TECHNICAL REPORT

ISO/TR 9241-100

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Ergonomics of human-system interaction —

Part 100: Introduction to standards related to software ergonomics

Ergonomie de l'interaction homme-système —

Partie 100: Introduction aux normes relatives à l'ergonomie des logiciels

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Foreword

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

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

In exceptional circumstances, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide by a simple majority vote of its participating members to publish a Technical Report. A Technical Report is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.

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/TR 9241-100 was prepared by Technical Committee ISO/TC 159, *Ergonomics*, Subcommittee SC 4, *Ergonomics of human-system interaction*.

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 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 129: Guidance on individualization*

— *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 143: Forms-based dialogues*

— *Part 154: Design guidance for interactive voice response (IVR) applications*

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

Evaluation methods for the design of physical input devices is to form the subject of a future part 411.

Introduction

The ISO 9241 series covers both the hardware and software-ergonomics aspects of human-system interaction. The individual parts of ISO 9241, their interrelationships, and the expected users of the parts are described in ISO 9241-1.

As part of the revision of ISO 9241, the scope of ISO 9241 has been broadened from “office work with visual display terminals (VDTs)” to cover a wide range of interactive systems and the title of the series was changed to “Ergonomics of human-system interaction”. In order to allow systematic integration of emerging standards into the ISO 9241 series, a structure and numbering scheme was introduced that allows standards to be grouped by subject area.

Ergonomics is the scientific discipline and systematic study concerned with the understanding of the 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. Software ergonomics, therefore, is the application of ergonomics to the software aspects of interactive systems.

The standards referred to in this part of ISO 9241 provide general guidance, principles, recommendations and requirements focusing on the interaction between human and system and also the processes and methods required to achieve usable and accessible interactive systems (e.g. ISO 9241 “200” subseries dealing with human-centred design).

NOTE There are a number of software-ergonomics standards which are not yet part of the ISO 9241 “100” series (e.g. ISO 14915). These standards will be revised and are presented in this part of ISO 9241 in their intended position within the structure of the ISO 9241 “100” subseries.

There are numerous International Standards, related to user interface design, which can be applied to software ergonomics. These cover a wide range of needs of standards users including ergonomists, designers, project managers, managers, workers or their representatives, consumers/their representatives, procurers and certification bodies.

This part of ISO 9241 is designed to help the potential users of software-ergonomics standards identify which of these standards are relevant to their needs.

The principles, recommendations and requirements given in the software-ergonomics standards help prevent users from experiencing usability problems such as:

— additional unnecessary steps not required as part of the task;

— misleading information;

— insufficient and poor information on the user interface;

— unexpected response of the interactive system;

— navigational limitations during use;

— inefficient error recovery.

In addition, the application of the principles, recommendations and requirements contributes to increased levels of accessibility.

Ergonomics of human-system interaction —

Part 100: Introduction to standards related to software ergonomics

1 Scope

This part of ISO 9241 enables users of standards related to software ergonomics to identify ergonomics standards particularly relevant to software development, gain an overview on the content of software-ergonomics standards, understand the role of software-ergonomics standards in specifying user requirements as well as designing and evaluating user interfaces and understand the relationship between the various standards.

The software-ergonomics standards are applicable to all those software components of an interactive system affecting usability, including:

— application software (including web-based applications);

— operating systems;

— embedded software;

— software development tools;

— assistive technologies.

The range of standards discussed in this part of ISO 9241 includes general International Standards relating to software ergonomics, International Standards for processes and methods related to software ergonomics and software-ergonomics standards.

This part of ISO 9241 provides summary information on standards relevant to the following professions:

— ergonomists;

— usability professionals;

— designers;

— project managers;

— managers;

— workers or their representatives;

— consumers or their representatives;

— procurers;

— certification bodies.

2 Terms and definitions

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

2.1
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, definition 2.3]

2.2
usability
extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use

[ISO 9241-11:1998, definition 3.1]

2.3
context of use
users, tasks, equipment (hardware, software and materials), and the physical and social environments in which a product is used

[ISO 9241-11:1998, definition 3.5]

2.4
effectiveness
accuracy and completeness with which users achieve specified goals

[ISO 9241-11:1998, definition 3.2]

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

[ISO 9241-11:1998, definition 3.3]

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

[ISO 9241-11:1998, definition 3.4]

2.7
accessibility
extent to which products, systems, services, environments or facilities can be used by people from a population with the widest range of capabilities to achieve specified goals in a specified context of use

NOTE Context of use includes direct use or use supported by assistive technology.

[ISO/TR 22411:2008, definition 3.6]

2.8
accessibility
〈interactive systems〉 usability of a product, service, environment or facility by people with the widest range of capabilities

NOTE 1 The concept of accessibility addresses the full range of user capabilities and is not limited to users who are formally recognized as having a disability.

NOTE 2 The usability-orientated concept of accessibility aims to achieve levels of effectiveness, efficiency and satisfaction that are as high as possible considering the specified context of use, while paying particular attention to the full range of capabilities within the user population.

[ISO 9241-20:2008, definition 3.1]

2.9
interactive system
combination of hardware and software components that receive input from, and communicate output to, a human user in order to support his or her performance of a task

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

[ISO 13407:1999, definition 2.1]

2.10
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, definition 3.9]

2.11
dialogue
interaction between a user and an interactive system as a sequence of user actions (inputs) and system responses (outputs) in order to achieve a goal

NOTE 1 User actions include not only entry of data but also navigational actions of the user.

NOTE 2 Dialogue refers to both the form (syntax) and the meaning (semantics) of interaction.

