INTERNATIONAL STANDARD

ISO 9241-210

First edition
2010-03-15

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

Reference number
ISO 9241-210:2010(E)

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Published in Switzerland

Contents

Page

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 2.

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 human-system interaction*.

This first edition of ISO 9241-210 cancels and replaces ISO 13407:1999, of which it constitutes a technical revision. The changes include the following:

— clarifying the role of iteration in the whole design process (not just evaluation);

— emphasizing that human-centred methods can be used throughout the system life cycle;

— explaining design activities;

— clarifying the principles of human-centred design.

ISO 9241 consists of the following parts, under the general title *Ergonomic requirements for office work with visual display terminals (VDTs)*:

— *Part 1: General introduction*

— *Part 2: Guidance on task requirements*

— *Part 3: Visual display requirements*

— *Part 4: Keyboard requirements*

— *Part 5: Workstation layout and postural requirements*

— *Part 6: Guidance on the work environment*

— *Part 9: Requirements for non-keyboard input devices*

— *Part 11: Guidance on usability*

— *Part 12: Presentation of information*

— *Part 13: User guidance*

— *Part 14: Menu dialogues*

— *Part 15: Command dialogues*

— *Part 16: Direct manipulation dialogues*

— *Part 17: Form filling dialogues*

ISO 9241 also consists of the following parts, under the general title *Ergonomics of human–system interaction:*

— *Part 20: Accessibility guidelines for information/communication technology (ICT) equipment and services*

— *Part 100: Introduction to standards related to software ergonomics* [Technical Report]

— *Part 110: Dialogue principles*

— *Part 151: Guidance on World Wide Web user interfaces*

— *Part 171: Guidance on software accessibility*

— *Part 210: Human-centred design for interactive systems*

— *Part 300: Introduction to electronic visual display requirements*

— *Part 302: Terminology for electronic visual displays*

— *Part 303: Requirements for electronic visual displays*

— *Part 304: User performance test methods for electronic visual displays*

— *Part 305: Optical laboratory test methods for electronic visual displays*

— *Part 306: Field assessment methods for electronic visual displays*

— *Part 307: Analysis and compliance test methods for electronic visual displays*

— *Part 308: Surface-conduction electron-emitter displays (SED)* [Technical Report]

— *Part 309: Organic light-emitting diode (OLED) displays* [Technical Report]

— *Part 400: Principles and requirements for physical input devices*

— *Part 410: Design criteria for physical input devices*

— *Part 420: Selection procedures for physical input devices*

— *Part 910: Framework for tactile and haptic interaction*

— *Part 920: Guidance on tactile and haptic interactions*

The following parts are under preparation:

— *Part 129: Guidance on software individualization*

— *Part 143: Forms-based dialogues*

— *Part 310: Visibility, aesthetics and ergonomics of pixel defects* [Technical Report]

Design guidance for interactive voice response (IVR) applications and evaluation methods for the design of physical input devices are to form the subjects of future parts 154 and 411.

Introduction

Human-centred design is an approach to interactive systems development that aims to make systems usable and useful by focusing 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.

The human-centred approach to 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.

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. This part of ISO 9241 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 for 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, and is concerned with ways in which both hardware and software components of interactive systems can enhance human–system interaction.

NOTE 1 Computer-based interactive systems vary in scale and complexity. Examples include off-the-shelf (shrink-wrap) software products, custom office systems, process control systems, automated banking systems, Web sites and applications, and consumer products such as vending machines, mobile phones and digital television. Throughout this part of ISO 9241, 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.

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

NOTE 2 Annex A and the Bibliography contain information about relevant related standards.

2 Terms and definitions

For this document, the following terms and definitions apply.

2.1
accessibility
⟨interactive systems⟩ usability of a product, service, environment or facility by people with the widest range of capabilities

[ISO 9241-171]

2.2
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]

2.3
effectiveness
accuracy and completeness with which users achieve specified goals

[ISO 9241-11:1998]

2.4
efficiency
resources expended in relation to the accuracy and completeness with which users achieve goals

[ISO 9241-11:1998]

2.5
ergonomics
study of 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]

2.6
goal
intended outcome

[ISO 9241-11:1998]

2.7
human-centred design
approach to systems design and development that aims to make interactive systems more usable by focusing on the use of the system and 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 part of ISO 9241 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 well-being, avoidance of stress, increased accessibility and reduced risk of harm.

