colour displays which are largely in addition to the monochrome requirements in part 3.

ISO 9241-9:—[1)], *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 9: Requirements for non-keyboard input devices* .

ISO 9241-9 specifies the ergonomic requirements for non-keyboard input devices which may be used in conjunction with a visual display terminal. It covers such devices as the mouse, trackerball and other pointing devices. It also includes a performance test. It does not address voice input.

ISO 9241-10:1996, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 10: Dialogue principles.*

ISO 9241-10 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.

ISO 9241-12:1998, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 12: Presentation of information.*

ISO 9241-12 contains specific 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.

ISO 9241-13:1998, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 13: User guidance.*

ISO 9241-13 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.

ISO 9241-14:1997, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 14: Menu dialogues.*

ISO 9241-14 provides recommendations for the ergonomic 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.). ISO 9241-14 is intended to be used by both designers and evaluators of menus, although its focus is primarily towards the designer.

ISO 9241-15:1997, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 15: Command dialogues.*

ISO 9241-15 provides recommendations for the ergonomic design of command languages used in user-computer dialogues. The recommendations cover command language structure and syntax, command representations, input and output considerations, feedback and help. ISO 9241-15 is intended to be used by both designers and evaluators of command dialogues, but the focus is primarily towards the designer.

ISO 9241-16:—[1)], *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 16: Direct-manipulation dialogues*.

ISO 9241-16 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" which are directly manipulated, and not covered by other parts of ISO 9241. ISO 9241-16 is intended to be used by both designers and evaluators of command dialogues, but the focus is primarily towards the designer.

ISO 9241-17:1998, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 17: Form filling dialogues.*

ISO 9241-17 provides recommendations for the ergonomic design of form filling dialogues. The recommendations cover form structure and output considerations, input considerations, and form navigation. ISO 9241-17 is intended to be used by both designers and evaluators of command dialogues, but the focus is primarily towards the designer.

ISO/IEC 10741-1:1995, *Information technology — User System Interfaces — Dialogue interaction — Part 1: Cursor control for text editing*.

ISO 10471-1 specifies how the cursor could move on the screen in response to the use of cursor control keys or other input devices.

ISO/IEC 11581-1:—[1)], *Information technology — User System Interfaces — Icon symbols and functions — Part 1: Icons: General.*

ISO 11581-1 contains a framework for the development and design of icons, including general requirements and recommendations applicable to all icons.

ISO/IEC 11581-2:—[1)], *Information technology — User System Interfaces — Icon symbols and functions — Part 2: Object icons.*

ISO 11581-2 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.

ISO/IEC 11581-3:—[1)], *Information technology — User System Interfaces — Icon symbols and functions — Part 3: Pointers.*

ISO 11581-3 describes user interaction with and appearance of pointers on the screen. It also specifies how pointers on a screen change appearance to give users feedback.

Product standards can be used in the following ways:

— to specify details of the appearance and behaviour of the user interface;

— to provide detailed guidance on the design of user interfaces;

— to provide criteria for the evaluation of user interfaces.

However, the attributes which a product requires for usability depend on the nature of the user, task and environment. A product has no intrinsic usability, only a capability to be used in a particular context. ISO 9241-11 can be used to help understand the context in which particular attributes can be required.

Annex B
(informative)

Example of a structure of a usability evaluation report

B.1 General

This is an example of the structure of a usability evaluation report used in a large international banking organization. The report itself was detailed and provided sufficient data to enable decisions to be made for the future of the project concerned. In such reports, the structure and the level of detail is a matter of negotiation between the involved parties.

B.2 Executive summary

This section provides an overview of the evaluation of the design at a particular project stage, details the evaluation objectives and provides a summary of the recommendations.

B.3 Product evaluated

This section describes the scope of the physical product/system under evaluation and also includes a breakdown of the functional areas covered by the evaluation.

B.4 Objectives of evaluation

This section describes the objectives of the evaluation and any areas of specific interest, for example:

a) to evaluate the ability of designated users to use effectively the application software at an appropriate level, through observing, recording and measuring,

   — user efficiency for a clearly defined set of tasks, and

   — different levels of user experience,

b) to evaluate the subjective reactions, attitudes and satisfaction ratings by

   — structured debriefing, and

   — user perception questionnaires.

B.5 Context of use

This section describes

— the context analysis which was carried out to ensure that the evaluation carried out matched the intended use of the system;

— the scenarios developed to incorporate the tasks identified in the context analysis, and

— the differences between the working and evaluation environments.

B.6 Measurement plan

B.6.1 Users

This section compares the participants selected to the intended users identified in the context of use description.

B.6.2 Methods

This section outlines the methods of measurement used during the evaluation, for example:

— usability analyst observation and videotape analysis;

— business area observation;

— user and customer debrief by usability analysts;

— user and customer questionnaire analysis.

