



International
Standard

ISO 9241-115

Ergonomics of human-system interaction —

Part 115:

Guidance on conceptual design, user-system interaction design, user interface design and navigation design

Ergonomie de l'interaction homme-système —

*Partie 115: Recommandations relatives à la conception
conceptuelle, la conception de l'interaction utilisateur-système,
la conception de l'interface utilisateur et la conception de la
navigation*

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Contents

Page

Foreword	v
Introduction	vi
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
3.1 Major subjects of designs	1
3.2 Modelling	2
3.3 Context of use, user needs and user requirements	3
3.4 Outcomes of use	4
3.5 Interactions and content	5
3.6 Navigation techniques	7
3.7 Links	7
4 Human-centred design in the context of this document	9
4.1 Human-centred design activities	9
4.2 General guidance	9
4.2.1 Mental model of the user	9
4.2.2 Support of appropriate user interface technology	9
4.2.3 Constraints on design	9
4.2.4 Overall consistency	10
4.2.5 Aesthetics	10
4.2.6 Accessibility	10
5 Conceptual design	10
5.1 General	10
5.2 Contents of a conceptual design	11
6 User-system interaction design	11
6.1 General	11
6.2 Types of interactions	12
6.3 The design of interaction scenarios	12
6.4 Compatibility of interaction scenarios	12
6.5 The design of user actions to be supported by the system	12
6.6 Interactions from the user's perspective	12
7 User interface design	13
7.1 General	13
7.2 Contents of a user interface design	13
7.2.1 Structure	13
7.2.2 User interface instances	13
7.2.3 User interface elements	14
7.3 Information architecture	14
7.3.1 Purpose of an information architecture	14
7.3.2 Contents of an information architecture	14
7.4 Information design	15
7.5 Design recommendations	15
7.5.1 User interface	15
7.5.2 User interface instances	15
7.5.3 User interface elements	16
7.5.4 Supporting different target devices	16
7.5.5 Accessibility	17
7.5.6 Innovative solutions	17
8 Navigation design	17
8.1 General	17
8.2 Contents of navigation sequence design	18
8.3 Navigation with additional user interface elements	18

8.4	Use of navigation structures	18
8.4.1	Use of linear structures	18
8.4.2	Navigation in linear structures	18
8.4.3	Use of tree structures	18
8.4.4	Navigation in tree structures	18
8.4.5	Use of network structures	19
8.4.6	Navigation in network structures	19
8.4.7	Navigation in hybrid structures	19
8.4.8	Navigation in dynamic structures	19
8.4.9	Determining navigation techniques	19
8.5	Guidance on the design of navigation to meet user needs	20
8.5.1	Minimizing user effort	20
8.5.2	Providing alternative navigation paths	20
8.5.3	Returning to an interrupted task	20
8.5.4	Supporting exploration	20
8.6	Guidance related to the use of links for navigation	20
8.6.1	Use of links	20
8.6.2	Use of system-activated links	20
8.6.3	Use of user-activated links	21
8.6.4	Use of permanent links	21
8.6.5	Use of temporal links	21
8.6.6	Duration of temporal links	21
8.6.7	Avoiding temporal link errors	21
8.6.8	Use of computed links	21
8.6.9	Recognizing computed links	22
8.6.10	Use of user-defined links	22
8.6.11	Supporting multiple sets of user-defined links	22
8.6.12	Discriminability of links	22
8.7	Guidance related to the use of general navigation functions	23
8.7.1	Providing users with navigation information	23
8.7.2	Providing search capabilities	23
8.8	Navigating across sessions	23
8.8.1	Saving the current state	23
8.8.2	Returning to a saved state	23
8.8.3	Restarting at a previous state	23
8.8.4	Exiting	24
	Bibliography	25

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 159, *Ergonomics*, Subcommittee SC 4, *Ergonomics of human-system interaction*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 122, *Ergonomics*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This first edition of ISO 9241-115 cancels and replaces the first edition of ISO 14915-2:2003, which has been technically revised.

The main changes are as follows:

- much of the content of ISO 14915-2:2003 has been removed or simplified. The content which has been retained is included in [Clause 8](#);
- the Scope has been expanded significantly from just navigation design to "conceptual design, user-system interaction design, user interface design and navigation design". New material has been added accordingly.

A list of all parts in the ISO 9241 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Every interactive system has a user interface, regardless of whether or not its design was planned, organized and documented. Risks related to the use of interactive systems can increase due a lack of a planning, organization and documentation in their design.

Within this context, there are two main categories of design for interactive systems, each with their own sub-categories.

- 1) Human-centred design: this deals with the design of interactive aspects of the system and its uses.
 - Human-centred design focuses on satisfying user needs and meeting user requirements.
 - Human-centred design includes conceptual design, user-system interaction design, user interface design and navigation design.
- 2) Technical design: this enables the required interactions between humans and the interactive system from an internal design perspective.
 - Technical design is beyond the scope of this document (see ISO/IEC/IEEE 12207 for further information relating to the technical design of software systems).

ISO 9241-210:2019, 7.1 provides high-level guidance on the human-centred design of interactive systems and recognizes that "human-centred design activities can be incorporated in design approaches as diverse as object-oriented, waterfall, HFI (human factors integration), agile, and rapid development, etc." As stated in the introduction of ISO 9241-210:2019, "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."

