Draft for Public Comment

Form 36
Version 8.0

DPC: 09/30186636 DC

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Date: 8 January 2009

Origin: International

Latest date for receipt of comments: 31 March 2009

Project no.: 2008/02456

Responsible committee: PH/9 Applied ergonomics

Interested committees:

Title: Draft BS ENISO 9241-210 Ergonomics of human-system interaction

Part 210: Human-centred design process for interactive systems

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Introduction
This draft standard is based on international discussions in which the UK has taken an active part. Your comments on this draft are invited and will assist in the preparation of the consequent standard. Comments submitted will be reviewed by the relevant BSI committee before sending the consensus UK vote and comments to the international secretariat, which will then decide appropriate action on the draft and the comments received.

If the international standard is approved, it is possible the text will be published as an identical British Standard.

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Date: xx/xx/200x	Document: **ISO/DIS xxxxx**

1	2	(3)	4	5	(6)	(7)
MB	**Clause No./ Subclause No./ Annex** (e.g. 3.1)	**Paragraph/ Figure/Table/ Note** (e.g. Table 1)	**Type of com-ment**	**Comment (justification for change) by the MB**	**Proposed change by the MB**	**Secretariat observations** on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '. . . so that the mains connector to which no connection ...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

DRAFT INTERNATIONAL STANDARD ISO/DIS 9241-210

ISO/TC **159**/SC **4** Secretariat: **BSI**

Voting begins on: **2008-11-28** Voting terminates on: **2009-04-28**

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

Ergonomics of human-system interaction —

Part 210: Human-centred design for interactive systems

Ergonomie de l'interaction homme-système —

Partie 210: Conception centrée sur l'opérateur humain pour les systèmes interactifs

ICS 13.180; 35.180

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Pour accélérer la distribution, le présent document est distribué tel qu'il est parvenu du secrétariat du comité. Le travail de rédaction et de composition de texte sera effectué au Secrétariat central de l'ISO au stade de publication.

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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.

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The main task of technical committees is to prepare International Standards. 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.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 9241-210 was prepared by Technical Committee ISO/TC 159, *Ergonomics*, Subcommittee SC 4, *Ergonomics of the human-system interaction*.

ISO 9241 consists of the following parts, under the general title *Ergonomics of human system interaction — Part 210: Human-centred design for interactive systems*:

Introduction

Human-centred design is an approach to interactive system development that aims to make systems usable by focussing on the users, their needs and requirements, and by applying human factors, ergonomics and usability knowledge and techniques. This approach enhances effectiveness and efficiency, improves human well-being, user satisfaction, accessibility and sustainability; and counteracts possible adverse effects of use on human health, safety and performance.

There is a substantial body of human factors, ergonomics and usability knowledge about how human-centred design can be organized and used effectively. This part of ISO 9241 aims to make this information available to help those responsible for managing hardware and software design and re-design processes to identify and plan effective and timely human-centred design activities.

Human-centred design described in this part of ISO 9241 complements existing systems design approaches. It can be incorporated in approaches as diverse as object oriented, waterfall and rapid application development.

This part of ISO 9241 replaces ISO 13407. The changes include clarifying the role of iteration in the whole design process, not just evaluation, emphasising that human-centred methods can be used throughout the system life cycle and explaining design activities and human-centred design principles more clearly. The principles of human-centred design and the related activities have not changed substantially since ISO 13407 was produced and have been validated by ten years of application. 9241-210 reflects this by making requirements as well as recommendations.

Ergonomics of human-system interaction —

Part 210:
Human-centred design for interactive systems

1 Scope

This part of ISO 9241 provides requirements and recommendations on human-centred design principles and activities throughout the life cycle of computer-based interactive systems. It is intended to be used by those managing design processes. This part of ISO 9241 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, web sites and applications, and consumer products, such as vending machines, mobile phones and digital television. Throughout this standard, such systems are generally referred to as products, systems or services although, for simplicity, sometimes only one term is used.

This part of ISO 9241 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 or safety aspects in detail. Although it addresses the planning and management of human-centred design, it does not address all aspects of project management.

The information in this part of ISO 9241 is intended for use by those responsible for planning and managing projects that design and develop interactive systems. It therefore addresses technical human factors and ergonomics issues only to the extent necessary to allow such individuals to understand their relevance and importance in the design process as a whole. It also provides a framework for human factors and usability professionals involved in human-centred design. Detailed human factors, ergonomics, usability and accessibility issues are dealt with more fully in a number of standards including other parts of ISO 9241 (see Annex A) and ISO 6385 which sets out the broad principles of ergonomics (see Annex B).

The requirements and recommendations in this part of ISO 9241 can benefit all parties involved in human-centred design and development. Annex C provides a checklist that can be used to support claims of conformance to this standard.

2 Terms and Definitions

For the purposes of this part of ISO 9241, the following definitions apply.

3.1
accessibility <interactive systems>
usability of a product, service, environment or facility by people with the widest range of capabilities
[ISO 9241-171]

3.2
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]

3.3
effectiveness
accuracy and completeness with which users achieve specified goals
[ISO 9241-11: 1998]

3.4
efficiency
resources expended in relation to the accuracy and completeness with which users achieve goals
[ISO 9241-11: 1998]

3.5
ergonomics (or human factors)
scientific discipline concerned with the understanding of interactions among human and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance
[ISO 6385:2004]

3.6
goal
intended outcome
[ISO 9241-11: 1998]

3.7
human-centred design
approach to system design and development that aims to make interactive systems more usable by focussing on the use of the system; applying human factors, ergonomics and usability knowledge and techniques

NOTE 1 The term “human-centred design” is used rather than “user-centred design” in order to emphasize that this standard also addresses impacts on a number of stakeholders, not just those typically considered as users. However, in practice, these terms are often used synonymously.

NOTE 2 Usable systems can provide a number of benefits including improved productivity, enhanced user wellbeing, avoidance of stress, increased accessibility, and reduced risk of harm.

3.8
interactive system
combination of hardware, software and /or services that receives input from and communicates output to users

NOTE This includes, where appropriate, packaging, branding, user documentation, on-line help, support and training.

3.9
prototype
representation of all or part of an interactive system, that, although limited in some way, can be used for analysis, design and evaluation

NOTE A prototype may be as simple as a sketch or static mock-up or as complicated as a fully functioning interactive system with more or less complete functionality.

3.10
satisfaction
freedom from discomfort, and positive attitudes to the use of the product
[ISO 9241-11: 1998]

3.11
task
the activities required to achieve a goal
[ISO 9241-11: 1998]

3.12
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]

3.13
user
person who interacts with the product
[ISO 9241-11: 1998]

3.14
user experience
A person's perceptions and responses that result from the use or anticipated use of a product, system or service

NOTE 1 User experience includes all the users' emotions, beliefs, preferences, perceptions, physical and psychological responses, behaviours and accomplishments.

NOTE 2 User experience is a consequence of the presentation, functionality, system performance, interactive behaviour, and assistive capabilities of the interactive system. It is also a consequence of the user's prior experiences, attitudes, skills and personality.

NOTE 3 Usability, when interpreted from the perspective of the users' personal goals, can include the kind of perceptual and emotional aspects typically associated with user experience. Usability criteria can be used to assess aspects of user experience.