B.6.3 Sequence

This section provides a breakdown and schedule of various activities performed during the day: welcome and introduction, on-site training, pre-task briefing, tasks, questionnaire completion, verbal debrief, goodbye.

B.7 Results

B.7.1 General

This is the major section of the evaluation report. It includes a warning that the experiences are those of a small number of people taken from the intended user population.

B.7.2 Video analysis

Analysis of each session in detail to record the length of time spent doing each task is given. Timings for each participant are provided for searches, snags, help within each task undertaken. Graphical presentation of results is preferred.

B.7.3 User interface design

Usability concerns relating to the screen design for each application area are recorded. Examples include problems with consistency, lack of fit with the task and the need for error messages which tell the user how to correct a situation. Also included are general design issues such as use of colour and crowding of information on screens.

B.7.4 Workflow and process

Issues relating to the number of steps within processes are reported from observation and from comments of participants.

B.7.5 Training

The section identifies user requirements for future training, based on observation of user performance.

B.7.6 User debriefing

Results from any project specific questionnaires completed by each participant are detailed and can include example quotes.

B.7.7 User perception questionnaires

Usability checklist scores and interpretation of responses are included.

B.8 Recommendations

The concluding section lists all recommendations made from analysis of the results as described earlier. Recommendations are listed in order of importance and ease of implementation (quick wins), together with the likely impact on user and business if not acted upon. Examples of design solutions can be suggested for consideration where evidence exists to support them.

B.9 Appendices

Task breakdowns.

Analysis of video recording of user performance.

Analysis of user responses to questions in user perception questionnaires.

Analysis of customer responses to questions in customer perception questionnaire.

Annex C
(informative)

Sample procedure for demonstrating conformance to this International Standard

C.1 Introduction

This annex provides an example of a procedure for determining whether a human-centred process, as described in this International Standard, has been applied in the development of an interactive system. It should be noted that the procedure described in C.2 is provided as guidance only, and parties may choose to use alternative procedures. The checklist is not intended to be used in isolation. It should only be used in conjunction with the full text of this International Standard. This annex provides a checklist-based procedure to do the following:

a) identify the information to be produced by each human-centred activity in the development of an interactive system;

b) describe how the production of such information should be assured;

c) record the results of the assessment process.

NOTE This procedure can be followed in any human-centred design project. In small projects some of the information may not be required or may be easily obtained and require little formal documentation.

C.2 Documentation

The checklists are completed as follows:

a) the relevance of the information to the project should be assessed;

b) the location of information and means of assessment columns are completed before an activity has been carried out;

c) during the check that the human-centred process has adhered to its procedures, an assessor makes the check for adherence using the defined means of assessment for each information item;

d) the adherence and comments columns are completed by the assessor.

Users of this International Standard can demonstrate how they complied with this standard by using the lists given in Tables C.1 to C.5 as evidence that they had correctly produced, managed and applied the information relating to human-centred activities in a project or design life cycle. Although ISO standards are copyright, the checklists may be freely reproduced.

The checklists headings are as follows.

— **Information item**. This column contains a list of the information which this International Standard suggests should be produced during a human-centred design process. Each item is labelled with the clause that describes the activity which generates or uses that information.

— **Location of information**. Although the documents described in this International Standard will be suitable for many projects, the items of information generated or used by the human-centred activities can be recorded in many different documents, files, databases, etc., depending on the nature of the project and development life cycle.This column in the checklist can be used to record the location of the information and the required format and level of detail of that information for the particular project or life cycle.

Table C.2 — Specification of the context of use

Information item (related clause)	Location of information	Relevance (Y/N)	Means of assessment	Adherence (Y/N)	Comments
Specification of the range of intended users, tasks and environments (7.2)					
The sources from which the context of use information was derived (7.2)					
Evidence of confirmation of context of use information (7.2)					
Evidence of the provision of context of use information to the design team (7.2)					
Evidence that the context of use has been used in the design process (7.4.1).					

Table C.3 — Specification of the user and organizational requirements

Information item (related clause)	Location of information	Relevance (Y/N)	Means of assessment	Adherence (Y/N)	Comments
The range and relevance of users and other personnel in the design (7.3)					
Statement of the human-centred design goals (7.3)					
Priorities for the different requirements (7.3)					
Criteria against which the design can be tested (7.3)					
Evidence of confirmation of the above by users or their representatives (7.3)					
List of statutory or legislative requirements (7.3)					
Evidence that the requirements have been used in the design process (7.4.1)					

Table C.4 — Production and testing of design solutions

Information item (related clause)	Location of information	Relevance (Y/N)	Means of assessment	Adherence (Y/N)	Comments

Table C.5 — Evaluation of designs against user requirements *(concluded)*

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