[ISO 9241-110:2006, definition 3.2]

3 International Standards and software ergonomics

3.1 Benefits of standards related to software ergonomics

The ultimate beneficiary of standards related to software ergonomics is the user of the interactive system. It is the needs of these users that provided the ergonomics recommendations in the software-ergonomics standards. Although it is unlikely that the end user would read standards related to software ergonomics or even know of their existence, their application could provide user interfaces which are more usable, accessible and consistent and which enable greater productivity.

3.2 Current International Standards relating to software ergonomics

There is a range of standards relating to software ergonomics which contribute to achieving these goals including:

a) software-ergonomics standards:

- ISO 9241-12 to ISO 9241-17;
- ISO 14915-1, ISO 14915-2 and ISO 14915-3;
- ISO 9241-110, ISO 9241-151 and ISO 9241-171.

b) standards on general ergonomics relevant to software ergonomics:

- ISO 6385;
- ISO 9241-11;
- ISO 9241-20.

c) standards for processes and methods relevant to software ergonomics:

- ISO/TR 16982;
- ISO/PAS 18152;
- ISO/TR 18529;
- ISO/IEC 25062.

3.3 Usability and context of use

Usability is an important consideration in the design of products, systems, services and facilities, because it is concerned with the extent to which the users are able to perform effectively, efficiently and with satisfaction. In order to determine the level of usability achieved, it is necessary to measure the performance and satisfaction of users. Measurement of usability is particularly important in view of the complexity of the interactions between the users, the tasks and the other elements of the context of use.

Planning for usability as part of the design and development involves the systematic identification of requirements for usability, including usability measures and verifiable descriptions of the context of use. These provide design targets that can be the basis for verification of the resulting design.

The concept of effectiveness relates the goals or secondary goals of the user to the accuracy and completeness with which these goals can be achieved.

The concept of efficiency relates the level of effectiveness achieved to the expenditure of resources. Relevant resources can include mental or physical effort, time, materials or financial cost. Human efficiency can be measured as effectiveness divided by human effort.

Satisfaction measures the extent to which users are free from discomfort and also measures their attitudes to the use of the product. Satisfaction can be measured by subjective ratings on scales, such as levels of discomfort experienced, satisfaction with use or acceptability of the workload when carrying out different tasks or the extent to which particular usability objectives (such as efficiency or suitability for learning) have been met.

3.4 Accessibility

Accessibility is an important consideration in the design of products, systems, services and facilities, because it affects the range of people who are able to use them and use them easily. Accessibility can be increased to improve usability for individuals and widen the range of people who can use the product, system, service and facility.

An accessible user interface with usability defects would not serve its purpose. Therefore, applying software-ergonomics standards is a precondition to achieving effective accessibility.

Accessibility can be improved by incorporating features and attributes known to benefit users with special requirements. To achieve a given level of accessibility, the effectiveness, efficiency and satisfaction for the widest range of users should be specified. Planning for accessibility is an integral part of the design and development process and involves the systematic identification of requirements for accessibility, including accessibility measurements and verification criteria within the context of use. These provide design targets that can be the basis for verification of the resulting design.

Measurement of accessibility is particularly important in view of the complexity of the interactions with the user, the goals, the task characteristics and the other elements of the context of use. A product, system, service or

facility can have significantly different levels of accessibility when used in different contexts, in particular by different user groups with special requirements.

ISO 9241-171 explicitly covers accessibility for software.

4 Software-ergonomics standards

4.1 General

Software-ergonomics standards contain guidance which assists both the specification of user requirements and the design and evaluation of the user interface of an interactive system. These standards do not aim at standardizing the user interface; rather, they give recommendations that should be applied in order to ensure the usability of the user interface of the product and eliminate design solutions which can be predicted to cause usability problems to users.

Figure 1 illustrates the role of software-ergonomics standards in analysis, design and evaluation. These standards contain recommendations which are applicable to a wide range of different contexts of use. Therefore, the standards themselves specify recommendations that need to be "contextualized" in the specific context of use of the interactive system to be designed or redesigned. Not all recommendations apply in every context of use. For every decision on user requirements and design solutions, the requirements and recommendations in software-ergonomics standards help to ensure that appropriate levels of usability and accessibility are established. The requirements and recommendations contained in these standards should be assessed for their applicability in the given context of use and applied accordingly.

Some other ergonomics standards also take this approach, e.g. ISO 9241-20 and ISO 9241-920.