3.15
user interface
all components of an interactive system (software or hardware) that provide information and controls for the user to accomplish specific tasks with the interactive system
[ISO 9241-110:2006]

3 Rationale for adopting human-centred design

Using a human-centred approach to design and development has substantial economic and social benefits for users, employers and suppliers. Highly usable systems and products tend to be more successful both technically and commercially. In some areas, for example consumer products, purchasers will pay a premium for well-designed products and systems. Support and help-desk costs are reduced when users can understand and use products without additional assistance. In most countries, employers and system providers have legal obligations to protect users from risks to their health and safety and human-centred methods can reduce these risks, for example musculoskeletal risks. Systems designed using human-centred methods improve quality, for example, by:

a) improving the productivity of users and the operational efficiency of organizations;

b) being easier to understand and use, thus reducing training and support costs;

c) increasing usability for people with a wider range of capabilities and thus increasing accessibility;

d) improving user experience;

e) reducing discomfort and stress;

f) providing a competitive advantage, for example by improving brand image;

g) contributing towards sustainability objectives.

The complete benefits of human-centred design can be determined by taking into account the total life cycle costs of the product, system or service including conception, design, implementation, support, use, maintenance and finally disposal. Taking a human-centred design approach contributes to other aspects of system design, for example by improving the identification and definition of functional requirements. Taking a human-centred design approach also increases the likelihood of completing the project successfully, on time, and within budget. Using appropriate human-centred methods can reduce the risk that the product fails to meet stakeholder requirements.

Examples of outputs from human-centred design activities are illustrated in Table 1.

Table 1 — Examples of outputs from human-centred design activities

Activities	Outputs from human-centred design
understand and specify the context of use	• Context of use description • User needs description
specify the user requirements	• Context of use specification • User requirements specification
produce design solutions to meet these requirements	• User interaction specification • User interface specification • An implemented user interface
evaluate the designs against requirements	• Evaluation results • Conformance test results • Long term monitoring results

More detailed information on each output can be found in ISO/IEC TR 25060 "*Common industry format for usability – General framework for usability-related information*".

4 Principles of human-centred design

4.1 General

This part of ISO 9241 provides a framework for human-centred design. It does not assume any particular design process, nor does it describe all the different activities necessary to ensure effective system design. It is complementary to existing design methodologies and provides a human-centred perspective that can be integrated into different design and development processes 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, a human-centred approach should follow the principles listed below (and described in Clauses 5.2 to 5.7):

a) The design is based upon an explicit understanding of users, tasks and environments;

b) Users are involved throughout design and development;

c) The design is driven and refined by user-centred evaluation;

d) The process is iterative;

e) The design addresses the whole user experience;

f) The design team includes multi- disciplinary skills and perspectives.

4.2 The design is based upon an explicit understanding of users, tasks and environments

Products, systems and services should be designed to take account of the people who will use them and other stakeholder groups, including those who might be affected by their use. Therefore all relevant user and stakeholder groups should be identified. Constructing systems based on an inappropriate or incomplete understanding of user needs is one of the major sources of systems failure.

The extent to which products are usable and accessible depends on the context, i.e. the specified users, performing specified tasks in a specified environment (ISO 9241-11). For example, the kind of interface which provides the right user experience for a young person downloading music on a phone may be completely inappropriate for accessing corporate data on a PDA (Personal Digital Assistant). The characteristics of the users, tasks and environment are called the context of use. Guidance on how to gather relevant information is provided in Clause 7.2. The context of use is a major source of the information used to establish requirements (see 7.3) and an essential input to the design process.

4.3 Users are involved throughout design and development

Involving users in design and development provides a valuable source of knowledge about the context of use, the tasks, and how users are likely to work with the future product, system or service. User involvement should be active, whether by participation in design, acting as a source of relevant data or by evaluating solutions. The people who are involved should have capabilities, characteristics and experience that reflect the range of users for whom the system is being designed. The nature and frequency of this involvement can vary throughout design and development and the nature of the project. The effectiveness of user involvement increases as the interaction between the developers and the users increases.

When custom-made systems are being developed, the intended 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 those who are actually going to be working with the future system can take part in evaluating proposed solutions. Such involvement and participation can also increase user acceptance and commitment.

When generic or consumer products are being developed, the user population is dispersed and products can be targeted at groups of users with particular characteristics. It is still essential that users or appropriate representatives are involved in development, in order that the user and task requirements relevant to the intended user group(s) can be identified for inclusion in the system specification, and in order to provide feedback through testing of the proposed design solutions.

4.4 The design is driven and refined by user-centred evaluation

Feedback from users is a critical source of information in human-centred design. Evaluating designs with users and improving them based on this feedback provides an effective means of minimizing the risk that a system does not meet user and organizational needs (including those requirements that are hidden or difficult to specify explicitly). Such evaluation allows preliminary design solutions to be tested against ‘real world’ scenarios, with the results being fed back into progressively refined solutions. User-centred evaluation should also take place as part of final acceptance of the product to confirm that requirements have been met. Feedback from users during operational use identifies long term issues and provides input to future design.

NOTE The term user-centred is used here to emphasise that this evaluation is from the user’s perspective.

4.5 The process is iterative

The most appropriate design for an interactive system cannot typically be achieved without iteration.

NOTE In this context, iteration means repeating a sequence of steps until a desired outcome is achieved.

Iteration should be used to progressively eliminate uncertainty during the development of interactive systems. Iteration implies that descriptions, specifications and prototypes are revised and refined when new information is obtained, in order to minimize the risk that the system under development fails to meet user requirements

The complexity of human computer interaction means that it is impossible to specify completely and accurately every detail of every aspect of the interaction at the beginning of development. Many of the needs and expectations of users and other stakeholders that will impact on the design of the interaction only emerge in the course of development, as the designers refine their understanding of the users and their tasks, and as users are better able to express their needs in response to potential solutions.

Iteration of proposed solutions incorporating feedback from a user perspective provides a means of mitigating these risks, for example:

— Feedback from a user perspective is used to update the intended context of use, to revise the requirements and to refine proposed design solutions.

— The requirements specification is refined iteratively by using scenarios, early mock-ups, and prototypes, to obtain feedback from users on whether these incorporate the user requirements correctly and completely.

The interaction between human-centred and other aspects of the design can also result in the need for iteration – for example, to take account of the manufacturability of a product, the impact on the production environment or changes in the marketplace.

4.6 The design addresses the whole user experience

User experience is a consequence of the presentation, functionality, system performance, interactive behaviour, and assistive capabilities of the interactive system. It is also a consequence of the user's prior experiences, attitudes, skills and personality. There is a common misconception that usability refers solely to making products easy to use. However, the concept of usability used in ISO 9241 is broader and, when interpreted from the perspective of the users' personal goals, can include the kind of perceptual and emotional aspects typically associated with user experience, as well as issues such as job satisfaction and the elimination of monotony.

It is a consequence of the presentation, functionality, implementation, system performance, interactive behaviour, and assistive capabilities of the interactive system, both hardware and software.

Designing for the user's experience involves considering, where appropriate, organisational impacts, user documentation, on-line help, support and maintenance (including help desks and customer contact points), training, long-term use, and product packaging (including the 'out-of-box experience'). The user's experience of previous or other systems and issues such as branding and advertising should also be considered. The need to consider these different factors and their interdependencies has implications for the project plan (see Clause 6).

