
**Ergonomics of human-system
interaction —**

**Part 110:
Interaction principles**

Ergonomie de l'interaction homme-système —

Partie 110: Principes d'interaction
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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

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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.

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 documents 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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

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

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.

This second edition cancels and replaces the first edition (ISO 9241-110:2006), which has been substantially technically revised.

The main changes compared to the previous edition are as follows:

- the principle of individualization has been merged into the principle of controllability;
- a new principle on user engagement has been developed;
- existing principles and general design recommendations have been revised.

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

Introduction

This document describes interaction principles (formerly referred to as "dialogue principles") and general design recommendations which are independent of any specific interaction technique and which are applicable in the analysis, design and evaluation of interactive systems.

This document significantly revises and updates the first edition. It incorporates relevant guidance previously contained in ISO 14915-1. The general design recommendations in this document are derived from a combination of ergonomics research and various sources of general and heuristic guidance (including Bastien^[16], Dzida^[19], Molich^[23], Nielsen^[24] and Tognazzini^[29]).

These interaction principles and general design recommendations can guide the development and evaluation of user interfaces, leading to improved usability.

The priority with which each interaction principle or general design recommendation is applied depends on the purpose of the interactive system, the characteristics of the intended and foreseeable users of the system, the tasks, the environment, the specific interaction technique used and the consequences arising from use. Guidance on identifying relevant aspects of the users, tasks and environment of use is given in ISO 9241-11.

The ultimate beneficiary of this document will be the user of an interactive system. Although it is unlikely that the user will read this document or even know of its existence, its application by the developers of the interactive system will lead to user interfaces which are more usable, accessible, consistent and that enable greater productivity and a more positive user experience, and which avoid harm from use. The benefits for suppliers of interactive systems include increased sales, customer satisfaction and loyalty, decreased costs of providing service.

Applying these interaction principles and the associated general design recommendations also helps prevent users of those products 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 responses of the interactive system (including those leading to harm from use);
- navigational limitations during use; and
- inefficient error recovery.

This document comprises the following:

- a) a framework for applying the interaction principles and general design recommendations;
- b) the interaction principles;
- c) general design recommendations corresponding to the interaction principles.

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Ergonomics of human-system interaction —

Part 110: Interaction principles

1 Scope

This document describes principles for interaction between a user and a system that are formulated in general terms (i.e. independent of situations of use, application, environment or technology). This document provides a framework for applying those interaction principles and the general design recommendations for interactive systems.

While this document is applicable to all types of interactive systems, it does not cover the specifics of every application domain (e.g. safety critical systems, collaborative work, artificial intelligence features).

It is intended for the following audiences:

- analysts of requirements (including market requirements, user requirements, and system requirements);
- designers of user interface development tools and style guides to be used by user interface designers and developers;
- designers of user interfaces who will apply the guidance during the design activities (either directly, based on training, or by using tools and style guides which incorporate the guidance);
- developers who will apply the guidance during the development process;
- evaluators who are responsible for ensuring that products meet the general design recommendations contained in this document;
- buyers who will reference this document in contracts during product procurement.

This document focuses on interaction principles related to the design of interactions between user and interactive system. ISO 9241-112 provides further guidance on the presentation of information.

This document does not consider any other aspect of design such as marketing, aesthetics and corporate identity.

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 terminological databases for use in standardization at the following addresses:

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

**3.1
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, characteristics and capabilities to achieve identified goals in identified contexts of use

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

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

**3.2
context of use**

combination of users, goals and tasks, 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
goal**
intended outcome

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

**3.4
interactive system**

combination of hardware and/or software and/or services and/or people that users interact with in order to achieve specific goals

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Note 1 to entry: This includes, where appropriate, packaging, user documentation, online and human help, support and training.

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Note 2 to entry: The term “system” is often used rather than “interactive system”.

[SOURCE: ISO 9241-11:2018, 3.1.5, modified — Note 2 to entry has been added.]

**3.5
task**

set of activities undertaken in order to achieve a specific goal

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.

Note 3 to entry: The term “task” is used here, as in ISO 9241-11, in its widest sense, rather than in reference to the specifics of use of the interactive system.

[SOURCE: ISO 9241-11:2018, 3.1.11, modified — Note 3 to entry has been added.]

**3.6
usability**

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

Note 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 knowledge, competencies, activities and design attributes that contribute to usability, such as usability expertise, usability professional, usability engineering, usability method, usability evaluation, usability heuristic.

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

3.7**use error**

user action or lack of user action while using the system, product or service that leads to a different result than that intended by the manufacturer or expected by the user

Note 1 to entry: Use error includes the inability of the user to complete a task.

Note 2 to entry: Use errors can result from a mismatch between the characteristics of the user, user interface, task, or use environment.

Note 3 to entry: Users might be aware or unaware that a use error has occurred.

Note 4 to entry: A malfunction of an interactive system that causes an unexpected result is not considered a use error.

Note 5 to entry: The term use error is used in preference to user error or human error in order to avoid the implied assignment of responsibility for the error to the user.