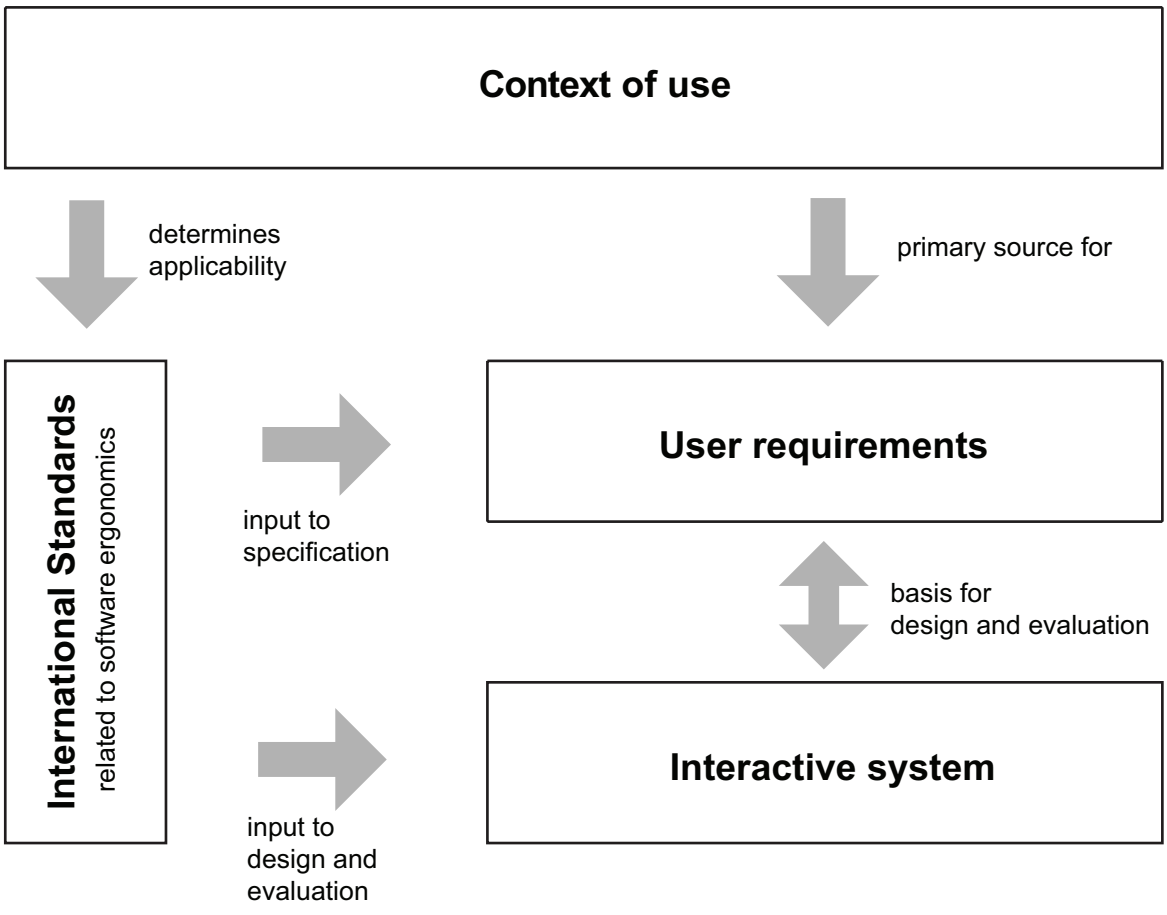

Figure 1 — The role of software-ergonomics standards in analysis, design and evaluation

4.2 Overall structure of software-ergonomics standards ISO 9241-100 to ISO 9241-199

In this subclause, the structure of the software-ergonomics standards in the ISO 9241 series is introduced. The structure below has been established for future software-ergonomics standards and for revisions of existing software-ergonomics standards. This structure should be used to help identify applicable standards:

a) general guidance on software ergonomics (ISO 9241-110 to ISO 9241-119);

b) input, output and interaction (ISO 9241-120 to ISO 9241-129);

c) performance support (ISO 9241-130 to ISO 9241-139);

d) interaction techniques (ISO 9241-140 to ISO 9241-149);

e) topic-specific guidance (ISO 9241-150 to ISO 9241-159);

f) interface control components (ISO 9241-160 to ISO 9241-169);

g) cross-topic guidance on accessibility (ISO 9241-170 to ISO 9241-179).

NOTE 1 4.3 to 4.10 introduce the software-ergonomics standards in the above structure, including introductions to published software-ergonomics standards, which will be incorporated in the structure upon revision.

NOTE 2 ISO 9241-180 to 189 and ISO 9241-190 to ISO 9241-199 have not yet been assigned to specific categories of software-ergonomics guidance. They are reserved numbers for future categories of software-ergonomics standards.

4.3 Overview of standards related to software ergonomics — ISO 9241-100

This part of ISO 9421 provides an overview on standards related to software ergonomics. This part of ISO 9241 is designed to help the potential users of software-ergonomics standards identify which of these standards are relevant to their needs.

4.4 General standards on software ergonomics — ISO 9241-110 to ISO 9241-119

4.4.1 General

This subseries of software-ergonomics standards provides high-level guidance on the design of interactions that applies across various types of user interfaces. Interaction includes all sequences and steps to be completed in order to accomplish a task. The standards within this category are augmented by guidance specific to various aspects of the user interface. The guidance is intended to be used for designing interaction, based on user needs and task requirements within the context of use.

This category includes guidance on

— dialogue principles and general guidelines, and

— interaction design.

ISO 9241-111 to ISO 9241-119 are reserved for standards containing general guidance on software ergonomics, e.g. internationalization. Upon revision, the content of ISO 14915-1 will be integrated into one (or more) standards within this subseries.

4.4.2 Dialogue principles — ISO 9241-110

The purpose of ISO 9241-110 is to present high-level ergonomics principles and 57 recommendations applicable to the design of dialogues between humans and information systems, irrespective of the chosen interaction technique(s). It provides seven principles of good practice for the design of the dialogue between the user and the interface software.

These seven principles are:

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.

The principles given in ISO 9241-110 form the basis for understanding any specific software-ergonomics recommendation given in other standards related to software ergonomics. These principles do not permit strict compliance checking, although it might be possible to evaluate whether these principles have been generally applied.

4.4.3 Software ergonomics for multimedia user interfaces — Design principles and framework — ISO 14915-1

Consisting of three parts, ISO 14915 contains guidance on the software ergonomics for multimedia user interfaces. ISO 14915-1, ISO 14915-2 and ISO 14915-3 will be integrated into the ISO 9241 “100” subseries upon revision.

ISO 14915-1 contains general guidance, while ISO 14915-2 and ISO 14915-3 contain specific guidance on input, output and interaction (see 4.5.4 and 4.5.5).

ISO 14915-1 establishes design principles for multimedia user interfaces and provides a framework for handling the different considerations involved in their design. It addresses user interfaces for applications that incorporate, integrate and synchronize different media. This includes static media such as text, graphics or images and dynamic media, such as audio, animation, video or media, related to other sensory modalities. Detailed design issues within a single medium (e.g. the graphical design of an animation sequence) are addressed only as far as they imply ergonomics consequences for the user.