User's strengths, limitations, preferences and expectations should be taken into account when specifying which activities are carried out by the users and which functions are carried out by the technology.

NOTE In safety critical and mission critical systems, satisfying user preferences is less important than ensuring the effectiveness or efficiency of the system.

Design decisions related to this allocation of function determine the extent to which a given job, task, function or responsibility is to be automated or assigned to human performance. The decisions are 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, safety, and user satisfaction (both short term, for example, comfort and pleasure, and long term, for example, health, well being and job satisfaction). Basing such decisions solely on which functions the technology is capable of performing and then simply allocating the remaining system functions to users, is likely to result in an ineffective design.

Representative users should generally be involved in these decisions.

The resulting human activities should form a meaningful set of tasks. This is particularly important for custom-made organisational systems where system use supports major elements of the users' jobs. For further guidance, see ISO 9241-2 and ISO 10075-1.

4.7 The design team includes multi- disciplinary skills and perspectives

Human-centred design teams do not have to be large, but the team should be sufficiently diverse to collaborate over design and implementation trade-off decisions at appropriate times. In human-centred design, the following skill areas and viewpoints might be needed in the design and development team:

a) human factors and ergonomics, usability, accessibility, human-computer interaction, user research;

b) users and other stakeholder groups (or those that can represent their perspectives);

c) application domain expertise, subject matter expertise;

d) marketing, branding, sales, technical support and maintenance, health and safety;

e) user interface, visual and product design;

f) technical writing, training, user support;

g) user management, service management and corporate governance;

h) business analysis, systems analysis;

i) systems engineering, hardware and software engineering, programming and production/manufacturing;

j) human resources, sustainability and other stakeholders.

Projects benefit from additional creativity and ideas from the interaction and collaboration of team members who, collectively, have an extensive skill base. An additional benefit of a multi-disciplinary and multi-perspective approach is that team members become more aware of the constraints and realities of the other disciplines, for example, technical experts can become more sensitised to user issues and users can become more aware of technical constraints.

5 Planning human-centred design

5.1 General

Human-centred design shall be planned and integrated into all phases of the product life cycle, i.e. conception, analysis, design, implementation, testing and maintenance.

5.2 Responsibility

Those responsible for planning the project shall consider the relative importance of usability in the project by evaluating:

a) how usability relates to the purpose and use of the product, system or service (for example – size, number of users, relationship with other systems, safety or health issues, accessibility, specialist application, extreme environments);

b) the levels of the various types of risk that might result from poor usability (for example – financial, poor product differentiation, safety, required level of usability, acceptance);

c) the nature of the development environment (for example - size of project, time to market, range technologies, internal or external project, type of contract).

NOTE Underestimating the extent of user interaction is a common feature of projects which do not plan human-centred design appropriately. For example, a system may be initially intended to be fully automated but ends up requiring significant user interaction.

In general, the aim is to select the most appropriate techniques and procedures in order to identify and mitigate human-system risks.

NOTE Descriptions of methods to implement human-centred design activities can be found in ISO TR 16982/9241-230. Details of human-centred design processes that can be used to implement the guidance in this International Standard can be found in the ISO TR 18529 P*rocess model for the human-centred design of interactive systems*. ISO TR 18529 uses the ISO standard format for process models, and also contains processes for ensuring human-centred design content in systems strategy and the introduction and operation of interactive systems. Details of the processes used by an enterprise in order to define and address the wider range of product and process issues raised by the human-centred approach can be found in ISO PAS 18152/9241-220.

5.3 Content of plan

The planning of human-centred design shall include:

a) identifying appropriate methods and resources for the activities described in Clause 7;

b) defining procedures for integrating these activities with other system development activities;

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

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

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

f) agreeing on suitable timescales to allow iteration, use of feedback, and possible design changes, to be incorporated into project schedule.

5.4 Integration with project plan

The plan for human-centred design shall form part of the overall project plan. To ensure that it is followed through and implemented effectively the plan for human-centred design should be subject to the same project disciplines (e.g. responsibilities, change control) as other key activities. The human centred design aspects of the project plan should be reviewed and revised as requirements change as appropriate throughout the life of the project.

5.5 Timing and resources

Project planning shall allocate time and resources for the human-centred activities. This shall include time for iteration and the incorporation of user feedback, and for evaluating whether the design solution satisfies the user requirements.

Additional time should also be allocated for communication among design team participants and for reconciling potential conflicts and trade-offs that involve human-system issues. Extra communication and discussion to identify and resolve usability issues early in the project will deliver significant savings at later stages (when changes are, inevitably, more costly).

Human-centred design activities should start at the earliest stage of the project (for example, as part of the process of formulating the initial concept for the product or system). Human-centred design continues throughout the life of the project.

6 Human-centred design activities

6.1 General

There are four linked human-centred design activities that shall take place during the design of any interactive system. These are described in 7.2 to 7.5 and are summarised below.

a) Understand and specify the context of use;

b) Specify the user requirements;

c) Produce design solutions;

d) Evaluate.

These activities take account of the challenges that:

a) it is not uncommon for there to be a number of different user groups and other stakeholders, whose needs must be taken into account;

b) the context of use can be highly diverse and can vary from user group to user group and between different tasks;

c) at the beginning of a project, the requirements that can be captured are unlikely to be exhaustive;

d) some requirements only emerge once a proposed solution is available;

e) user requirements can be diverse and potentially contradictory with each other and with those of other stakeholders;

f) initial design solutions rarely satisfy all the user needs;

g) it is difficult to ensure that all parts of the system are considered in an integrated manner.

At a high level, project human-centred design activities correspond to the overall stages of design and development from requirements through design to validation. But at a more detailed level, these activities can be applied to obtain feedback on initial design concepts before requirements are finalised. Evaluating rough prototypes and mock-ups of potential designs will help obtain a deeper understanding of user needs, as well as providing initial feedback on the design concepts. These activities can also be applied during revisions to an interactive system and can be useful in evaluating systems in routine operation.

Figure 1 illustrates the interdependence of human-centred design activities. Figure 1 does not imply a strict linear process, it rather illustrates that each human-centred design activity uses outputs from other activities.