ISO 9241-220 elaborates on ISO 9241-210 to identify processes, typical activities and process outcomes for enabling, executing and assessing human-centred design within organizations. Many of the process outcomes focus on attributes of the design of interactive systems.

While both ISO 9241-210 and ISO 9241-220 focus on design activities, there is a need for guidance on the outcomes of those design activities.

This document therefore focuses particularly on guidance concerning the outcomes of conceptual design, user-system design, user interface design and navigation design.

Ergonomics of human-system interaction —

Part 115:

Guidance on conceptual design, user-system interaction design, user interface design and navigation design

1 Scope

This document provides guidance on aspects of the design of human-system interaction, including conceptual design, user-system interaction design, user interface design and navigation design for interactive systems.

This document applies to all design and development approaches and methodologies, including human-centred design, object-oriented, waterfall, human factors integration (HFI), agile and rapid development.

It is intended for the following types of users:

- user interface designers, who will apply the guidance during the development process;
- developers, who will apply the guidance during the design and implementation of system functionality;
- evaluators, who are responsible for ensuring that products meet the recommendations;
- designers of user interface development tools and style guides to be used by user interface designers;
- project managers, who are responsible for managing development processes.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1 Major subjects of designs

3.1.1

design, verb

<process> to define the architecture, system elements, interfaces, and other characteristics of a system or system element

[SOURCE: ISO/IEC/IEEE 12207:2017, 3.1.1]

3.1.2

conceptual design, noun

outcome of *design* (3.1.1) that describes the intended approach to how the system will be perceived and be used by the *user* (3.3.2)

Note 1 to entry: Conceptual design is discussed in [Clause 5](#).

3.1.3

interaction design, noun

user-system interaction design

outcome of *design* (3.1.1) that describes how *interaction sequences* (3.5.3) serve each of the *tasks* (3.3.4) within an interactive system

Note 1 to entry: Interaction design also includes *navigation design* (3.1.5).

Note 2 to entry: Interaction design is discussed in [Clause 6](#).

3.1.4

interface design, noun

user interface design

outcome of *design* (3.1.1) that describes the selection, combination, arrangement and behaviour of *user interface elements* (3.5.7) for all *user interface instances* (3.5.6) as required for *interaction* (3.5.1) between the *user* (3.3.2) and the *user interface* (3.5.5)

Note 1 to entry: Interface design is discussed in [Clause 7](#).

3.1.5

navigation design

outcome of *design* (3.1.1) that describes how access to interface elements and *interactions* (3.5.1) is enabled and structured for *users* (3.3.2)

Note 1 to entry: Information architecture leads to navigation design.

Note 2 to entry: Different users and user groups can have different needs for *navigation* (3.5.8), which can be served differently by a common navigation design.

Note 3 to entry: Navigation design is discussed in [Clause 8](#).

3.1.6

information design

design (3.1.1) that describes the presentation of meaningful information (e.g. texts, labels, icons, symbols) in order to support the comprehensibility and interpretability of the contents presented in the *task* (3.3.4) objects

3.2 Modelling

3.2.1

mental model

belief and understanding *users* (3.3.2) have of themselves, others, the environment and the objects with which they interact

3.2.2

task model

description of a *task* (3.3.4) and its subtasks that has to be carried out in order to reach the *user's* (3.3.2) *goals* (3.3.3)

3.2.3

conceptual model

designer's understanding of how each *user's* (3.3.2) *task* (3.3.4) will be performed supported by the interactive system

3.2.4

scenario of use

description of the sequence of events from the *user's* (3.3.2) perspective to perform a *task* (3.3.4) in a specified *context of use* (3.3.1)

3.3 Context of use, user needs and user requirements

3.3.1

context of use

combination of *users* (3.3.2), *goals* (3.3.3) and *tasks* (3.3.4), resources and environment

Note 1 to entry: The “environment” in a context of use includes the technical, physical, social, cultural and organizational environments.

[SOURCE: ISO 9241-11:2018, 3.1.15]

3.3.2

user

person who interacts with a system, product or service

Note 1 to entry: Users of a system, product or service include people who operate the system, people who make use of the output of the system and people who support the system (including providing maintenance and training).

[SOURCE: ISO 9241-11:2018, 3.1.7]

3.3.3

goal

intended outcome

[SOURCE: ISO 9241-11:2018, 3.1.10]

3.3.4

task

set of activities undertaken in order to achieve a specific *goal* (3.3.3)

Note 1 to entry: These activities can be physical, perceptual and/or cognitive.

Note 2 to entry: While goals are independent of the means used to achieve them, tasks describe particular means of achieving goals.

[SOURCE: ISO 9241-11:2018, 3.1.11]

3.3.5

user need

prerequisite identified as necessary for a *user* (3.3.2), or a set of users, to achieve an intended outcome, implied or stated within a specific *context of use* (3.3.1)

EXAMPLE 1 A presenter (user) needs to know how much time is left (prerequisite) in order to complete the presentation in time [*goal* (3.3.3)] during a presentation with a fixed time limit (context of use).

EXAMPLE 2 An account manager (user) needs to know the number of invoices received and their amounts (prerequisite), in order to complete the daily accounting log (goal) as part of monitoring the cash flow (context of use).

Note 1 to entry: A user need is independent of any proposed solution for that need.

Note 2 to entry: User needs are identified based on various approaches, including interviews with users, observations, surveys, evaluations and expert analysis.