[SOURCE: ISO 9241-11:2018, 3.3.3]

3.8**user**

person who interacts with the 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]

3.9**user experience**

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

Note 1 to entry: Users' perceptions and responses include the users' 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.

Note 3 to entry: The term "user experience" can also be used to refer to competence or processes such as user experience professional, user experience design, user experience method, user experience evaluation, user experience research, user experience department.

Note 4 to entry: Human-centred design can only manage those aspects of user experience that result from designed aspects of the interactive system.

[SOURCE: ISO 9241-11:2018, 3.2.3]

3.10**user interface**

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

3.11

user-system interaction **user interaction**

exchange of information between a user and an interactive system via the user interface to complete the intended task

Note 1 to entry: User-system interaction represents a subset of human-system interaction that only focusses on intended users and not other humans who can be affected by the interactive system.

[SOURCE: ISO/IEC 25060:2010, 2.22, modified — Note 1 to entry has been added.]

4 Interaction principles

4.1 Overview

This clause introduces the interaction principles. Seven principles have been identified as being important for the design and evaluation of interactive systems.

- **Suitability for the user's tasks:** An interactive system is suitable for the user's tasks when it supports the users in the completion of their tasks, i.e. when the operating functions and the user-system interactions are based on the task characteristics (rather than the technology chosen to perform the task).
- **Self-descriptiveness:** The interactive system presents appropriate information, where needed by the user, to make its capabilities and use immediately obvious to the user without unnecessary user-system interactions.
- **Conformity with user expectations:** The interactive system's behaviour is predictable based on the context of use and commonly accepted conventions in this context.
- **Learnability:** The interactive system supports discovery of its capabilities and how to use them, allows exploration of the interactive system, minimizes the need for learning and provides support when learning is needed.
- **Controllability:** The interactive system allows the user to maintain control of the user interface and the interactions, including the speed and sequence and individualization of the user-system interaction.
- **Use error robustness:** The interactive system assists the user in avoiding errors and in case of identifiable errors treats them tolerantly and assists the user when recovering from errors.
- **User engagement:** The interactive system presents functions and information in an inviting and motivating manner supporting continued interaction with the system.

NOTE The order in which the principles are presented here does not imply any priority.

For each of the principles, this document provides a list of general design recommendations. The application of a single recommendation does not mean that the application of a principle has been fully satisfied.

[Table 1](#) identifies the main categories used to structure recommendations for each of the principles. These recommendations help in the identification and specification of user requirements relevant to specific contexts of use (see ISO 25065).

Table 1 — Interaction principles and their main categories of recommendations

Interaction Principle	Categories of recommendations
Suitability for the user's tasks	<ul style="list-style-type: none"> a) identifying suitability of the interactive system for a given task b) optimizing effort in task accomplishment c) defaults supporting the task
Self-descriptiveness	<ul style="list-style-type: none"> a) presence and obviousness of the information b) clear indication of processing status
Conformity with user expectations	<ul style="list-style-type: none"> a) appropriate system behaviour and responses b) consistency (internal and external) c) changes in the context of use
Learnability	<ul style="list-style-type: none"> a) discovery (of information and controls that users are looking for) b) exploration (of information and controls that users have discovered) c) retention (of information about the system)
Controllability	<ul style="list-style-type: none"> a) interruption by the user b) flexibility c) individualization
Use error robustness	<ul style="list-style-type: none"> a) use error avoidance b) use error tolerance c) use error recovery
User engagement	<ul style="list-style-type: none"> a) motivating the user b) trustworthiness of the system c) increasing user involvement with the system

4.2 Coverage of this set of interaction principles and general design recommendations

The principles and general design recommendations identified in this document are generic and are not tied to any particular system or context of use. General design recommendations are organized under the principles to which they appear to be most relevant. However, it is recognized that since the principles can overlap, recommendations can relate to more than one principle. Each recommendation is presented under only a single principle, since understanding and using the recommendations is more important than categorizing them.

While the recommendations presented in this document summarize important guidance obtained from current knowledge, it is possible that additional guidance will become important as technology and ergonomics develop.

This document applies to most interactive systems in most contexts of use. It is up to individuals using this document to determine any system and contexts of use where they do not apply. Not every recommendation within this document is applicable in every context of use.

4.3 Use of the interaction principles in human-centred design

While this document describes product-related principles for interaction between users and interactive systems, ISO 9241-210:2019 provides principles and guidance on activities of human-centred design for interactive systems.

4.4 Contribution of the interaction principles to usability

Usability is the extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use (see ISO 9241-11). This recognizes that usability results from a complex set of factors and can be different for different users, different goals and tasks, and different contexts of use.

Usability consists of effectiveness, efficiency and satisfaction, each of which is composed of more specific components:

- effectiveness: the accuracy and completeness with which users achieve specified goals;
- efficiency: the resources used in relation to the results achieved;
- satisfaction: the extent to which the user's physical, cognitive and emotional responses that result from the use of a system, product or service meet the user's needs and expectations.