ISO 14915-1 gives requirements and recommendations for the ergonomics design of multimedia applications mainly intended for professional and vocational activities, such as work or learning. It does not specifically address applications outside this area, such as entertainment, although some recommendations can also be applicable in such domains.

ISO 14915-1 is applicable to software aspects related to multimedia user interfaces and does not address hardware or implementation issues. The ergonomics requirements and recommendations described in ISO 14915-1 can be realized through very different techniques, e.g. the delivery system, a scripting language, or the application.

The focus of ISO 14915-1 is on multimedia presentation issues. Multimodal input which uses different media, such as speech in combination with pointing for entering information, is not considered in the recommendations provided.

4.5 Standards on input, output and interaction — ISO 9241-120 to ISO 9241-129

4.5.1 General

This subseries of software-ergonomics standards provides guidance on input, output and interaction considerations across different media and modalities.

This category includes guidance on software aspects of:

a) presentation principles;

b) media selection and combination;

c) multimodal interaction and navigation;

d) visual presentation;

e) auditory interaction (including speech input);

f) tactile/haptic interaction.

ISO 9241-120 to ISO 9241-128 are reserved for standards containing guidance on input, output and interaction.

NOTE Upon revision, the content of ISO 9241-12, ISO 14915-2 and ISO 14915-3 will be integrated in one (or more) standards within the ISO 9241 “120” subseries.

4.5.2 Guidance on software individualization — ISO 9241-129

ISO 9241-129 contains ergonomics requirements and recommendations for individualization of human-computer interactions. There are a variety of different basic individualization mechanisms, each of which can have different positive and negative effects on users.

— Individualization can result from customization (initiated intentionally by the user) and adaptation (initiated by the system).

— Individualization can result in a variety of changes to the user interface, depending on the particular individualization mechanisms involved.

ISO 9241-129 includes guidance on:

a) determining where individualization is appropriate;

b) selecting appropriate types of individualization mechanisms;

c) using all types of individualization mechanisms;

d) using specific types of individualization mechanisms;

e) using combinations of different types of individualization mechanisms.

4.5.3 Presentation of information — ISO 9241-12

ISO 9241-12 introduces characteristics of presented information. These characteristics are the following:

a) clarity (the information content is conveyed quickly and accurately);

b) discriminability (the displayed information can be distinguished accurately);

c) conciseness (users are given only the information necessary to accomplish the task);

d) consistency (the same information is presented in the same way throughout the application, according to the user's expectation);

e) detectability (user's attention is directed towards information required);

f) legibility (information is easy to read);

g) comprehensibility (meaning is clearly understandable, unambiguous, interpretable and recognizable).

The characteristics of presented information given in ISO 9241-12 apply to visual design aspects of user guidance and any specific dialogue techniques.

ISO 9241-12 also gives recommendations on the presentation of information. For example, ISO 9241-12 recommends that groups of information items should be perceptually distinct by spacing and location, without giving precise criteria for this. However, this recommendation can be used by tool designers and style guide designers to set up rules for their specific design environment.

4.5.4 Software ergonomics for multimedia user interfaces — Multimedia navigation and control — ISO 14915-2

ISO 14915-2 provides recommendations and requirements for the design of multimedia user interfaces with respect to the following aspects: design of the organization of the content, navigation and media-control issues. ISO 14915-2 is limited to the design of the organization of the content and does not deal with the design of the content in general. Design issues within a single medium (e.g. the lighting of a film sequence) are only addressed with respect to the ergonomics issues related to user controls.

4.5.5 Software ergonomics for multimedia user interfaces — Media selection and combination — ISO 14915-3

ISO 14915-3 gives recommendations for, and guidance on, the design, selection and combination of interactive user interfaces that integrate and synchronize different media. It addresses user interfaces for applications that incorporate, integrate and synchronize different media. This includes static media, such as text, graphics, images and dynamic media, such as audio, animation, video or media, related to other sensory modalities. Detailed design issues within a single medium (e.g. the graphical design of an animation sequence) are only addressed as far as they imply ergonomics consequences for the user.

4.6 Standards on performance support — ISO 9241-130 to ISO 9241-139

4.6.1 General

This subseries of software-ergonomics standards provides guidance on elements of the user interface that assist the user in learning and using the interactive system.

The guidance includes

— user guidance, and

— learning support.

ISO 9241-130 to ISO 9241-139 are reserved for standards containing guidance on performance support, e.g. documentation, tutorials and instructions.

NOTE Upon revision, the content of ISO 9241-13 will be integrated into one (or more) standards within this subseries.

4.6.2 User guidance — ISO 9241-13

ISO 9241-13 provides recommendations for user guidance provided by software user interfaces and its evaluation. User guidance, as defined in ISO 9241-13, is additional information beyond the regular user-computer-dialogue, provided to the user on request or automatically provided by the system, for example, status information, feedback messages and on-line help. Presenting user guidance is always appropriate and should help users in accomplishing their goals with the system. Sufficient user guidance should be provided such that users accomplish the task which the system was designed to support without undue effort or stress. Any specific dialogue technique incorporates user guidance, for example by highlighting a selected menu item or by underlining a field label of a required entry field. Therefore, the recommendations given in ISO 9241-13 should always be considered when designing a specific dialogue technique.

4.7 Standards on interaction techniques — ISO 9241-140 to ISO 9241-149

4.7.1 General

This subseries of software-ergonomics standards provides guidance on the different techniques used to support the dialogues within human-system interaction.

This category includes guidance on:

a) selecting and combining interaction techniques;

b) menus;

c) commands;

d) direct manipulation;

e) forms;

f) natural language dialogues;

g) question and answer dialogues.