Note 3 to entry: User needs often represent gaps (or discrepancies) between what is desired and what is.

[SOURCE: ISO 25065:2019, 3.1.9, modified — Original Notes 2 and 3 to entry have been modified and Note 4 to entry has been removed.]

3.3.6

user requirements

set of requirements for use that provide the basis for *design* (3.1.1) and evaluation of interactive systems to meet identified *user needs* (3.3.5)

Note 1 to entry: User requirements are derived from user needs and capabilities in order to allow the *user* (3.3.2) to make use of the system in an effective, efficient, safe and satisfying manner.

Note 2 to entry: User requirements are not requirements of users on systems, rather than on the users.

Note 3 to entry: User requirements include *user-system interaction requirements* (3.3.7) and *use-related quality requirements* (3.3.8).

Note 4 to entry: In software engineering terms, user requirements include both "functional" and "non-functional" requirements derived from user needs and capabilities.

[SOURCE: ISO 9241-220:2019, 3.46, modified — Original Notes 1 and 2 to entry have been modified. Note 3 to entry added.]

3.3.7

user-system interaction requirements

user requirements (3.3.6) that specify *interactions* (3.5.1) (e.g. recognizing information, making inputs, making selections and receiving outputs) required by the *users* (3.3.2) to achieve the *goals* (3.3.3)

[SOURCE: ISO 25065:2019, 3.1.11]

3.3.8

use-related quality requirements

user requirements (3.3.6) that specify the intended outcomes of use of the interactive system and associated quality criteria

[SOURCE: ISO 25065:2019, 3.1.12]

3.3.9

user assistance

additional information or interactive capabilities beyond the regular *user-system interaction* (3.5.1) that is provided to the *user* (3.3.2) on request (user-initiated) or is automatically provided by the system (system initiated).

Note 1 to entry: User assistance can be presented as text, images, videos and auditive information dependent on the *context of use* (3.3.1).

Note 2 to entry: User assistance can be information only or provide interactive capabilities ("interactive user assistance").

3.4 Outcomes of use

3.4.1

human-centred quality

extent to which requirements for *usability* (3.4.3), *accessibility* (3.4.2), *user experience* (3.4.4) and avoidance of *harm from use* (3.4.5) are met

Note 1 to entry: Provision of the necessary technical functionality is a prerequisite for human-centred quality.

Note 2 to entry: Usability, accessibility, user experience and avoidance of harm from use can only be managed to the extent that they can be controlled by designed aspects of the interactive system.

Note 3 to entry: Human-centred quality is a collective term for the intended outcomes of interaction of the *user* (3.3.2) with the system.

[SOURCE: ISO 9241-220:2019, 3.12]

3.4.2

accessibility

extent to which products, systems, services, environments and facilities can be used by people from a population with the widest range of *user needs* (3.3.5), characteristics and capabilities to achieve identified *goals* (3.3.3) in identified *contexts of use* (3.3.1)

Note 1 to entry: Context of use includes direct use or use supported by assistive technologies.

[SOURCE: ISO 9241-112:2017, 3.15]

3.4.3

usability

extent to which a system, product or service can be used by specified *users* (3.3.2) to achieve specified *goals* (3.3.3) with effectiveness, efficiency and satisfaction in a specified *context of use* (3.3.1)

Note 1 to entry: The “specified” users, goals and context of use refer to the particular combination of users, goals and context of use for which usability is being considered.

Note 2 to entry: The word “usability” is also used as a qualifier to refer to the *design* (3.1.1) knowledge, competencies, activities and design attributes that contribute to usability, such as usability expertise, usability professional, usability engineering, usability method, usability evaluation and usability heuristic.

[SOURCE: ISO 9241-11:2018, 3.1.1]

3.4.4

user experience

user's (3.3.2) perceptions and responses that result from the use and/or anticipated use of a system, product or service

Note 1 to entry: User perceptions and responses include the user's emotions, beliefs, preferences, perceptions, comfort, behaviours and accomplishments that occur before, during and after use.

Note 2 to entry: User experience is a consequence of brand image, presentation, functionality, system performance, interactive behaviour and assistive capabilities of a system, product or service. It also results from the user's internal and physical state resulting from prior experiences, attitudes, skills, abilities and personality, and from the *context of use* (3.3.1).

[SOURCE: ISO 9241-11:2018, 3.2.3, modified — Notes 3 and 4 to entry have been removed.]

3.4.5

harm from use

negative consequences regarding health, safety, finances or the environment that result from use of the system

Note 1 to entry: The negative consequences can be for the *user* (3.3.2) or for any other stakeholder.

Note 2 to entry: Although avoidance of harm from use, i.e. eliminating any exposure of risk that poses a potential harm, cannot be achieved completely, designing an interactive system can aim at mitigating risks to an acceptable minimum.

[SOURCE: ISO 9241-220:2019, 3.10]

3.5 Interactions and content

3.5.1

interaction

user-system interaction

exchange of information between a *user* (3.3.2) and an interactive system via the *user interface* (3.5.5)

[SOURCE: ISO 9241-110:2020, 3.11, modified — “interaction” has been made a preferred term. “to complete the intended task” has been removed from the definition. Note 1 to entry has been removed.]