User-system interactions can affect each component. While some principles and some general design recommendations appear to focus more on one component than the others, some principles and recommendations affect all three components.

NOTE Suitability for the task addresses both effectiveness "to complete the task" and efficiency avoiding "unnecessary steps and unnecessary information", while suitability for engagement primarily addresses satisfaction.

4.5 Relationships between interaction principles

The interaction principles are not strictly independent and can semantically overlap. A usability problem or a general design recommendation can relate to one or more interaction principles.

NOTE 1 If users do not detect some information because it is placed at a location where users do not expect it, a usability problem occurs because the interactive system does not conform with user expectations. As a consequence, since the information is not present from the user's perspective, when needed, the *self-descriptiveness* of the interactive system is affected.

EXAMPLE 1 While creating a presentation, users use the undo function repeatedly to explore the look of different styles. In this context, the undo function is used as a tool to achieve *controllability*. However, if users in this situation use the undo function to explicitly correct an error, it is used to maintain *use error robustness*.

While the set of principles and general design recommendations are intended to optimize the usability of the system, constraints can make it necessary to make "trade-offs" between the application of principles in order to optimize usability. The applicability and the priority given to each principle varies with the specific field of application, user groups and the interaction technique chosen.

NOTE 2 Examples for fields of application can range from work equipment over entertainment systems to safety critical systems.

EXAMPLE 2 The limited display space on a smart watch leads to trade-offs between applying the interaction principles. Because the display space is not sufficient to provide the information necessary for *self-descriptiveness* a higher priority is assigned to achieving *conformity with user expectations*.

Each of the principles needs to be considered in analysis, design and evaluation. However, principles can vary in their relative importance depending on the context of use and any constraints on the design. In practice, within design situations for an interactive system, compromises are made.

4.6 Framework for using this document

This document provides interaction principles and general design recommendations for the interaction between user and system that apply across application domains and particular technologies.

[Annex A](#) provides a checklist to aid in applying the general design recommendations in this document.

ISO 9241-112 provides principles and general recommendations for the presentation of information that apply across the three main modalities (visual, auditory, tactile/haptic) typically used in ICT. Those principles and recommendations also apply across application domains and across technologies. The principles of self-descriptiveness and conformity with user expectations are related to the presentation of information. Information, which is not self-descriptive, can mislead the user.

Other ISO standards contain recommendations and requirements with a specific thematic focus:

- requirements and recommendations specific to the visual presentation of information are provided in ISO 9241-125;
- requirements and recommendations specific to interaction techniques are provided in standards such as ISO 9241-143;
- requirements and recommendations specific to an application domain are provided in standards such as ISO 9241-154;
- requirements and recommendations specific to accessibility are provided in standards such as ISO 9241-171.

[Figure 1](#) illustrates the different levels of guidance contained in ISO standards for human-system interaction. ISO standards related to human-system interaction contain guidance at the levels of:

- principles;
- general design recommendations;
- requirements and recommendations specific to a thematic subject.

They do not prescribe “standardized solutions” in terms of conventions (e.g. “the title bar of a window in focus is coloured blue” or “the OK button is always placed left to the CANCEL button”). Such “standardized conventions” are published by industry sources, in organizational style guides and can be found in literature. However, the guidance relating to presented information in ISO standards related to human-system interaction is intended to be applied when establishing or assessing standardized conventions for user interfaces of interactive systems.

[The following serves as alternative text for Figure 1]

Figure 1 illustrates the relationship of major sources of guidance on user-system interaction. The figure focuses on guidance from international standards, but also recognizes standardized conventions not in scope of ISO standards. ISO 9241-11 introduces the concepts of usability, and its components effectiveness, efficiency, and satisfaction and the concept of context of use. ISO/IEC 29138-1 identifies the range of user accessibility needs. Two standards (this document, ISO 9241-110, Interaction principles, and ISO 9241-112, Principles for the presentation of information) provide high-level guidance for achieving usability. The interaction principles in this document include: suitability for the task, self-descriptiveness, conformity with user expectations, learnability, controllability, use error robustness, and user engagement. The ISO 9241-112 principles for the presentation of information include: detectability, freedom from distraction, discriminability, unambiguous interpretability, conciseness, and consistency (internal and external). Numerous other international standards (both within the ISO 9241 series and beyond) provide specific guidance for human-system interaction, the presentation of information, and accessibility. Some sources of specific guidance include: software standards ISO 9241-13 and ISO 9241-14 and standards in the ISO 9241-100 series, hardware standards in the ISO 9241-300 and ISO 9241-400 series, workplace and environmental standards in the ISO 9241-500 and ISO 9241-600 series, tactile/haptic standards in the ISO 9241-900 series, and other standards outside the ISO 9241 series (such as ISO/IEC 62366-1). Examples of standardized conventions (not in the scope of ISO standards) include: Microsoft Windows User Experience Guidelines and iOS Human Interface Guidelines.

[End of alternative text]