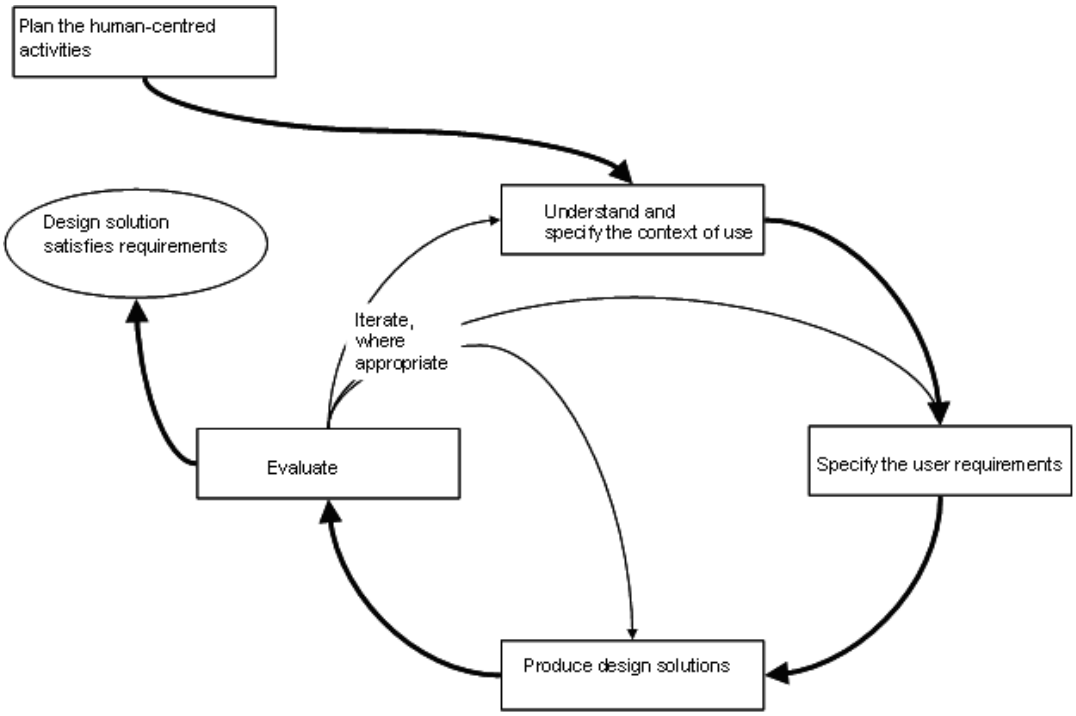

Figure 1 — The interdependence of human-centred design activities

6.2 Understand and specify the context of use

6.2.1 General

The characteristics of the users, tasks and the organizational, technical and physical environment define the context in which the system is used. It is useful to gather and analyse information on the current context in order to understand and then specify the context that will apply in the future system. Analysis of existing or similar systems (including manual systems if appropriate) can, if still valid, provide information on a whole range of context issues including deficiencies and baseline levels of performance and satisfaction. It can reveal needs, problems and constraints that might otherwise be overlooked but which must be met by the future system. Also some aspects of the current context will persist, even if the system is highly novel. If an existing system is to be upgraded or enhanced, some of this information will already be available. If there are extensive results from user feedback, help desk reports and other data, these can provide a basis for prioritizing system modifications and changes.

NOTE A context of use description can be a description of the current context of use or a description of the context intended for design.

ISO TR 16982/9241-230 provides information on a variety of methods which can be used for collecting and communicating this information.

6.2.2 Context of use description

The context of use description shall include the following:

a) **The users and other stakeholder groups**: there can be a range of different user groups as well as other stakeholder groups whose needs are important. Relevant groups shall be identified and their relationship with the proposed development described in terms of key goals and constraints.

b) **The characteristics of the users or groups of users**: relevant characteristics of the users shall be identified. These can include knowledge, skill, experience, education, training, physical attributes, habits, preferences and capabilities. If necessary, the characteristics of different types of users should be defined, for example with different levels of experience or physical capability. In order to achieve accessibility, products, systems and services should be designed to be used by people with the widest range of capabilities in intended user populations. This is a legal requirement in many countries.

c) **The tasks of the users**: the task goals of the users and the overall goals of the system shall be identified. The characteristics of tasks that can influence usability and accessibility shall be described, e.g. the frequency and duration of performance, interdependencies, activities to be carried out in parallel. If there are any potential adverse consequences for health and safety (e.g. excessive workload caused by inappropriate pacing in a call centre) or if the task can be completed incorrectly (e.g. making an incorrect purchase) these should also be identified. Tasks should not be described solely in terms of the functions or features provided by a product or system.

d) **The environment(s) of the system**: the technical environment, including the hardware, software and materials, shall be identified. In addition, the relevant characteristics of the physical and social environment shall be described. The physical attributes include issues such as thermal conditions, lighting, workplace layout, furniture. The social and cultural aspects of the environment include factors such as work practices, organizational structure and attitudes.

NOTE The context of use description is a 'working document' that is first produced in outline terms and is then reviewed, maintained, extended and updated during the design and development process. For example, at an early stage of development it might only be possible to identify task goals rather detailed task activities. It can also flag up important design implications which emerge during the analysis.

6.2.3 Sufficient detail to support design

The context of use of the system should be described in sufficient detail to support the design activity.

6.2.4 Context of use intended for design

The context of use intended for design and in which the system will be used should be specified as part of the user requirements specification to clearly identify the conditions under which the requirements apply. (See ISO 9241-11 for more information about the context of use and a sample report).

6.3 Specify the user requirements

6.3.1 General

In most design projects, identifying user needs and specifying the functional and other requirements for the product or system is a major activity. For human-centred design, this activity shall be extended to create an explicit statement of user requirements in relation to the intended context of use and the business objectives of the system.

The user requirements can include requirements for organisational changes, revised work styles, opportunities to combine products and services. If the proposed interactive system will impact on organisational practice the development process should involve organisational stakeholders with the aim of optimising both the organizational and technical systems.

6.3.2 Identify user and other stakeholder needs

User and other stakeholder needs should be identified, taking account of the context of use. These should include what users need to achieve (rather than how) and any constraints imposed by the context of use.

6.3.3 User requirements to be specified

The specification of user requirements shall include:

a) the intended context of use;

b) requirements derived from the user needs and the context of use, for example there might be a requirement for a product to be used outdoors;

c) requirements arising from relevant ergonomics and user interface knowledge, standards and guidelines, for example there might be a requirement for a computer display to conform to ISO 9241-301;

d) usability requirements and objectives including measurable usability performance and satisfaction criteria in specific contexts of use, for example there might be an objective that 90 % of the intended users can successfully divert an incoming call to voicemail, or for the aesthetic design of a web page to achieve a given user satisfaction score;

e) requirements derived from organizational requirements that directly affect the user, for example a call centre system might require a customer to be responded to within a specific time frame.

User requirements provide the basis for the design and evaluation of interactive systems to meet the user needs.

User requirements are developed in conjunction with, and form part of, the overall requirements specification of an interactive system.

6.3.4 Trade-offs between user requirements

Potential conflicts between user requirements should be resolved, for example between accuracy and speed.

The rationales for trade-offs should be documented so that they can be understood in the future.

NOTE Making such trade-offs can require re-visiting initial assumptions and the involvement of relevant stakeholders

6.3.5 Ensuring the quality of user requirements specifications

The user requirements specification should be:

a) stated in terms that permit subsequent testing;

b) verified by the relevant stakeholders;

c) internally consistent;

d) updated as necessary, during the life of the project.

6.4 Produce design solutions

6.4.1 General

Design decisions can have a major impact on the user experience. Human centred design aims to achieve a good user experience by considering it throughout the design process. [see Clause 5.6].

Potential design solutions are produced by drawing on the description of the context of use, the results of any baseline evaluations, the established state of the art in the application domain, and the experience and knowledge of the participants. Further user requirements can emerge as potential design solutions are detailed and evaluated.

Producing design solutions should include the following sub-activities:

a) designing user tasks, interaction and interface to meet the user requirements, considering the whole user experience;

b) making the design solutions more concrete (for example, making use of scenarios, simulations, prototypes or mock-ups);

c) altering the design solutions in response to user-centred evaluation and feedback (see 7.5 for detail on user evaluation);

d) communicating the design to those responsible for implementation.