3.5.2

specific interaction

single *user-system interaction* (3.5.1) within an *interaction design* (3.1.3)

3.5.3

interaction sequence

specific order of *specific interactions* (3.5.2) in a set of *interactions* (3.5.1) that can be used to complete the intended *task* (3.3.4)

Note 1 to entry: There can be any number of possible interaction sequences for any set of interactions depending on the design of the interactive system.

3.5.4

interaction step

specific interaction (3.5.2) within an *interaction sequence* (3.5.3)

3.5.5

user interface

set of all the components of an interactive system that provide information and controls for the *user* (3.3.2) to accomplish specific *tasks* (3.3.4) with the interactive system

[SOURCE: ISO 9241-110:2020, 3.10]

3.5.6

user interface instance

view

portion of the *user interface* (3.5.5) that is presented at one time during the use of an interactive system

Note 1 to entry: Although the word "view" is typically associated with visual information, it is used synonymously with (user interface) instance. In this context, it is not limited to visual renderings and can include renderings of information presented via auditory or tactile modalities or a combination of these.

EXAMPLE 1 A webpage.

EXAMPLE 2 An individual screen within an app.

3.5.7

user interface element

entity of the *user interface* (3.5.5) that is presented to the *user* (3.3.2) by the software

EXAMPLE Text, graphic, check box

Note 1 to entry: User interface elements can be interactive or not.

Note 2 to entry: Both entities relevant to the *task* (3.3.4) and entities of the user interface are regarded as user interface elements. A user interface element can be a visual representation or an interaction mechanism for a task object (e.g. letter, sales order, electronic part, wiring diagram) or a system object (e.g. printer, hard disk, network connection). It can be possible for the *user* (3.3.2) to directly manipulate some of these user interface elements.

Note 3 to entry: User interface elements in a graphical user interface include such things as basic objects (e.g. window title bars, menu items, push buttons, image maps, editable text fields) or containers (e.g. windows, grouping boxes, menu bars, menus, groups of mutually-exclusive option buttons, compound images that are made up of several smaller images). User interface elements in an audio user interface include such things as menus, menu items, messages and action prompts.

[SOURCE: ISO 9241-171:2008, 3.38, modified — The preferred term, "user interface element," is no longer hyphenated. The admitted term "user-interface object" has been removed. "control" has been changed to "check box" in the EXAMPLE.]

3.5.8

navigation

act of moving from one *user interface element* (3.5.7) to another within a *user interface* (3.5.5) and to move throughout an interactive system

[SOURCE: ISO 9241-161:2016, 3.13, modified — "ability to move" has been changed to "act of moving" in the definition.]

3.5.9**navigation sequence**

portion of an *interaction sequence* (3.5.3) concerned with navigating between locations within the *user interface* (3.5.5)

3.6 Navigation techniques**3.6.1****system-initiated**

movement of the focus within the *user interface* (3.5.5) without an explicit request from the *user* (3.3.2)

EXAMPLE The automatic movement of the cursor between parts of a credit card number, where, once the user has entered four digits, the cursor moves to the next section without any interaction.

Note 1 to entry: System-initiated *navigation* (3.5.8) could be adapted by the system based on the content and some combination of an individual's history, an individual's personal characteristics, a group's social history and/or a group's characteristics.

3.6.2**linear navigation**

movement within the *user interface* (3.5.5) where movement is designed to be limited to forward or backward in a linear structure, but where the *user* (3.3.2) has control over when to navigate and optionally how far to navigate

EXAMPLE 1 Upon answering question 2 in a quiz, the user is sent to question 3.

EXAMPLE 2 The system requires the user to click on a "continue" button before navigating to the next step of a multi-step operation.

EXAMPLE 3 An electronic reader allows the user to jump forward (or backward) to the start of the next (or previous) chapter.

EXAMPLE 4 A media player allows the user to rewind, fast forward or jump some predefined amount of time in the presentation of the media.

3.6.3**flexible navigation**

user-initiated movement where the *user* (3.3.2) is offered choice(s) of where and when to go to another location within the *user interface* (3.5.5).

EXAMPLE 1 The user chooses between going into further detail on a topic or moving on to the next topic.

EXAMPLE 2 A media player allows the user to rewind, fast forward or jump to some user-defined time in the presentation of the media.

3.7 Links**3.7.1****link**

any *user-interface element* (3.3.7) that allows *navigation* (3.5.8) to a specified location within an interactive system

Note 1 to entry: Links can be activated by the *user* (3.3.2) or by the system.

Note 2 to entry: Some types of links include: menu items, hyperlinks and buttons.

EXAMPLE 1 Pressing 1 at the main menu of an interactive voice response system brings the user to a subsequent menu.

EXAMPLE 2 A "shopping cart" button links to the location in the *user interface* (3.5.5) where the order can be processed for payment.

3.7.2

system-activated link

link (3.7.1) that is activated by a system action

Note 1 to entry: System-activated links can be fixed links, *temporal links* (3.7.5) or *computed links* (3.7.6).

EXAMPLE A link is activated by the completion of a time delay in an automatic slide show.

3.7.3

user-activated link

link (3.7.1) that is activated by a *user* (3.3.2) action

Note 1 to entry: User-activated links can be fixed links, *temporal links* (3.7.5), *computed links* (3.7.6) and *user-defined links* (3.7.7).

EXAMPLE 1 A link is activated by the user placing the cursor over the link and clicking on the left mouse button.

EXAMPLE 2 A link is activated by the user selecting the third choice in a menu of links.