ISO 9241-140 to ISO 9241-149 are reserved for standards containing guidance on interaction techniques, for example question and answer dialogues and natural language dialogues.

NOTE Upon revision, the content of ISO 9241-14, ISO 9241-15, ISO 9241-16 and ISO 9241-17 will be integrated into one (or more) standards within the ISO 9241 “140” subseries.

4.7.2 Menu dialogues — ISO 9241-14

ISO 9241-14 is concerned with the ergonomic design of menu dialogues (e.g. pull-down menus and pop-up menus). In menu dialogues, the dialogue system presents one or more groups of options to the user, the user chooses one or more options and the computer executes the desired process denoted by the option(s).

4.7.3 Command dialogues — ISO 9241-15

ISO 9241-15 is concerned with the ergonomic design of command dialogues. In command dialogues, users input (by recall) either complete or abbreviated command phrases as required by the command language syntax, and the computer performs the actions associated with the commands and their parameters.

4.7.4 Direct manipulation dialogues — ISO 9241-16

ISO 9241-16 is concerned with the ergonomic design of direct manipulation dialogues, where users perform operations by acting on displayed objects in ways analogous to manipulating physical entities.

4.7.5 Form filling dialogues — ISO 9241-17

ISO 9241-17 is concerned with the ergonomic design of form filling dialogues. In form filling dialogues, users fill in, select entries for, or modify labelled fields, on an area of the display.

4.8 Topic-specific standards — ISO 9241-150 to ISO 9241-159

4.8.1 General

ISO 9241-150 and ISO 9241-152 to ISO 9241-159 are reserved for standards containing guidance on specific topics, for example interactive voice response (IVR), interactive television (ITV), interpersonal and collective communication, performance support systems, and computer simulation and games.

4.8.2 Guidance on World Wide Web user interfaces — ISO 9241-151

The recommendations and guidelines provided in ISO 9241-151 apply primarily to designing the content of a website or, more generally, a Web application, the user's navigation and interaction, as well as the presentation of the content. The user interface of different types of user agents (such as Web browsers) or additional tools, such as Web authoring tools are not the subject of ISO 9241-151, although some guidelines might apply to these systems as well. Aspects of the technical implementation of the recommendations are also not a focus of ISO 9241-151.

This subseries of software-ergonomics standards provides guidance on particular application-specific topics.

The topics include:

— guidance on World Wide Web software user interfaces;

— interpersonal communication;

— interactive voice response;

— virtual reality.

4.9 Standards on user interface control components — ISO 9241-160 to ISO 9241-169

ISO 9241-160 to ISO 9241-169 are reserved for standards containing guidance on user interface control components.

This subseries of software-ergonomics standards provides guidance on common user interface elements.

The guidance includes:

— controlling groups of information (including windows);

— specific instances of prompts and feedback;

— lists;

— media controls.

NOTE Guidance on media controls is given in ISO 14915-2.

4.10 Cross-topic guidance on accessibility — ISO 9241-170 to ISO 9241-179

4.10.1 General

ISO 9241-170 and ISO 9241-172 to ISO 9241-179 are reserved for standards containing cross-topic guidance on accessibility.

NOTE The approach to accessibility in the ISO 9241 “100” subseries of software-ergonomics standards is to integrate guidance on accessibility within the standards by subject area, rather than producing separate accessibility standards.

4.10.2 Guidance on software accessibility — ISO 9241-171

ISO 9241-171 explicitly provides requirements and recommendations for the design of accessible software for use at work, in the home, in education and in public places. It covers issues associated with designing accessible software for people with the widest range of physical, sensory and cognitive abilities, including those who are temporarily disabled and the elderly. ISO 9241-171 addresses software considerations for accessibility which complement general design for usability.

ISO 9241-171 is applicable to the accessibility of interactive systems. It addresses a wide range of software (e.g. office, Web, learning support and library systems).

ISO 9241-171 promotes increased usability of systems for a wider range of users. While it does not cover the behaviour or requirements for assistive technologies (including assistive software), it addresses the use of assistive technologies as an integrated component of interactive systems. ISO 9241-171 is intended for use by those responsible for the specification, design, development, evaluation and procurement of software platforms and software applications.

4.11 Numbers reserved for future use — ISO 9241-180 to 189 and ISO 9241-190 to ISO 9241-199

ISO 9241-180 to ISO 9241-189 and ISO 9241-190 to ISO 9241-199 have not been assigned yet to specific categories of software-ergonomics guidance. They are reserved numbers for potential future categories of software-ergonomics standards.

5 Standards on human-centred design processes and methods relevant to software ergonomics

5.1 Human-centred design process for interactive systems — ISO 9241-210

ISO 9241-210 is the revision of ISO 13407. ISO 9241-210 provides guidance on human-centred design activities throughout the life cycle of computer-based interactive systems. It is aimed at those managing design processes. Guidance is provided on sources of information and standards relevant to the human-centred approach. ISO 9241-210 is applicable to both hardware and software.

There are four linked human-centred design activities which should take place during the design of any interactive system. Figure 2 illustrates the interdependence of these activities. Figure 2 does not imply a strict linear process; rather, it illustrates that each human-centred design activity uses outputs from other activities. If a specific human-centred design activity has not taken place, the next human-centred design activity would be based on assumptions, increasing the risk of the system failing to meet user requirements. Figure 2 also shows that evaluations lead to an increased number of findings.

NOTE Figure 2 is reproduced from ISO 9241-210:—, Figure 1.