6.4.2 Designing user tasks, interaction and interface to meet the user requirements, considering the whole user experience

6.4.2.1 Principles for design

Designing for the user experience is a process of innovation that takes account of user satisfaction (including emotional and aesthetic aspects) as well as effectiveness and efficiency. Design involves a variety of creative approaches to achieve a good user experience.

The following principles (taken from ISO 9241-110) should be taken into account when designing interactive systems:

a) suitability for the task;

b) self-descriptiveness;

c) conformity with user expectations;

d) suitability for learning;

e) controllability;

f) error tolerance;

g) suitability for individualization.

There are a number of other design principles in other human-system interaction standards which provide guidance to support this design activity. These are listed in the Bibliography:

6.4.2.2 Designing the tasks and interaction between user and system

Appropriate design of the user-system interaction relies on a clear understanding of the intended context of use, including the users' roles and tasks and their outputs. This leads to an appropriate 'allocation of function' – the division of system tasks into those performed by humans and those performed by technology.

When the system is being developed for use within a specific organisation, for example a new branch banking system, this activity can also involve job and organisational design. (ISO 9241-2 provides guidance on job design.)

Designing the interaction involves deciding how users will accomplish tasks with the system rather than describing what the system looks like. For example, decisions at this point can include such issues as the choice of modality (for example, auditory, visual and tactile) and the choice of media (for example, text versus graphics, dialogue boxes versus wizards, mechanical versus electronic controls).

Designing the interaction should include:

a) making high level decisions (for example, initial design concept, essential outcomes);

b) identifying tasks and sub-tasks;

c) allocating tasks to user and system;

d) identifying the interaction objects required for the completion of the tasks;

e) identifying and selecting appropriate dialogue techniques [see ISO 9241 parts 12 to 17];

f) designing the sequence and timing (dynamics) of the interaction;

g) designing the information architecture of the user interface of an interactive system to allow efficient access to interaction objects.

NOTE The order in which these activities are undertaken depends on the type of interaction being designed and is itself an iterative activity.

6.4.2.3 Designing the user interface

For the detailed design of the user interface there is a substantial body of ergonomics and user interface knowledge, standards and guidelines which should be used to inform the design of both hardware and software. These include standards within the ISO 9241 series on displays, input devices, dialogue principles, menus, presentation of information, user guidance etc., and other user interface and accessibility guidelines. Many organizations also have internal user interface style guides, product knowledge and knowledge on users and other aspects of the context of use, such as user expectations (see ISO 1503) and stereotypes. See Annex A for relevant standards in the ISO 9241 series.

6.4.3 Making the design solutions more concrete (using scenarios, simulations, prototypes, mock-ups)

Using simulations, models and mock-ups or other forms of prototype allows designers to communicate in a meaningful way what the proposed design is/would be like to users and other stakeholders.

The benefits include:

a) making design proposals more explicit (this enables members of the design team to communicate with each other and with users early in the development process);

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

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

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

e) improving the quality and completeness of the functional design specification.

Simple prototypes are valuable at an early stage to explore alternative design solutions. Whilst there can be substantial benefit in making the design solutions as realistic as possible, the level of detail and realism should be appropriate to the issues that need to be investigated. There is a risk that investing too much time or money in producing detailed working prototypes can lead to a reluctance to change the design.

6.4.4 Altering the design solutions based on user-centred evaluation and feedback (see 7.5 for detail on user-centred evaluation)

Feedback from evaluation should be used to improve and refine the system.

NOTE Feedback reveals strengths and weakness in the design solution and can provide new information about user needs and propose where the design can be improved.

The costs and benefits of proposed changes should be evaluated and used to inform decisions about what will be modified.

NOTE The effort of redesign depends on the nature of the issue: it can be small or require substantial resources and the decision to redesign is assessed against the criticality of the issue.

Changes proposed on the basis of early evaluation are likely to be most cost effective.

Project plans should allow sufficient time for making the changes as a result of such feedback.

6.4.5 Communicating the design solution to those responsible for implementation

There are a variety of ways of communicating the design solution to those teams and individuals responsible for implementation or manufacture. Effective means of communication can vary from providing appropriate documentation, to producing revised prototypes, to embedding experts in human-centred design in the design and development team.

Whatever the nature of the overall project, there should be some sustained channel of communication between those responsible for human-centred design and other members of the project team. When design solutions are communicated, they should be accompanied by an explanation and justification of the design decisions, especially where trade-offs are necessary.

The communication should take account of the constraints imposed by the project and the level of knowledge and understanding about ergonomics and user interface design.

6.5 Evaluate

6.5.1 General

User-centred evaluation is a required activity in human-centred design.

Even at the earliest stages in the project, design concepts should be evaluated to obtain a better understanding of the user needs. Real life use of a product, system or service is complex and even though ergonomic design guidance can provide useful support to designers, user-centred evaluation is an essential element of human-centred design. However, user based testing is not always practical or cost effective at every stage of a project. In such circumstances, design solutions should also be evaluated in other ways, for example using task modelling and simulations. These methods are still centred on how the user will experience the system even though the users themselves might not participate directly. User-centred evaluation can be used to:

a) collect new information about user needs;

b) provide feedback on strengths and weaknesses of the design solution from the users' perspective (in order to improve the design);

c) assess whether user requirements have been achieved (which can include assessing conformity to international, national, local, corporate or statutory standards);

d) establish baselines or make comparisons between designs.

6.5.2 Conducting user-centred evaluation

User-centred evaluation should involve:

a) allocating resources both for obtaining early feedback to improve the product, and later for determining if requirements have been satisfied;

b) planning the user-centred evaluation so that it fits the project schedule;

c) sufficiently comprehensive testing to give meaningful results for the system as a whole;

d) analysing the results, prioritising issues and proposing solutions;

e) communicating the solutions appropriately so that they can be used effectively by the design team.

6.5.3 User-centred evaluation methods

There is a variety of user-centred evaluation methods which can be used to evaluate designs. Guidance on these and other usability methods and how to select the most appropriate method or set of methods is provided in ISO TR 16982/9241-230. Further information, recommendations and tests, checklists and other means of conformance to ergonomic criteria can be found in the standards listed in Annexes A and B.

To obtain valid results, the evaluation should be carried out by experienced practitioners, and should use appropriate methods.

User-centred evaluation is useful at all stages in the project from early concept design to long term usage (which can then provide an input to future versions of the product, system or service). In the early stages of development and design, changes are relatively inexpensive. The longer the process is allowed to progress, and the more fully the system is defined, the greater the cost of changes.

Resources for evaluation should be allocated both for obtaining early feedback to improve the product, and later for determining if requirements have been satisfied. The extent of this later (summative) evaluation should depend on the risks associated with not meeting requirements.

Two widely used approaches to user-centred evaluation are:

— user based testing;

— expert evaluation using usability and accessibility guidelines or requirements.

NOTE Some guidelines and standards for software can be tested automatically, which can be useful to identify basic problems. For example, aspects of the accessibility of software can be evaluated using automated testing tools. However, automated testing can only deal with limited aspects of usability or accessibility.

User-centred evaluation can also be used for long-term monitoring (see 7.5.6).

6.5.4 User based testing

User testing can be undertaken at any stage in the design.