3.7.4

permanent link

persistent link (3.7.1) that can be activated whenever the link is presented

EXAMPLE 1 The *user* (3.3.2) clicks on a word and is provided with a description of what the word means.

EXAMPLE 2 The user clicks on an animated icon which starts a video presentation.

3.7.5

temporal link

link (3.7.1) that is only available for a certain period of time while the link is presented

Note 1 to entry: Links that have limited temporal availability can create *accessibility* (3.4.2) challenges if they are too limited to permit some *users* (3.3.2) to activate them. ISO 9241-171 provides guidance related to providing users with sufficient time to complete actions.

EXAMPLE 1 Links to descriptions of characters are made available only while the characters are visible in a video sequence.

EXAMPLE 2 A link to descriptive information is available only during the first 20 s of viewing a picture.

3.7.6

computed link

temporal link (3.7.5), created on demand where the location linked to is dynamically determined based on the current state and/or history of the system

Note 1 to entry: It is possible that in future the same computed links will not be created for similar states and/or histories of the system.

EXAMPLE The results of a search include several links to different parts of the application that will be replaced by the results of any subsequent search.

3.7.7

user-defined link

permanent link (3.7.4) or *temporal link* (3.7.5) created by a *user* (3.3.2) during the use of an application that is intended to supplement the *links* (3.7.1) created by the application

EXAMPLE The user creates a bookmark or favourite to provide a future link to a given location for future use.

4 Human-centred design in the context of this document

4.1 Human-centred design activities

ISO 9241-210 focuses on all human-centred design activities. This document focuses specifically on the human-centred design activity "producing design solutions". The following clauses describe the outcomes of four sub-activities within producing design solutions:

- 1) conceptual design;
- 2) user-system interaction design;
- 3) user interface design;
- 4) navigation design.

NOTE 1 ISO/TR 9241-810 identifies ergonomic issues that are unique to robotic, intelligent and autonomous systems.

NOTE 2 ISO 9241-820:—¹⁾ provides ergonomic guidance related to interactions in immersive environments including augmented reality and virtual reality.

4.2 General guidance

4.2.1 Mental model of the user

The conceptual design, the user-system interaction design, the user interface design, and the navigation design should match the user's mental model to fulfil their expectations considering all aspects of the context of use.

It is important for the users to be able to easily assimilate the conceptual model into their mental model.

NOTE This takes into consideration and will influence the whole user experience.

4.2.2 Support of appropriate user interface technology

User-system interactions and user interfaces should support appropriate user interface technologies.

NOTE Various technologies can be utilized to implement user interfaces. Selection of the appropriate user interface technologies for use involves consideration of the following points:

- a) which technologies best suit the identified user needs and requirements of the majority of intended users;
- b) when to use individual technologies in the user interface for different types of content;
- c) which additional alternative technologies are needed to make user-system interactions accessible to all intended users.

4.2.3 Constraints on design

In addition to meeting user requirements, user-system interactions and user interfaces should meet applicable:

- a) market requirements;
- b) organizational or business requirements.

These additional requirements are typically identified within the overall system development and can provide constraints on the user-system interaction and user interface design.

1) Under development. Stage at the time of publication: ISO/PRF 9241-820:2024.

Additional constraints on the user-system interaction design and the user interface design can come from:

- the platforms that are intended to be used for the interactive system;
- consistency with other systems or user interfaces, design systems or user interface guidelines existing in the organization.

4.2.4 Overall consistency

User-system interactions and user interfaces should be consistent in their intent, behaviour and appearance.

NOTE Consistent design is important for achieving self-descriptiveness and for meeting user expectations.

4.2.5 Aesthetics

User-system interactions and user interfaces should be based on suitable aesthetics in addition to the basic functional requirements of the tasks.

NOTE 1 Aesthetic considerations include both physical (tactile, visual and auditory) considerations and affective (user experience-related) considerations.

NOTE 2 An approved aesthetic aspect contributes to the acceptability of a system and reinforces the esteem value associated with its use. Suitable aesthetics will result in the harmony between the execution of actions by the user and the intended user experience during the interaction.

NOTE 3 Style expectations on an interactive system typically go beyond any existing general organizational style guide to incorporate user requirements, design constraints, applicable principles and high-level guidance, and any other general design decisions in a manner that is easy for developers to implement. Style guides can evolve over time, as long as changes to the style guide are also implemented in existing portions of the design, in order to maintain consistency.

4.2.6 Accessibility

User-system interactions and user interfaces should apply the guidance in ISO 9241-171.

Tactile/haptic interactions should apply the guidance in ISO 9241-971.

User-system interactions and user interfaces should also apply additional applicable accessibility guidance.

NOTE Some sources of additional accessibility guidance include:

- ISO/IEC 20071-11, which provides guidance on alternative text for images;
- ISO/IEC TS 20071-21, which provides guidance on audio descriptions;
- ISO/IEC 20071-23, which provides guidance on captions and subtitles;
- ISO/IEC TS 20071-25, which provides guidance on the audio presentation of text in videos;
- ISO/IEC 40500:2012, which provides guidance about web accessibility.

5 Conceptual design

5.1 General

A conceptual design describes at an abstract level how the interactive system can satisfy user needs.

It provides the basis for user-system interaction design, user interface design and navigation design by identifying all the major inputs needed for those designs.

Conceptual design is based upon a context of use analysis, identified user needs and a user requirements specification as described in ISO/IEC 25063 and ISO/IEC 25064.