2.8
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.

2.9
prototype
〈interactive system〉 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.

2.10
satisfaction
freedom from discomfort and positive attitudes towards the use of the product

[ISO 9241-11:1998]

2.11
stakeholder
individual or organization having a right, share, claim or interest in a system or in its possession of characteristics that meet their needs and expectations

[ISO/IEC 15288:2008]

2.12
task
activities required to achieve a goal

[ISO 9241-11:1998]

2.13
usability
extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use

NOTE Adapted from ISO 9241-11:1998.

2.14
user
person who interacts with the product

[ISO 9241-11:1998]

2.15
user experience
person's perceptions and responses resulting from the use and/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 that occur before, during and after use.

NOTE 2 User experience is a consequence of brand image, presentation, functionality, system performance, interactive behaviour and assistive capabilities of the interactive system, the user's internal and physical state resulting from prior experiences, attitudes, skills and personality, and the context of use.

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.

2.16
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]

2.17
validation
confirmation, through the provision of objective evidence, that the requirements for a specific intended use or application have been fulfilled

[ISO 9000:2005]

NOTE Validation is the set of activities ensuring and gaining confidence that a system is able to accomplish its intended use, goals and objectives (i.e. meet stakeholder requirements) in the intended operational environment.

2.18
verification
confirmation, through the provision of objective evidence, that specified requirements have been fulfilled

[ISO 9000:2005]

NOTE Verification is a set of activities that compares a system or system element against the required characteristics. This can include, but is not limited to, specified requirements, design description and the system itself.

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, such as 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 suppliers have legal obligations to protect users from risks to their health, and safety and human-centred methods can reduce these risks (e.g. musculoskeletal risks). Systems designed using human-centred methods improve quality, for example, by:

a) increasing 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 of the product failing to meet stakeholder requirements or being rejected by its users.

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
Specify the user requirements	Context of use specification User needs description User requirements specification
Produce design solutions to meet these requirements	User interaction specification User interface specification Implemented user interface
Evaluate the designs against requirements	Evaluation results Conformance test results Long-term monitoring results
NOTE More detailed information on each output is to be found in ISO/IEC/TR 25060.	

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 systems 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 6 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 4.2 to 4.7):

a) the design is based upon an explicit understanding of users, tasks and environments (see 4.2);

b) users are involved throughout design and development (see 4.3);

c) the design is driven and refined by user-centred evaluation (see 4.4);

d) the process is iterative (see 4.5);

e) the design addresses the whole user experience (see 4.6);

f) the design team includes multidisciplinary skills and perspectives (see 4.7).

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 as well as other stakeholder groups, including those who might be affected (directly or indirectly) 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, having specified goals, performing specified tasks in a specified environment (see ISO 9241-11). For example, the kind of interface that provides good 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 6.2. The context of use is a major source of information for establishing requirements (see 6.3) 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 participating in design, acting as a source of relevant data or 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, depending on the type of 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 important that users or appropriate representatives be involved in development so that the user and task requirements relevant to the intended user group(s) can be identified for inclusion in the system specification 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 their feedback provides an effective means of minimizing the risk of a system not meeting user or 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 the 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 emphasize that this evaluation is made 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 1 In this context, iteration means repeating a sequence of steps until a desired outcome is achieved.

NOTE 2 In development methods that consist of mini-development cycles, human-centred activities can be iterated for individual parts of the system and again at a macro level across the whole product, system or service.

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 of the system under development failing 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 risk.

EXAMPLE 1 Feedback from a user perspective is used to update the intended context of use, to revise the requirements and to refine proposed design solutions.

EXAMPLE 2 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 market-place.

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 an interactive system, both hardware and software. It is also a consequence of the user's prior experiences, attitudes, skills, habits 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.

Designing for the user's experience involves considering, where appropriate, organizational 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 5).

Users' 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 1 In safety-critical and mission-critical systems, it might be more important to ensure the effectiveness or efficiency of the system than to satisfy user preferences.

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. These include the 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, e.g. as comfort and pleasure, and long-term, e.g. as health, well-being and job satisfaction). Basing such decisions solely on those 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. Allocation of function is further described in 6.4.2.2.

Representative users should generally be involved in these decisions.

NOTE 2 "Representative" in this context means corresponding appropriately to the target end-user population.

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