At a very early stage, users can be presented with models, scenarios or sketches of the design concepts and asked to evaluate them in relation to a real context. For example, a new checkout concept can be evaluated using a three-dimensional model, or simple drawings of screens can be used to evaluate a new mobile phone navigation design. Such early testing may provide valuable feedback on the acceptability of the proposed design. Detailed aspects of the design can often be quickly and inexpensively assessed, for example using paper versions of proposed dialogues. A mock-up of the interaction through simulated or actual tasks and suitable context is always necessary.

When prototypes are used, they should be used to collect user feedback while carrying out tasks, rather than just being demonstrations to show users a preview of the design. The information gathered is used to drive the design.

Later in development, user testing can be used to assess whether usability objectives including measurable usability performance and satisfaction criteria have been met in the intended context or contexts of use.

One form of user based testing involves field validation, i.e. testing the designs or design concepts in real environments. For software products, such testing is often referred to as beta testing, where an early version of the software is made available for use with users being made aware that the product is not final and still being refined. Hardware products can be produced in small quantities for similar real world testing. Fully developed products can also be evaluated in field settings to provide input to future developments.

Techniques which can be used to gather data from field validation include help desk data, field reports, incident analysis, near miss reports, log files, defect reports, real user feedback, performance data, satisfaction surveys, reports of health impacts, design improvements, user observation and requests for changes.

6.5.5 Expert evaluation

Expert evaluation can be valuable and cost effective and can also complement user testing. It can be used to eliminate major issues before user testing (and hence make the user testing more cost-effective).

Usability experts frequently base their judgements on their previous experience of problems encountered by users and their knowledge of ergonomic guidelines and standards. The assessment of several experts can be combined to reduce individual bias. Expert evaluation can involve the expert putting themselves into the role of the user working with the system, product or service. Expert evaluation can be supported by checklists, lists of user requirements, general usability guidance, industry best practices, usability heuristics, guidelines or standards. However, the effectiveness of the expert evaluation always depends on the skills, experience and knowledge of the experts.

Expert evaluation is simpler and quicker to carry out than user testing and can, in principle, take account of a wider range of users and tasks than user-based evaluation (for example, to assess if a product satisfies user requirements in contexts of use not selected for user testing). Experts do not always find the same problems that would be found in user based testing. Expert evaluation tends to

emphasize obvious problems and might not scale well for complex or novel interfaces. The greater the difference between the knowledge and experience of the experts and the real users, the less reliable are the results. When appropriate, expert evaluation can be carried out with domain experts working alongside the usability expert.

Relevant guidelines and standards are an important input to design (7.4.2), and compliance can be assessed by expert inspection. Assessing compliance can be time consuming or resource intensive. However, it might be necessary to check compliance, for example, with web accessibility regulations.

6.5.6 Long term monitoring

Human-centred design should also include long term monitoring of the use of the product, system or service. This involves collecting user input in different ways, over a period of time.

Follow-up evaluation is often a formal part of system evaluation done within a specific period, for example 6 months to 1 year after system installation. Follow-up evaluation often tests performance of the system and also collects data to determine whether user needs and requirements were met and were correctly stated.

There is an important difference between short term evaluation and long term monitoring. Some effects of working with an interactive product, system or service are not recognisable until it has been used for a period of time, or there may be effects which result from external factors, for example, unforeseen changes in legislation. Even if such issues do not need to be addressed immediately, information obtained can be used for the future modification or development of the product or system.

Long term performance data and reports about any health effects can provide valuable information. Criteria and measurements should be sensitive enough to identify system failure, or system problems, as early as possible.

NOTE Identifying unsafe behaviour is clearly preferable to registering accidents, and identifying mental or physiological overload is preferable to registering medical disorders.

7 Sustainability and human-centred design

Sustainability, in terms of standardisation, involves considering the integration of, and balance between, economic, social and environmental considerations.

NOTE ISO has made a commitment to develop ‘standards for a sustainable world’. The 1987 United Nations' Brundtland Commission report "Our Common Future" defined sustainable development as "meeting the needs of the present without compromising the ability of future generations to meet their own needs".

Human-centred design directly supports the first two pillars of sustainability:

a) economic – matching a design to user's needs and abilities enhance its utilisation, quality, and efficiency, thus providing cost effective solutions and reducing the likelihood that systems products and services will be rejected by their users ;

b) social – taking a human-centred approach results in systems, products and services which are better for the health and wellbeing of their users, including users with disabilities;

Human-centred design also supports the environmental component through promoting a whole lifecycle approach to design. It explicitly encourages all those involved in design to consider the longer term implications of their system for their users and therefore for the environment.

8 Conformance

Conformance with this part of ISO 9241 is achieved by satisfying all the requirements and applicable recommendations.

Those wishing to claim conformance to this part of ISO 9241 shall evaluate the applicability of each recommendation (a “should” statement) to determine whether it is applicable.

If a product or system is claimed to have met the requirements and the applicable recommendations in ISO 9241-210, the procedure used shall be specified. The level of specification of the procedure is a matter of negotiation between the involved parties.

Annex C provides a means both for recording the applicability of the recommendations and reporting that the requirements and applicable recommendations have been met.

Users of this part of ISO 9241 may either utilize the procedure and forms provided in Annex C, or develop another procedure tailored to their particular needs.

NOTE ISO TR 18529 provides an assessment model for demonstrating capability in human-centred design within a project or an organisation.

Annex A
(informative)

Overview of the ISO 9241 series

The annex presents an overview of the structure of ISO 9241. For an up to date overview of its structure, subject areas and the current status of both published and projected parts, please refer to:

http://isotc.iso.org/livelink/ISO-9241-contents

The structure reflects the numbering of the original ISO 9241 standard, for example displays were originally part 3 and are now the 300 series. In each section, the 'hundred' is an introduction to the section, for example, Part 100 gives an introduction to the software ergonomics parts. The number of parts which will be developed in each section varies depending on the complexity of the area and the need for specific standards.

Only three part numbers will be retained (following revision) from the original ISO 9241 structure, as these address issues which apply across all other parts of ISO 9241:

Part 1 Introduction;

Part 2 Job design;

Part 11 Hardware and software usability.

An additional part which also applies across all of ISO 9241 is:

Part 20 Accessibility and human-system interaction.

The rest of the parts are structured in 'hundreds' as follows:

100 series Software ergonomics

200 series Human system interaction processes

300 series Displays and display related hardware

400 series Physical input devices - ergonomics principles

500 series Workplace ergonomics

600 series Environment ergonomics

700 series Application domains - Control rooms

900 series Tactile and haptic interactions

Annex B
(informative)

Sample procedure for assessing applicability and conformance

B.1 General

This Annex provides an example of a checklist that can be used to determine whether the requirements in this part of ISO 9241 have been met and the applicable recommendations followed.

This checklist contains all requirements and recommendations from this part of ISO 9241, presented in sequence.

It should be noted that the procedure described is itself provided as guidance and is not an exhaustive process to be used as a substitute for the use of the standard itself.

Use of the checklist provides a basis for:

— determining which of the recommendations are applicable;

— determining whether requirements have been met and whether applicable recommendations have been followed;

— providing a list in support of a claim of conformance showing that all requirements have been met, and a systematic listing of all the applicable recommendations that have been followed.

Several of the requirements and recommendation in this standard have more than one component. These are presented in lists. Satisfaction of the requirement or recommendation depends on consideration of each component, rather than the requirement or recommendation itself. Each item of these lists is therefore presented in a separate row in the checklist and the row containing the requirement is marked with a grey fill. To indicate the extent of these lists the clause numbers of the elements of the list are indented.