5.2 Contents of a conceptual design

A conceptual design contains at least:

- a) task models for all supported tasks;
- b) identification of scenarios of use for each supported task;

NOTE The detailed specification of scenarios of use is then part of the user-system interaction design.

- c) task objects, their attributes and executable functions to manipulate each task object.

A conceptual design may include illustrations of list items a), b) and c) in terms of storyboards, user journey maps, and/or a schematic diagram of the relationship between task objects.

6 User-system interaction design

6.1 General

A user-system interaction design should describe how sets of interactions serve the intended scenarios of use for each of the tasks within an interactive system. It also describes system behaviour in case unintended or unexpected interactions occur.

A user-system interaction design should describe, at each step of the scenario of use supporting the design:

- what information the system needs to present to the user;
- what actions the user needs be able to perform to continue the realization of the scenario of use.

NOTE 1 The design of how sets of interactions are rendered in the user interface is part of the user interface design.

Interaction scenarios should apply the principles and general recommendations contained in ISO 9241-110. The ISO 9241-110 principles are:

- suitability for the user's tasks;
- self-descriptiveness;
- conformity with user expectations;
- learnability;
- controllability;
- use error robustness;
- user engagement.

NOTE 2 User-system interactions exist within:

- a) the context of use;
- b) the interactive system;
- c) one or more goals;
- d) one or more tasks for each goal (with optional levels of sub-tasks);
- e) one or more scenarios for each task.

A scenario contains a specific sequence of one or more sets of interactions on an interactive system that are input via the user interface to complete the intended task.

6.2 Types of interactions

There are two main types of interaction:

- a) interaction scenarios that accomplish scenarios of use and tasks which achieve parts of the goals of the application;
- b) navigation interactions that move between different parts of the system or user interface (which support navigation).

6.3 The design of interaction scenarios

An interaction scenario provides the detailed design of the series of actions to be implemented to support a scenario from the conceptual design.

The design of an interaction scenario should identify:

- a) a brief description of the scenario that it represents;
- b) an ordered sequence of sets of interactions involved.

6.4 Compatibility of interaction scenarios

Individual interaction scenarios should be compatible with other interaction scenarios within the interactive system.

Once the full set of interaction scenarios has been designed, it is important to evaluate the overall effect of this design and, where necessary, to iterate the design until it is adequate for the needs of the interactive system.

NOTE This evaluation is important for ensuring the consistency and completeness of the set of interaction scenarios.

6.5 The design of user actions to be supported by the system

NOTE Specific interactions can serve one or more tasks.

The design of each supported user action should identify:

- a) any prerequisite(s) to performing the supported user action;
- b) how the supported user action is performed;
- c) the intended outcome of the supported user action.

6.6 Interactions from the user's perspective

User-system interactions should be meaningful to the intended user.

NOTE 1 It is important that the purpose of user-system interactions can be associated with the user's task rather than with technical needs of the interactive system.

NOTE 2 Meaningfulness increases when the precondition(s) and result(s) of an interaction are self-descriptive and meet user expectations.

User-system interactions should be obvious to the user, minimizing the need for additional instructive information.

NOTE 3 This helps the system to be self-descriptive.

7 User interface design

7.1 General

A user interface design describes the selection, combination, arrangement and behaviour of user interface elements for the functionality and resulting user experience as required for user-system interaction between user and user interface.

This includes both interactive user interface elements that implement user-system interactions and non-interactive elements that provide information to the user.

Content should apply the principles and general recommendations contained in ISO 9241-112. The ISO 9241-112 principles are:

- detectability;
- freedom from distraction;
- discriminability;
- unambiguous interpretability;
- conciseness;
- consistency (internal and external).

NOTE 1 Evaluation can identify emergent needs, refinements to the user requirements and possible design improvements.

NOTE 2 It can be necessary to iterate the design of the user-system interactions and the user interfaces until they are suitable or adequate for meeting the user's expectations and the needs of the interactive system, and for achieving acceptable human-centred quality.

7.2 Contents of a user interface design

7.2.1 Structure

The design of the user interface of an interactive system consists of designs for user interface instances (e.g. webpages, app screens, etc.) composed of user interface elements.

7.2.2 User interface instances

The design of a user interface instance should identify:

- a) the user interface elements that are part of the user interface instance;
- b) the logical relationships between user interface elements;

NOTE 1 Groups of user interface elements can be used to identify logical relationships.

- c) the preferred physical relationship between user interface elements and, if applicable, the change of this relationship based on the system environment;

NOTE 2 There are various types of physical relationships, such as spacing, location distance between elements and alignment.

NOTE 3 The change of relationships is either for catering for device capabilities (e.g. smaller or larger screens) or for different settings allowed in the system (e.g. adoption of window sizes).

- d) a linear relationship between user interface elements that can be used in providing accessibility to the interface;
- e) the temporal relationship between user interface elements, if applicable to the user interface instance.

EXAMPLE 1 After 14 min of inactivity on a banking web site, the user is prompted that they will automatically be logged out in one min.

EXAMPLE 2 On a smart speaker, pieces of content are played in an order determined by the user's profile settings.

