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Ergonomics of human-system interaction —

Part 500:
Ergonomic principles for the design and evaluation of environments of interactive systems

Ergonomie de l'interaction homme-système —

Partie 500: Principes ergonomiques pour la conception et l'évaluation d'environnements des systèmes interactifs

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Foreword

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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).

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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.

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

Introduction

This document introduces basic ergonomic principles for the design of environments for interactive systems.

This document deals with the physical environment in which a user can be assigned one or more spatial environments to accomplish a task. The entirety of the spatial environments assigned to a user is called environment.

The use of interactive systems takes place within a physical environment the design of which is decisive for a successful outcome. According to the system concept of ISO 26800, the physical environment is embedded in an organizational, a social and a cultural environment.

These principles can be applied to a variety of environments including dedicated environment, activity based environment and mobile environment. Further guidance on application to these environments is provided in other specific standards in the ISO 9241-500 series. Relevant physical attributes of the environment include issues such as furniture, spatial layout, equipment, air quality, thermal conditions, lighting, and noise.

Ergonomics of human-system interaction —

Part 500:
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1 Scope

This document specifies ergonomic principles which apply to the user requirements, design, and procurement of the physical equipment and environment, which contribute to the context of use of interactive systems. It provides requirements, recommendations and explanations related to these principles.

In particular, the general principles and requirements specified in this document apply to the standards specifying functional design of furniture and equipment constituting the environment.

The principles specified in this document utilize ergonomic knowledge (from the disciplines anthropometry, acoustics, vision, thermal environments, indoor air quality, mechanical vibrations, etc.) to design and evaluate environments that enhance usability (effectiveness, efficiency and satisfaction), accessibility, performance and well-being for organized and non-organized use of interactive systems.

The intended users of this document include:

— developers of systems, products and services;

— public and corporate purchasers;

— occupational health and safety professionals;

— architects and interior designers;

— human resource professionals;

— usability/ergonomics/human factors professionals.

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/

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3.1
accessibility
extent to which products, *systems* (3.3), 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* (3.2)

Note 1 to entry: *Context of use* (3.1) 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
system
combination of interacting elements organized to achieve one or more stated purposes

Note 1 to entry: In ergonomics, the "elements" of a system are often called "components".

Note 2 to entry: A system can consist of products, equipment, services and people.

Note 3 to entry: The word "system" can be qualified by adding a context-dependent term (e. g. aircraft system).

[SOURCE: ISO 26800:2011, 2.7, modified — Note 4 to entry has been removed.]

3.4
intended user population
people for whom the design is intended, specified according to relevant characteristics

Note 1 to entry: Relevant characteristics include, for example, the skill level, capabilities or physical characteristics — such as anthropometric dimensions — of these people. Gender and age can be related to variations in these characteristics. In addition to these intrinsic characteristics, extrinsic factors (e. g. cultural differences) can also be relevant.

3.5
workplace
arrangement of resources allocated to one person to complete a task

3.6
workstation
combination and spatial arrangement of work equipment, surrounded by the work environment under the conditions imposed by the work tasks

Note 1 to entry: Workstations in the context of this document involve an *interactive system* (3.7) and its immediate environment of use.

[SOURCE: ISO 6385:2016, 2.18, modified — Note 1 to entry has been added.]

3.7
interactive system
combination of hardware, software and/or services that receives input from, and communicates output to, users

3.8
worksurface
surface on which equipment and task materials are used

[SOURCE: ISO 9241-5:1998, 3.25]

4 Ergonomic principles for the design and evaluation of environments

4.1 General considerations

The environment comprises the workspace, the physical and chemical attributes of which can be relevant for the health and safety of the users of interactive systems and for their performance and comfort.

The basis of any design process of a system or parts thereof is an analysis of relevant factors to be considered, i.e. all factors that can influence the interactions between the user and other components of a system, such as other humans, machines, products, services, environments and tools.

According to ISO 26800, the following factors need to be taken into account:

— purpose of the system, product or service;

— characteristics of the intended target population;

— goals to be achieved and tasks to be performed;

— existing constraints (e.g. legacy equipment or processes or economic issues);

— factors of the physical, organizational and social environment;

— life cycle and any dynamic changes within it.

For the design of systems, products and services, the characteristics of the intended context of use are relevant. For an ergonomic evaluation, the actual characteristics (and their foreseeable changes) apply.