B.2 The completed checklist can be used in support of statements relating to conformance of a project with the standard. It provides a list of all of the requirements and recommendations for which conformance has been achieved. How to use the checklist

Clause numbers and titles are presented in the first two columns of the table. The third column is used to indicate whether the requirement or recommendation in each clause is applicable or not applicable. All requirements already have Y (yes) inserted in column 3. All the other clauses need to be checked in relation to the project context and Y or N (no) entered in column 3, as appropriate.

For each recommendation, information on applicable circumstances is given in the relevant clause in the standard. If the recommendation is not applicable, this should be indicated in column 3 in the Applicability section of the table, and a brief explanation should be provided in column 4 ‘Reason not applicable’.

Checking whether a requirement or recommendation has been satisfied involves reviewing all those items which are shown to be applicable in column 3 and determining whether the project being evaluated conforms to these requirements and recommendations (where applicable). The exact method for making this determination could vary.

The Conformance section of the checklist provides space in columns 5 and 6 to indicate the decision as to whether each applicable requirement or recommendation has been satisfied (Y) or not satisfied (N). Any clause which is not satisfied should be accompanied by a brief note in column 7 explaining the reasons why this is the case. Column 6 can also be used to record information about the method used.

B.3 Copying the checklist

Copyright release for the table in this Annex: Users of this standard may freely reproduce the table contained in Annex C of this standard for use in the demonstration of conformance with this standard.

Editable versions of the checklist is provided on the ISO TC internet site in a sub-folder to the public information folder called "ISO-9241-210-tables". The URL is:

(this URL to be confirmed) http://isotc.iso.org/livelink/ISO-9241-210-tables

You should click on the 'Proceed to public areas' section when you get the ISO TC log in page.

Table B.1 — Checklist for assessing applicability and conformity with this part of ISO 9241

Clause	Requirement or recommendation in this clause	Applicability		Conformance		
		Yes/No	Reason not applicable	Yes	No	Comments
4	**Principles of human-centred design**					
4.1	Whatever the design process and allocation of responsibilities and roles adopted, a human-centred approach should follow the principles listed [in 5.1].					
4.2	Products, systems and services should be designed to take account of the people who will use them as well as other stakeholder groups including those who might be affected by their use.					
4.2	All relevant user and stakeholder groups should be identified.					
4.3	User involvement should be active.					
4.3	The users who are involved should have capabilities, characteristics and experience that reflect the range of users for whom the system is being designed.					
4.4	User centred evaluation should take place as part of final acceptance of the product to confirm that requirements have been met.					
4.5	Iteration should be used to progressively eliminate uncertainty during the development of interactive systems.					
4.6	The user's experience of previous or other system and issues such as branding and advertising should also be considered.					
4.6	User's strengths, limitations, preferences and expectations should be taken into account when specifying which activities are carried out by the users and which functions are carried out by the technology.					
4.6	Representative users should generally be involved in decisions related to the allocation of function.					
4.6	The human activities resulting from the allocation of function should form a meaningful set of tasks.					
4.7	Human-centred design teams do not have to be large but the team should be sufficiently diverse to collaborate over design and implementation trade-off					

	decisions at appropriate times.					
5	**Planning human-centred design**					
5.1	Human-centred design shall be planned and integrated into all phases of the product life cycle.	Y				
5.2	**Those responsible for planning the project shall consider the relative importance of usability in the project by evaluating:**					
5.2.a)	how usability relates to the purpose and use of the product, system or service;	Y				
5.2.b)	the levels of the various types of risk that might result from poor usability;	Y				
5.2.c)	the nature of the development environment.	Y				
5.3	**The planning of human-centred design shall include:**					
5.3.a)	identifying appropriate methods and resources for the activities described in Clause 6;	Y				
5.3.b)	defining procedures for integrating these activities with other system development activities;	Y				
5.3.c)	identifying the individuals and the organization(s) responsible for the human-centred design activities and the range of skills and viewpoints they provide;	Y				
5.3.d)	developing effective procedures for establishing feedback and communication on human-centred design activities as they affect other design activities and trade-offs, and methods for documenting these activities;	Y				
5.3.e)	agreeing on appropriate milestones for human-centred activities integrated into the overall design and development process;	Y				
5.3.f)	agreeing on suitable timescales to allow iteration, use of feedback, and possible design changes, to be incorporated into project schedule.	Y				
5.4	The plan for human-centred design **shall** form part of the overall system development project plan.	Y				
5.4	To ensure that it is followed through and implemented effectively the plan for human-centred design should be subject to the same project disciplines (e.g. responsibilities, change control) as other key activities					
5.4	The human centred design aspects of the project plan should be reviewed and revised as requirements change as appropriate throughout the life of the project.					

5.5	Project planning **shall** allocate time and resources for the human-centred activities.	Y				
5.5	[The plan] **shall** include time for iteration and the incorporation of user feedback, and for evaluating if the design solution satisfies the user requirements.	Y				
5.5	Additional time **should** be allocated for communication among design team participants and for reconciling potential conflicts and trade-offs that involve human-system issues.					
5.5	Human-centred design activities **should** start at the earliest stage of the project.					
5.5	The human centred design aspects of the project plan **should** be reviewed throughout the life of the project.					
6	**Human-centred design activities**					
6.1	There are four linked human-centred design activities that **shall** take place during the design of any interactive system					
6.1.a)	Understand and specify the context of use	Y				
6.1.b)	Specify the user requirements.	Y				
6.1.c)	Produce design solutions.	Y				
6.1.d)	Evaluate	Y				
6.2.2.a)	Relevant groups **shall** be identified and their relationship with the proposed development described in terms of key goals and constraints.	Y				
6.2.2.b)	Relevant characteristics of the users **shall** be identified.	Y				
6.2.2.b)	If necessary, the characteristics of different types of users should be defined					
6.2.2.b)	In order to achieve accessibility, products, systems and services should be designed to be used by people with the widest range of capabilities in intended user populations.					
6.2.2.c)	The task goals of the users and the overall goals of the system **shall** be identified.	Y				
6.2.2.c)	The characteristics of tasks that can influence usability and accessibility **shall** be described.	Y				
6.2.2.c)	Are there are any potential adverse consequences for health and safety or if					

	the task can be completed incorrectly these should also be identified					
6.2.2.c)	Tasks should not be described solely in terms of the functions or features provided by a product or system.					
6.2.2.d)	The technical environment, including the hardware, software and materials, **shall** be identified.	Y				
6.2.2.d)	The relevant characteristics of the physical and social environment **shall** be described.	Y				
6.2.3	The context of use of the system should be described in sufficient detail to support the design activity.	Y				
6.2.4	The intended context of use should be specified as part of the user requirements specification to clearly identify the conditions under which the requirements apply					
6.2.4	The intended context of use should be specified as part of the user requirements specification to clearly identify the conditions under which the requirements apply.					
6.3.1	Identifying user needs and specifying the functional and other requirements for the product or system should be extended to create an explicit statement of user requirements in relation to the intended context of use and the business objectives of the system.					
6.3.1	If the proposed interactive system will impact on organisational practice the development process should involve organisational stakeholders in the design process with the aim of optimising both the organizational and technical systems.					
6.3.2	User and other stakeholder needs should be identified, taking account of the context of use.					
6.3.2	User and other stakeholder needs should include what users need to achieve (rather than how) and any constraints imposed by the context of use.					
6.3.3	The specification of user requirements **shall** include:					
6.3.3.a)	the intended context of use;	Y				
6.3.3.b)	requirements derived from the user needs and the context of use;	Y				
6.3.3.c)	requirements arising from relevant ergonomics and user interface knowledge, standards and guidelines;	Y				