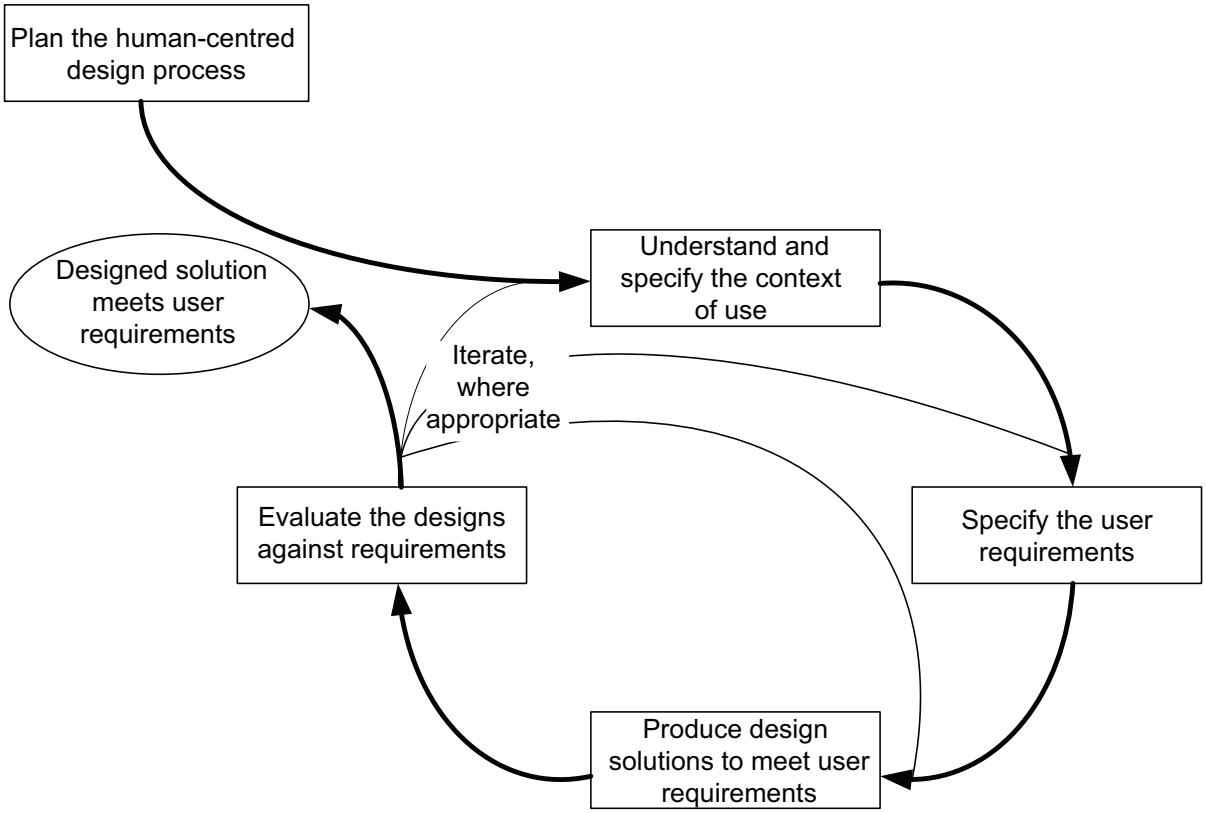

Figure 2 — The interdependence of human-centred design activities

5.2 Human-centred life cycle process descriptions — ISO/TR 18529

ISO/TR 18529 contains a formalized model based on the human-centred processes described in ISO 9241-210. It can be used in the specification, assessment and improvement of the human-centred processes in system development and operation.

The model presented in ISO/TR 18529 uses the format common to process assessment models. These models describe the processes which should be performed by an organization to achieve defined technical goals. Although the primary use of a process assessment model is for the measurement of how well an organization carries out the processes covered by the model, such models can also be used as a description of what is required in order to design and develop effective organizational and project processes.

Human sciences experts (e.g. ergonomists and usability engineers) might find the model useful as a means of presenting the activities required when projects or companies adopt a human-centred approach or need to develop products with an assured degree of quality in use. Process modelling and process definitions are means of discussing and planning the work required in order to take account of human sciences input in system development and operation. Process definitions are widely understood in the systems and software development communities.

The ability to describe human sciences methods and techniques, and their inputs and outputs, in the language used by systems and software engineers and their managers simplifies the adoption and implementation of the human-centred approach.

5.3 Usability methods supporting human-centred design — ISO/TR 16982

5.3.1 General

ISO/TR 16982 provides an overview of existing usability methods that can be used on their own or in combination to support design and evaluation. Each method is described with its advantages, disadvantages and other factors relevant to its selection and use. These include the implications of the project's stage in the life cycle for the choice of method.

5.3.2 Specification for the process assessment of human-system issues — ISO/PAS 18152

ISO/PAS 18152 presents a human-system model of the maturity of an organization in performing the processes that make a system usable, healthy and safe. It describes processes that address human-system issues and the outcomes of these processes. It specifies the practices and work products associated with achieving the outcomes of each process.

The model describes processes for specifying and evaluating usability, health and safety, but it does not address all processes relating to their achievement. It includes guidance on tailoring the model to the specific organizational and system context prior to use in assessment. The human-system model does not define the roles or competencies of staff who perform human-system processes. ISO/PAS 18152 is intended for use by process assessors and those developing process assessment models and tools. It might be informative for those responsible for human factors activities and human factors specialists. The latter groups of readers should familiarize themselves with the vocabulary of process modelling and process assessment prior to reading ISO/PAS 18152.

5.4 Common Industry Format (CIF) for usability – General framework for usability-related information — ISO/IEC TR 25060

ISO/IEC TR 25060 describes a potential family of standards that document the specification and evaluation of the usability of interactive systems named the Common Industry Format (CIF). The purpose of ISO/IEC TR 25060 is to provide a general overview of the CIF framework and contents, definitions and the relationship of the framework elements. The intended users of the framework are identified, as well as the situations in which the framework may be applied. The assumptions and constraints of the framework are also enumerated.