7.2.3 User interface elements

The design of a user interface element should identify:

- a) the name of the user interface element;
- b) the purpose of the user interface element;
- c) the possible states of the user interface element;
- d) the possible interactions with the user interface element;
- e) the preferred rendering of the user interface element and its states, in terms of:
 - 1) modality,
 - 2) user interface element type,
NOTE ISO 9241-161 contains guidance on a number of types of visual user interface elements.
 - 3) user interface element attribute(s) and, where applicable, limits on permitted values;
- f) alternative renderings of the user interface element, including a text equivalent that is accessible.

7.3 Information architecture

7.3.1 Purpose of an information architecture

An information architecture fulfils two purposes:

- to ensure that the task objects and executable functions match the mental model and expectations of the users and are learnable;
- to help users locate task objects and executable functions; e.g. task objects and executable functions can be “signposted”.

7.3.2 Contents of an information architecture

An information architecture contains:

- a) titles of all task objects (e.g. “book”) and titles of all attributes of each task object (e.g. “author of book”);
- b) titles of executable functions (e.g. “proceed to checkout”) and titles of all individual actions enabled within each executable function (e.g. “select number of copies to be ordered”);
- c) content which includes attributes of task objects (e.g. “author of book”) and parameters for setting executable functions (e.g. “filter categories”);
- d) terminology, i.e. all terms used in the user interface, for all contents, and all labels of signposts such as “add to shopping cart”;
- e) navigation structure to:
 - navigate towards task objects and executable functions using titled signposts,
 - navigate within task objects and executable functions (e.g. “table of contents” of a book is presented to the user, which allows them to navigate within the book to see parts of the contents),

- navigate across task objects and executable functions using connection paths (e.g. other books with similar contents).

NOTE Guidance on navigation structures is given in [Clause 8](#).

7.4 Information design

The information presented in all renderings of the user-system interface should be comprehensible and consistent.

NOTE 1 Information design includes the design of all elements containing meaningful information, such as textual and visual content, labels, symbols or icons considering users expectations, prior knowledge and user requirements.

In addition to task-based content, the user-system interface should provide (or make available) sufficient user assistance information for the user to be informed:

- a) which actions the interactive system can perform on which user interface elements;
- b) how actions of the interactive system can be initiated.

Information design should utilize action guidance to support the users in performing the intended actions, minimizing the need for additional instructive information.

NOTE 2 Action guidance uses action wording such as "locate", "recognize" or "understand" to refer to inputs or choices.

NOTE 3 Action guidance is only about advising the user with appropriate actions that the user can choose to do and does not include the system taking control away from the user.

7.5 Design recommendations

7.5.1 User interface

The user interface structure should support completion of one or more tasks by the intended range of users.

NOTE Some techniques that can aid in the design of user interfaces include:

- a) deciding whether to use a single design for all approaches or whether to support individualization to specific user needs;
- b) identifying appropriate interaction styles (interaction techniques);
- c) deriving the necessary interactive user interface elements, the sequence and timing (dynamics) of the user-system interactions and the navigation structure;
- d) designing the information architecture to allow efficient access to interactive user interface elements;
- e) comparing testable user interface design alternatives with a level of detail and realism that is appropriate to the issues that need to be investigated;
- f) utilizing prototypes.

7.5.2 User interface instances

User interface instances are the major identifiable components of the structure of a user interface. It is important that the user interface structure is optimized according to the suitability for the task of the user interface instances.

- a) The user interface should be optimized so that individual tasks can be completed with a minimum of movement between user interface instances.
- b) The user interface should be optimized so that similar tasks share the use of the same or similar user interface instances.

- c) The user interface should avoid combining content from dissimilar tasks, to avoid creating unnecessary complexity.
- d) The user interface should reflect the level of detail needed in the different tasks or expectations of the user.
- e) The user interface should help the user to locate individual user interface elements to perform their tasks.
- f) The user interface should be able to be understood by the user as a meaningful, cohesive group of information.

NOTE 1 The use of design patterns can be helpful in the structuring of groups of user interface elements.

- g) If content exists at various levels of granularity (specificity) then navigation should be provided to access each of these levels.

NOTE 2 Concern for granularity in structuring is referred to by a variety of names, including layering and progressive disclosure.

EXAMPLE 1 Some possible examples of applying content granularity include:

- an introduction to the content topic;
- detailed information on the content topic;
- specialized information on a particular use of the content;
- examples of the use of the content;
- references to related content.

- h) User interface elements should be appropriate to the user-system interactions they support.

EXAMPLE 2 Where selecting one choice among a list is the interaction, it is more appropriate to use a set of radio buttons than a set of check boxes.

NOTE 3 This is because the user-system interactions accomplish tasks, while the interactive user interface elements are tools that support user-system interactions.

- i) The grouping or separation of user interface elements should enhance the correct understanding of the task by the user.
- j) Where different levels of importance exist, user interface elements should make clear their different levels of importance.
- k) The default state for user interface elements should be chosen to optimize user-system interaction.

7.5.3 User interface elements

The design of each user interface element should:

- a) meet the expectations and understanding of users;
- b) be compatible with the design of every other user interface element;
- c) meet the needs of the user-system interactions;
- d) provide acceptable usability, accessibility, user experience and avoidance of harm from use.

7.5.4 Supporting different target devices

Where the context of use identifies significant differences in the capabilities of devices (e.g. large and small display sizes) or the available settings (e.g. resizable windows/viewports) that the interactive system is intended to be used on, the user interface design can be either:

- a) a single design with information on how it can be rendered under different conditions;

- b) a set of similar designs specific to different devices, that differ only where necessary to take into account the different capabilities of different devices or available settings;
- c) a combination of a) and b).