6.3.3.d)	usability requirements and objectives including measurable usability performance and satisfaction criteria in specific contexts of use;	Y				
6.3.3.e)	requirements derived from organizational requirements that directly affect the user	Y				
6.3.4	Potential conflicts between user requirements should be resolved.					
6.3.4	The rationales for any trade-offs should be documented so that they can be understood in the future.					
6.3.5	The user requirements specification should be:					
6.3.5.a)	stated in terms that permit subsequent testing;					
6.3.5.b)	verified by the relevant stakeholders;					
6.3.5.c)	internally consistent;					
6.3.5.d)	updated as necessary, during the life of the project.					
6.4.1	Producing design solutions should include the following sub-activities:					
6.4.1.a)	designing user tasks, interaction and interface to meet the user requirements, considering the overall user experience;					
6.4.1.b)	making the design solutions more concrete;					
6.4.1.c)	altering the design solutions in response to user centred evaluation and feedback;					
6.4.1.d)	communicating the design to those responsible for implementation.					
6.4.2.1	The following principles (taken from ISO 9241-110) should be taken into account when designing interactive systems:					
6.4.2.1. a)	suitability for the task					
6.4.2.1. b)	self-descriptiveness					
6.4.2.1. c)	conformity with user expectations					
6.4.2.1. d)	suitability for learning					
6.4.2.1.	controllability					

e)						
6.4.2.1. f)	error tolerance					
6.4.2.1. g)	suitability for individualization					
6.4.2.2	Designing the interaction should include:					
6.4.2.2. a)	making high level decisions;					
6.4.2.2. b)	identifying tasks and sub-tasks;					
6.4.2.2. c)	allocating tasks to user and system;					
6.4.2.2. d)	identifying the interaction objects required for the completion of the tasks;					
6.4.2.2. e)	identifying appropriate dialogue techniques;					
6.4.2.2. f)	designing the sequence and timing (dynamics) of the interaction;					
6.4.2.2. g)	designing the information architecture of the user interface of an interactive system to allow efficient access to interaction objects.					
6.4.2.3	Ergonomics and user interface knowledge, standards and guidelines should be used to inform the design of both hardware and software of the user interface.					
6.4.3	The level of detail and realism [of prototypes] should be appropriate to the issues that need to be investigated.					
6.4.4	Feedback from evaluation should be used to improve and refine the system.					
6.4.4	The costs and benefits of proposed changes should be evaluated and used to inform decisions about what will be modified.					
6.4.4	Project plans should allow sufficient time for making the changes as a result of such feedback.					
6.4.5	There should be some sustained channel of communication between those responsible for human-centred design and other members of the project team.					

6.4.5	When design solutions are communicated, they should be accompanied by an explanation and justification of the design decisions especially where trade-offs are necessary					
6.4.5	The communication [of details of the design] should take account of the constraints imposed by the project and the level of knowledge and understanding about ergonomics and user interface design.					
6.5.1	User centred evaluation **is a required** activity in human centred design.	Y				
6.5.1	Even at the earliest stages in the project, design concepts should be evaluated to obtain a better understanding of the user needs.					
6.5.1	If user based testing is not practical or cost effective at a particular stage of a project, design solutions should be evaluated in other ways.					
6.5.2	User centred evaluation should involve:					
6.5.2.a)	allocating resources both for obtaining early feedback to improve the product, and later for determining if requirements have been satisfied;					
6.5.2.b)	planning the user centred evaluation so that it fits the project time schedule;					
6.5.2.c)	sufficiently comprehensive testing to give meaningful results for the system as a whole;					
6.5.2.d)	analysing the results, prioritising issues and proposing solutions;					
6.5.2.e)	communicating the solutions appropriately so that they can be used effectively by the design team.					
6.5.3	To obtain valid results, the evaluation should be carried out by experienced practitioners, (and)					
6.5.3	[To obtain valid results the evaluation] should use appropriate methods.					
6.5.3	Resources for evaluation should be allocated both for obtaining early feedback to improve the product, and later for determining if requirements have been satisfied.					
6.5.3	The scope of this later (summative) evaluation should depend on the extent of the risks associated with not meeting requirements.					
6.5.4	When prototypes are used, they should be used to collect user feedback while carrying out tasks rather than just being demonstrations to show users a preview of the design.					

6.5.6	A human-centred design process should include long term monitoring of the use of the product, system or service.					
6.5.6	Criteria and measurements [for long term monitoring] should be sensitive enough to identify system failure, or system problems, as early as possible.					
6.5.6	The scope of this later (summative) evaluation should depend on the extent of the risks associated with not meeting requirements.					

Bibliography

The entire ISO 9241 series is relevant to human-centred design (see Annex A for the overall structure). The following parts of ISO 9241 have been specifically referenced in 7.4.2.1:

[1] ISO 9241-11:1998, Ergonomics of Human System Interaction: Guidance on usability

[2] ISO 9241-12:1998, Ergonomics of Human System Interaction: Presentation of information

[3] ISO 9241-20:2008, Ergonomics of Human System Interaction: Accessibility guidelines for information/communication technology (ICT) equipment and services

[4] ISO 9241-171:2008, Ergonomics of Human System Interaction: Guidance on software accessibility

[5] ISO 9241-400: 2007, Ergonomics of Human System Interaction: Principles and requirements for physical input devices

Other standards:

[6] ISO 1503:2008, Spatial orientation and direction of movement – Ergonomic requirements

[7] ISO 6385-1:2004, Ergonomic principles in the design of work systems

[8] ISO 20282-1:2006, Ease of operation of everyday products – Part 1: Design requirements for context of use and user requirements

[9] ISO TS 20282-2:2006, Ease of operation of everyday products – Part 2: Test methods for walk-up and use products

[10] ISO/IEC TR 25060:2008, *Common industry format for usability – General framework for usability-related information*

[11] ISO/IEC PDTR 29138-1:2007, Information technology – Accessibility considerations for people with disabilities. Part 1: User needs summary

It is planned that the following standards will become part of the ISO 9241 series and therefore their numbers are likely to change during the life of this standard. See Annex A for instructions on how to access the latest versions.

[12] ISO 11064-1:2000, Principles for the design of control centres

[13] ISO 11064-2:2000, Principles for the arrangement of control suites

[14] ISO 14915-1:2002, Software ergonomics for multimedia user interfaces. Design principles and framework

[15] ISO 14915-2:2003, Software ergonomics for multimedia user interfaces. Multimedia navigation and control

[16] ISO 14915-3:2002 Software ergonomics for multimedia user interfaces. Media selection and combination

[17] ISO TR16982:2002, Ergonomics of human-system interaction. Usability methods supporting human-centred design

[18] ISO/PAS 18152:2003, Ergonomics of human-system interaction. Specification for the process assessment of human-system issues

[19] ISO 18529:2000, Ergonomics of human-system interaction. Human-centred life cycle process descriptions