The framework content includes:

— consistent terminology and classification of specification, evaluation and reporting;

— a definition of the type and scope of formats and the high level structure to be used for documenting required information and the results of evaluation.

The framework can be used with software and hardware products used for predefined tasks (excluding generic products, such as a display screen or keyboard). The documentation elements are intended to be used as part of system-level documentation resulting from development processes, such as those defined in ISO 13407 (replaced by ISO 9241-210) and other process standards.

The CIF framework focuses on documenting those elements needed for design and development of usable systems rather than prescribing a specific process and is intended to be used in conjunction with existing standards, including ISO 13407, ISO 9241, ISO 20282-1, ISO 9126-1 and the ISO 25000 SquaRE series.

This framework does not prescribe any kind of method, life cycle or process. To ensure that these information items can be used within the broadest range of process models and used in combination with other information items, the descriptions are given in the format defined in ISO/IEC 15289 and ISO/IEC TR 15504-6.

The information items for documenting usability-related information can be integrated in any process models. For the purpose of establishing process models, ISO/IEC TR 24774 and ISO/IEC 15504-2 specify the format and conformance requirements for process models, respectively. In addition, ISO/IEC 15289 defines the types

and content of information items developed and used in process models for system and software life cycle management. ISO/IEC 15504-5 and ISO/IEC TR 15504-6 define work products, including information items, for the purpose of process capability assessment. Process models and associated information items for human-centred design of interactive systems are given in ISO 9241-210 and ISO/PAS 18152, respectively.

5.5 Common Industry Format (CIF) for usability test reports — ISO/IEC 25062

ISO/IEC 25062 is intended to be used to report the measures obtained from a test of usability, as defined in ISO 9241-11: effectiveness, efficiency and satisfaction in a specified context of use.

ISO/IEC 25062 is intended to be used by:

— usability professionals within supplier organizations to generate reports that can be used by customer organizations;

— customer organizations to verify that a particular report conforms to ISO/IEC 25062;

— human factors or other usability professionals in customer organizations, who are evaluating both the technical merit of usability tests and the usability of the products, and

— other technical professionals and managers in the customer organization, who are using the test results to make business decisions about product suitability and purchase.

ISO/IEC 25062:2006, 5.2 and 5.3 (executive summary and introduction) provide summary information for non-usability professionals and managers. ISO/IEC 25062:2006, 5.4 and 5.5 describe the test methodology and results in technical detail suitable for replication, and also support application of test data to questions about the product's expected costs and benefits.

Understanding and interpreting these subclauses requires technical background in human factors or usability engineering for optimal use. The report format assumes sound practice has been followed in the design and execution of the test. Test procedures that produce measures which summarize usability should be used, i.e. the test is summative in nature. Some usability evaluation methods, such as formative tests, are intended to identify problems, rather than produce measures; the format is not structured to support the results of such testing methods.

6 General standards relevant to software ergonomics

6.1 Ergonomic principles in the design of work systems — ISO 6385

ISO 6385 establishes the fundamental principles of ergonomics as basic guidelines for the design of work systems and defines relevant basic terms. It describes an integrated approach to the design of work systems, where ergonomists cooperate with others involved in the design, with attention to the human, the social and the technical requirements in a balanced manner during the design process.

While the principles in ISO 6385 are oriented to the design of work systems, they are applicable to any field of human activity, e.g. in the design of products for domestic and leisure activities.

NOTE A new standard, of which the subject is principles and concepts of ergonomics, is under development.

6.2 Guidance on usability — ISO 9241-11

ISO 9241-11 defines usability and explains how to identify the information which it is necessary to take into account, when specifying or evaluating usability in terms of measures of user performance and satisfaction. Guidance is given on how to describe the context of use of the product (hardware, software or service) and the relevant measures of usability in an explicit way. The guidance is given in the form of general principles and techniques, rather than in the form of requirements to use specific methods.

The guidance in ISO 9241-11 can be used in procurement, design, development, evaluation and communication of information about usability. ISO 9241-11 includes guidance on how the usability of a product can be specified and evaluated. It applies both to products intended for general application and products being acquired for or being developed within a specific organization.

ISO 9241-11 also explains how measures of user performance and satisfaction can be used to measure how any component of a work system affects the whole work system in use. The guidance includes procedures for measuring usability, but does not specify all of the activities to be undertaken. Specification of detailed user-based methods of measurement is beyond the scope of ISO 9241-11, but further information can be found in Annex B and the Bibliography. It can also apply in other situations where a user is interacting with a product to achieve goals. The software-ergonomics standards (e.g. ISO 9241-110 to ISO 9241-199) provide conditional recommendations which are applicable in specific contexts of use. The guidance in ISO 9241-11 can be used in conjunction with software-ergonomics standards in order to help identify the applicability of individual recommendations.

ISO 9241-11 focuses on usability and does not provide comprehensive coverage of all objectives of ergonomic design referred to in ISO 6385. However, design for usability contributes positively to ergonomics objectives, such as the reduction of possible adverse effects of use on human health, safety and performance.

6.3 Accessibility guidelines for information/communication technology (ICT) equipment and services — ISO 9241-20

ISO 9241-20 is intended for use by those responsible for planning designing, developing, acquiring and evaluating information/communication technology (ICT) equipment and services. ISO 9241-20 provides recommendations to improve the accessibility of ICT equipment and services. Equipment and services that follow ISO 9241-20 have wider accessibility for use in work, home, mobile and public environments. It covers issues associated with designing equipment and services for people with a wide range of sensory, physical and cognitive abilities, including those who have temporary disabilities and the elderly.