Human-centred design, as defined in ISO 9241-210, means that all designable components of a system, product or service are fitted to the characteristics of the intended users rather than selecting and/or adapting humans to fit the system, product or service, with the exception of education and training as far as required after creating an appropriately designed system, product or service.

According to ISO 9241-210:2010, 4.1, whatever the design process and allocation of responsibilities and roles adopted, a human-centred approach should follow the principles listed below:

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

b) users are involved throughout design and development;

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

d) the process is iterative;

e) the design addresses the whole user experience;

f) the design team includes multidisciplinary skills and perspectives.

Those affected by the design (e.g. workers or users) should be involved throughout the whole design process, including evaluation. This helps to optimize solutions (e.g. by providing specific experience and requirements). Their early and continued participation and involvement is regarded as an efficient design strategy within ergonomics.

Any design activity should be preceded by understanding and specifying the entire context of use, including:

— definition of the intended user population;

— analysis of the relevant characteristics of the task to support;

— analysis of the relevant attributes of the environment with a potential impact on the user, the task, and the outcome (performance, work load, fatigue, etc.).

4.2   Basic principles

4.2.1   Introduction to the basic principles

For the design of an environment, the following interrelated principles apply:

— fit for the intended user population;

— versatility—flexibility;

— freedom from interference between task and environment;

— postural change;

— maintainability;

— adaptability.

4.2.2   Fit for the intended user population

Fit concerns the extent to which the equipment [including: work chairs, worksurfaces, information and communications technology (ICT)] can accommodate individual users' needs within the intended user population.

Good fit is needed for the intended user population including users sharing workspaces or workstations and users with special needs (see 4.3).

The design of the environment (e.g. selection and design of furniture and equipment, characteristics of lighting, ambient temperature) should consider the needs of the intended user population.

In addition, the design of the environment including the workstations should be appropriate for the range of tasks to be performed in the specific environment, taking into account user characteristics (e.g. task-related skills, anthropometric variation and user preferences).

4.2.3   Versatility - flexibility

Versatility and flexibility concern the extent to which the environment enables the intended user population to perform a range of tasks.

Some dedicated environments (that focus on a single task) do not require versatility or flexibility.

Safety of operations, e.g. the time spent at the interactive system, increase the importance of versatility and flexibility in design.

An environment should be planned to enable the intended user population to perform a range of tasks comfortably and efficiently.

4.2.4 Freedom from interference between task and environment

Freedom from interference between task and environment concerns the extent to which the use of an interactive system is degraded by the environment and/or the environment is degraded by the use of the interactive system.

NOTE   Graceful degradation concerns the extent to which a system can continue operating properly in the event of interference of the environment.

Ideally, an environment can be designed only in consideration of the needs of the user if the interactive system is designed or selected to not interfere with the environment, and operations thereof are not affected by it. For the example of acoustics, this means that the system under consideration does not emit noise and its functioning is independent from ambient noise conditions.

Any interference between the environment and the interactive system used in that environment should be avoided or, if not reasonably achievable, kept to a minimum so that the user can maintain full control of the task under consideration.

4.2.5 Postural change

Postural change concerns the extent to which the user can move between various postures.

Postural change facilitates user performance and comfort and avoids biomechanical stress and fatigue.

NOTE   Postures adopted by users and the need for changes in posture are very markedly influenced by work organization and in particular, task requirements.

The organization of the workspace and the furniture utilised should encourage active postural changes and movement.

4.2.6 Maintainability

Maintainability concerns the extent to which the environment provides access to parts of the interactive system for its installation, dismantling, replacement, reconfiguration and maintenance.

Maintainability takes into account the predicted life of interactive systems within the environment.

The environment should provide access for maintenance that can be accomplished easily and minimize disruption to ongoing task performance.

4.2.7 Adaptability

Adaptability concerns the extent to which the workplace can adapt to changing requirements.

Adaptability takes into account changes which were not predictable when the environment was first developed. Adaptability can support sustainability.

The environment should facilitate the ability of furniture and equipment to adapt in response to changing requirements and circumstances.

4.3 Accessibility

The term accessibility is important for two different reasons:

1)   accessibility as defined in legal documents;

2)   accessibility as defined in 3.1.

Accessibility as defined in legal documents gives certain rights to persons as defined and confined in those documents, mostly referenced as "people with disabilities".