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Indian Standard

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ISO 9241-20 : 2021

मानव-प्रणाली अंत: क्रिया का श्रमदक्षता शास्त्र

भाग 20 आईएसओ 9241 श्रृंखला के अंतर्गत अभिगम्यता के लिए श्रमदक्षता सम्बन्धी दृष्टिकोण

(पहला पुनरीक्षण)

Ergonomics of Human-System Interaction

Part 20 An Ergonomic Approach to Accessibility within the ISO 9241 Series

(First Revision)

ICS 13.180

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NATIONAL FOREWORD

This Indian Standard (Part 20) (First Revision) which is identical to ISO 9241-20 : 2021 'Ergonomics of human-system interaction — Part 20: An ergonomic approach to accessibility within the ISO 9241 series' issued by the International Organization for Standardization (ISO) was adopted by the Bureau of Indian Standards on recommendation of the Ergonomics Sectional Committee and approval of the Production and General Engineering Division Council.

This standard was first published in 2018 based on ISO 9241-20 : 2008. This revision has been undertaken to align it with the latest version of ISO 9241-20.

This standard has been published in 12 parts. Other parts in this series are:

Part 5	Workstation layout and postural requirements
Part 11	Usability: Definitions and concepts (*first revision*)
Part 110	Interaction principles
Part 154	Interactive voice response (IVR) applications
Part 171	Guidance on software accessibility
Part 210	Human centered design for interactive systems
Part 300	Introduction to electronic visual display requirements
Part 302	Terminology for electronic visual displays
Part 410	Design criteria for physical input devices
Part 411	Evaluation method for the design of physical input devices
Part 971	Accessibility of tactile/haptic interactive systems

The major changes have been incorporated in this revision are as follows:

a) The guidance in the previous edition has been replaced by references to many different standards within the IS 16595/ISO 9241 series that now contain applicable guidance. The standard now references other standards relevant to the accessibility of interactive systems, such as IS 16595 (Part 171)/ISO 9241-171 and IS 16595(Part 971)/ISO 9241-971; and

b) The standard now provides an introduction to the importance of accessibility to human system interaction and a discussion of the relationship of principles within the IS 16595/ISO 9241 series and accessibility.

The text of ISO standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are however not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'; and

b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be same as that of the specified value in this standard.

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Introduction

The ISO 9241 series provides ergonomic guidance that contributes to the accessibility of interactive systems to meet the needs of users.

Two parts of ISO 9241 particularly address accessibility: ISO 9241-171 and ISO 9241-971. In addition, a number of parts in the ISO 9241 series integrate guidance supporting accessibility.

Accessibility in the design of products, systems and services is important to ensure that they are usable by the widest possible range of users. Designed solutions that support accessibility result from the understanding and implementation of user requirements, including those user requirements specific to accessibility.

Ergonomic principles and human-centred design activities contained in the ISO 9241 series provide a basis for identifying user accessibility needs and deriving user requirements specific to accessibility.

This document identifies standards within the ISO 9241 series and in other related standards that contain guidance related to accessibility.

Indian Standard

ERGONOMICS OF HUMAN-SYSTEM INTERACTION

PART 20 AN ERGONOMIC APPROACH TO ACCESSIBILITY WITHIN THE ISO 9241 SERIES

1 Scope

This document provides:

a) an introduction to the importance of accessibility to human-system interaction;

b) a discussion of the relationship of principles within the ISO 9241 series and accessibility;

c) descriptions of activities related to the processes in ISO 9241-210 that focus on accessibility;

d) references to standards relevant to the accessibility of interactive systems.

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 https://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
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]

3.3
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]

3.4
user accessibility need
user need related to features or attributes that are necessary for a system to be accessible

Note 1 to entry: User accessibility needs vary over time and across contexts of use.

Note 2 to entry: User accessibility needs are transformed into user requirements considering the context of use, user priorities, trade-offs with other system requirements and constraints.

[SOURCE: ISO/IEC 29138-1:2018, 3.10]

4 Accessibility and ergonomics of human-system interaction

Accessibility in the design of products, systems and services is important to ensure that they are usable by the widest possible range of users.

Design solutions that support accessibility result from understanding and application of specific user requirements, including those user requirements specific to accessibility.

While the ISO 9241 series currently contains two standards specifically focused on accessibility (ISO 9241-171 and ISO 9241-971), all parts of the ISO 9241 series provide ergonomic guidance that can benefit accessible design solutions. Additionally, ISO 9241-220 identifies the concept of human-centred quality, which includes accessibility as one of its four main components.

Planning for accessibility as an integral part of the human-centred design process (as described in ISO 9241-210 and ISO 9241-220) involves the systematic identification of requirements for accessibility, including accessibility measurements and verification criteria within the context of use. These provide design targets that can form the basis for verification of the resulting design.

5 Ergonomic principles in the ISO 9241 series supporting accessibility

5.1 General

There are many principles contained within the ISO 9241 series that provide important support for accessibility. Violating any of these principles will limit the accessibility of any resulting system, product or service.

This clause identifies both principles and sources of guidance related to these principles that are found in the ISO 9241 series.

NOTE Annex A contains further information about major sources of international-level accessibility guidance.

5.2 Principles from ISO 9241-171

5.2.1 Suitability for the widest range of use

ISO 9241-171:2008, Clause 5, contains the principle of “suitability for the widest range of use”, which it says “involves designing with the objective of producing solutions that will be useful, acceptable

and available to the widest range of users within the intended user population, taking account of their special abilities, variations in their capabilities, the diversity of their tasks, and their differing environmental, economic and social circumstances."