7.5.5 Accessibility

The rendering of user interface elements should make use of the modalities and media that best convey their meaning to the users.

All non-text user interface elements should include text alternatives for those users who cannot make use of their main rendering.

NOTE ISO/IEC 20071-11 provides guidance on text alternatives for images. ISO/IEC TS 20071-21 provides guidance on descriptive audio. ISO/IEC 20071-23 provides guidance on captioning and subtitles.

7.5.6 Innovative solutions

The content of an interactive system may use innovative solutions (e.g. the use of creative design and/or new technologies) to maximise its benefits.

NOTE While familiar design can help to meet the expectations of some users, other users will possibly expect that an innovative solution ensures that the system is more modern and better serves their needs. Neither of these expectations is necessarily superior to the other.

It is important to properly investigate the potential of various innovative solutions to meet user requirements, in order to achieve an optimal design of the user interface.

8 Navigation design

8.1 General

Navigation is the act of moving from one user interface element to another within a user interface and moving throughout an interactive system.

Navigation can include movements:

- within a user interface instance;
- between user interface instances or user interface elements in user interface instances within an interactive system;
- to other locations outside the interactive system.

Navigation design describes how users can access interface elements and interactions to:

- explore the interactive system;
- perform identified tasks;
- switch between tasks;
- exit or enter the interactive system.

Navigation design comprises all navigation paths and identifies how to get from one location to another within the user interface structure. A complete navigation design for most interactive systems is typically too complicated to visualize or otherwise consider all at once. Thus, navigation designs are broken into:

- a) the design of individual navigation sequences;
- b) the design of user interface elements for navigation.

8.2 Contents of navigation sequence design

The content of an interaction sequence design should include information on:

- a) where the navigation is coming from, including:
 - 1) the user interface instances from which the navigation originates,
 - 2) the user interface element used to initiate the navigation;
- b) where the navigation is going to, including:
 - 3) the user interface instances to which the navigation action will take the user,
 - 4) the user interface element, if applicable, to which the navigation action will take the user.

8.3 Navigation with additional user interface elements

While the initial set of user interface elements is typically limited to those that serve identified tasks, additional user interface elements could be needed to enable navigation actions.

8.4 Use of navigation structures

8.4.1 Use of linear structures

Linear structures should be used when the user's expectation of task implies sequential dependency or temporal ordering.

NOTE 1 A linear structure can also be used to reduce the complexity of some interactions (e.g. where there are numerous or difficult interaction steps), to favour certain users (e.g. beginners) or to facilitate unfamiliar interactions.

NOTE 2 If needed, multiple linear paths can be provided to accommodate different usage scenarios.

8.4.2 Navigation in linear structures

If appropriate to the task, the system should provide a means for the user to:

- go backward and forward to locations in the structure;
- go to the beginning or the end of the structure.

NOTE Linear structures limit the ability of users to go to a particular element within the structure, instead allowing only sequential access. However, this ability can be added by providing a search control and/or providing support for creating bookmarks to specific locations. Situations where such additional functionality could be suitable would possibly be better served by providing at least alternative access to a non-linear structure, such as a hierarchical structure.

8.4.3 Use of tree structures

Tree structures should be used when the content can be hierarchically clustered into logical units in terms of subjects that can be defined at different levels of detail.

NOTE Tree structures can be particularly appropriate when the content is complex.

8.4.4 Navigation in tree structures

If appropriate to the task, the system should provide a means for the user to:

- a) go back and forward within a level in the structure;
- b) go up and down in the structure;

- c) go to the beginning of the structure;
- d) (optionally) go to a table of contents or index.

NOTE These navigation locations are usually appropriate unless there is a reason to exclude them.

8.4.5 Use of network structures

Network structures should be considered when there are multiple relationships between individual groups of user interface elements.

NOTE A default linear path can be provided to assist users in navigating through the network structure in a linear order, for example in order to guide the user through the network structure to accomplish a particular task.

8.4.6 Navigation in network structures

The user should be presented with a meaningful structure of navigation alternatives where the differences between these alternatives are made explicit.

If appropriate to the task, the system should provide a means for the user to:

- a) go back to the previous location from which they have navigated;
- b) go to any related location;
- c) go to a table of contents, index, site map or search function to identify other desired locations.

8.4.7 Navigation in hybrid structures

A user interface is often structured as a hybrid composition of a number of individual linear, hierarchical and network structures (e.g. hub and spoke structures can be created from a combination of network and hierarchical structures).

If appropriate to the task, the system should provide a means for the user to:

- a) navigate between different individual structures;
- b) navigate within each of the individual structures in the means appropriate to the individual structure.

8.4.8 Navigation in dynamic structures

Dynamic structures can occur where the components of a structure are created based on the current state of information (e.g. when created from a database or a set of search results).

Although the system will possibly access these components in no predefined order:

- a) it should arrange their presentation in a logical order making use of a linear, hierarchical or network structure, whichever is most appropriate to the tasks involved;
- b) it should then provide the corresponding means of navigation for this dynamically created structure.

8.4.9 Determining navigation techniques

The tasks, the users and the nature of the content should be considered in deciding whether navigation at a given point within an application is:

- a) system-initiated navigation;
- b) linear navigation;
- c) flexible navigation.