A detailed design for specific equipment or services can be developed based on ISO 9241-20. If a specific detailed standard exists on the equipment or service, users of ISO 9241-20 can also refer to that more specific standard. Where such standards are not available, ISO 9241-20 can be the basis of designing accessibility features of ICT equipment and services.

ISO 9241-20 is also intended to provide general guidelines for acquiring and evaluating ICT equipment and services. This includes hardware and software aspects of information processing equipment, electronic communication facilities, office machines, and other similar technologies and services, which can be used in work, home, mobile and public environments.

ISO 9241-20 also provides important information about context of use. Accessibility is increased by expanding the range of contexts in which equipment and services can be used. Context of use can result from the various components of the equipment or service, including user characteristics, task characteristics, equipment (hardware, software and materials) characteristics, and the characteristics of physical and social environments. Context of use needs be considered when planning, designing, developing, acquiring and evaluating ICT equipment and services.

ISO 9241-20 is a high-level standard and is applicable to all ICT equipment and services; therefore, detailed descriptions specific to equipment or service are avoided. To prevent barriers to trade or the movement of people each national, regional and international standardization activity in this area can refer to ISO 9241-20. More specific recommendations on software accessibility are contained in ISO 9241-171.

7 Other standards that include specific software-ergonomics guidance

7.1 Guidance on tactile and haptic interactions — ISO 9241-920

ISO 9241-920 gives ergonomics requirements and recommendations for tactile and haptic hardware and software interactions. It provides guidance related to the design and evaluation of hardware, software and combinations of hardware and software interactions.

7.2 Information technology — Accessibility considerations for people with disabilities — User needs summary — ISO/IEC TR 29138-1

ISO/IEC TR 29138-1 identifies a collection of user needs of people with disabilities for standards developers to take into consideration when developing or revising their standards. These user needs are also useful for developers of information technology products and services and for accessibility advocates to consider.

In addition to identifying user needs, ISO/IEC TR 29138-1 identifies problems that people with disabilities experience with information technologies which lead to these user needs, and identifies the relationship of these user needs with the accessibility factors found in ISO/IEC Guide 71, for standards developers to consider.

7.3 Ergonomics data and guidelines for the application of ISO/IEC Guide 71 to products and services to address the needs of older persons and persons with disabilities — ISO/TR 22411

ISO/TR 22411 is intended to assist standards developers in incorporating accessible design principles from ISO/IEC Guide 71 into individual standards. It also contains significant ergonomics data related to human capabilities (particularly for special populations and the elderly) which can be applied by designers of products, services and systems. The guidance contained in ISO/TR 22411 is divided into two main areas, a section of general guidance and design considerations pertaining to each of the factors described in ISO/IEC Guide 71, and a section providing basic knowledge and reference data on human capabilities. It is intended that ISO/TR 22411 be revised and expanded periodically, as new data and information become available.

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://www.iso.org/iso/search.htm?qt=iso+9241&sort=rel&type=simple&published=on

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.

Table A.1 — Structure of ISO 9241 — Ergonomics of human-system interaction

Part	Title
1	Introduction
2	Job design
11	Hardware and software usability
20	Accessibility and human-system interaction
21-99	Reserved numbers
100	Software ergonomics
200	Human-system interaction processes
300	Displays and display-related hardware
400	Physical input devices — Ergonomics principles
500	Workplace ergonomics
600	Environment ergonomics
700	Control rooms
900	Tactile and haptic interactions

Bibliography

[1] ISO/IEC Guide 71, *Guidelines for standards developers to address the needs of older persons and persons with disabilities*

[2] ISO 6385:2004, *Ergonomic principles in the design of work systems*

[3] ISO/IEC 9126-1, *Software engineering — Product quality — Part 1: Quality model*

[4] ISO 13407:1999, *Human-centred design processes for interactive systems*

[5] ISO 14915-1, *Software ergonomics for multimedia user interfaces — Part 1: Design principles and framework*

[6] ISO 14915-2, *Software ergonomics for multimedia user interfaces — Part 2: Multimedia navigation and control*

[7] ISO 14915-3, *Software ergonomics for multimedia user interfaces — Part 3: Media selection and combination*

[8] ISO/IEC 15504-2, *Information technology — Process assessment — Part 2: Performing an assessment*

[9] ISO/IEC 15504-5, *Information technology — Process Assessment — Part 5: An exemplar Process Assessment Model*

[10] ISO/IEC TR 15504-6, *Information technology — Process assessment — Part 6: An exemplar system life cycle process assessment model*

[11] ISO/TR 16982, *Ergonomics of human-system interaction — Usability methods supporting human-centred design*

[12] ISO/PAS 18152, *Ergonomics of human-system interaction — Specification for the process assessment of human-system issues*

[13] ISO/TR 18529, *Ergonomics — Ergonomics of human-system interaction — Human-centred lifecycle process descriptions*

[14] ISO 20282-1, *Ease of operation of everyday products — Part 1: Design requirements for context of use and user characteristics*

[15] ISO/TR 22411:2008, *Ergonomics data and guidelines for the application of ISO/IEC Guide 71 to products and services to address the needs of older persons and persons with disabilities*

[16] ISO/IEC TR 24774, *Software and systems engineering — Life cycle management — Guidelines for process description*

[17] ISO/IEC DTR 25060, *Software engineering — Software product Quality Requirements and Evaluation (SQuaRE) — Common Industry Format (CIF) for usability — General framework for usability-related information*[1)]

[18] ISO/IEC 25062, *Software engineering — Software product Quality Requirements and Evaluation (SQuaRE) — Common Industry Format (CIF) for usability test reports*

[19] ISO/IEC TR 29138-1, *Information technology — Accessibility considerations for people with disabilities — Part 1: User needs summary*

1) Under preparation.

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