NOTE ISO/IEC Guide 71:2014, 6.2.1 transforms this principle into a goal it calls "suitability for the widest range of users". It explains that "A system is suitable for the widest range of users if it meets the needs of diverse users in diverse contexts."

ISO 9241-11:2018, 3.1.7, defines a user as a "person who interacts with a system, product or service". It recognizes that, "the objective of designing for accessibility is to enable products, systems, services, environments and facilities to be used by people with the widest range of user needs, characteristics and capabilities in diverse contexts of use. Accessibility is included as a component of human-centred quality to emphasize its importance as part of human-centred design."

While the accessibility guidance in ISO 9241-171 and ISO 9241-971 can support suitability for the widest range of users, there are no parts of the ISO 9241 series that provide guidance on identifying the widest range of users.

5.2.2 Equitable use

ISO 9241-171:2008, Clause 5, contains the principle of "equitable use", which it describes thus: "Equitable solutions provide the same means of use for all users: identical whenever possible; equivalent when not. Achieving equitable use will ensure that solutions designed to increase accessibility do not result in such things as loss of privacy, increased risks to personal safety or security, or the stigmatization of individuals."

NOTE ISO/IEC Guide 71:2014, 6.2.10 transforms this principle into a goal it calls "equitable use". It explains that "A system provides equitable use if it allows diverse users to accomplish tasks in an identical manner whenever possible or in an equivalent manner when an identical manner is not possible."

5.2.3 Robustness

ISO 9241-171:2008, Clause 5, contains the principle of "robustness", which it describes thus: "Software should be designed to be as robust as possible to allow it to work with current and future assistive technologies. Although it is not feasible to make all software accessible without add-on assistive technologies, these guidelines should help designers develop software that increases accessibility without the use of assistive technologies, and, by providing the necessary interface information, enables assistive software and devices to operate effectively and efficiently when used. The software can promote integration of assistive technologies by providing information that can be read by assistive technologies, and by communicating through standard application-to-application communication protocols."

NOTE ISO/IEC Guide 71:2014, 6.2.11 transforms this principle into a goal it calls "compatibility with other systems". It explains that "A system provides compatibility if it allows diverse users to use other systems as a means to interact with it to accomplish the task."

5.3 Principles from ISO 9241-110

5.3.1 Suitability for the user's tasks

ISO 9241-110:2020, 5.1 contains the principle of "suitability for the user's tasks", which it describes thus: "An interactive system is suitable for the user's tasks when it supports 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)." It also notes that, "A

prerequisite for suitability for the user's tasks is that the tasks themselves have been based on user needs."

NOTE ISO/IEC Guide 71:2014, 6.2.8 replaces this principle with a goal that it calls "usability". It explains that "A system is usable if it supports diverse users in their diverse contexts to accomplish their tasks with effectiveness, efficiency and satisfaction." The ISO 9241 series recognizes usability as an outcome of use, rather than as a goal. ISO 9241-11 provides definitions and concepts related to usability.

ISO 9241-110 provides general design recommendations related to suitability for the user's tasks, including guidance on:

— identifying suitability of the interactive system for a given task;

— optimizing effort in task accomplishment;

— defaults supporting the task.

5.3.2 Self-descriptiveness

ISO 9241-110:2020, 5.2 contains the principle of "self-descriptiveness", which it describes thus: "The interactive system presents appropriate information, where needed by the user, to make its capabilities and use immediately obvious to the user without the need for unnecessary user-system interactions."

NOTE ISO/IEC Guide 71:2014, 6.2.5 and 6.2.6 replaces this principle with two goals:

— "perceivability", which it describes thus: "A system is perceivable if diverse users in diverse contexts can sense the information and functionalities it presents."

— "understandability", which it describes thus: "A system is understandable if its information and functionalities are interpretable by diverse users."

ISO 9241-110 provides general design recommendations related to self-descriptiveness, including guidance on:

— presence and obviousness of information;

— clear indication of processing status.

ISO 9241-112 provides ergonomic guidance on the presentation of information (see also 5.4).

5.3.3 Conformity with user expectations

ISO 9241-110:2020, 5.3 contains the principle of "conformity with user expectations", which it describes thus: "The interactive system's behaviour is predictable based on the context of use and commonly accepted conventions in this context."

NOTE ISO/IEC Guide 71:2014, 6.2.2 transforms this principle into a goal it calls "conformity with user expectations". It explains that "A system conforms to user expectations if it is predictable based on the user's past experience, the context of use, laws and standards, and/or commonly accepted conventions."

ISO 9241-110 provides general design recommendations related to conformity with user expectations, including guidance on:

— appropriate system behaviour and responses;

— consistency (internal and external);

— changes in the context of use.

5.3.4 Learnability

ISO 9241-110:2020, 5.4 contains the principle of "learnability", which it describes thus: "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."

NOTE ISO/IEC Guide 71:2014, 6.2.8 combines the ISO 9241-110 principles of "suitability for the task" and "learnability" within its goal of "usability". (See 5.3.1 for a discussion of this ISO/IEC Guide 71 goal.)

ISO 9241-110 provides general design recommendations related to learnability, including guidance on:

— discovery (of information and controls that users are looking for);

— exploration (of information and controls that users have discovered);

— retention (of information about the system).

5.3.5 Controllability

ISO 9241-110:2006[1)], 4.9 contained a principle of "suitability for individualization" which it described thus: "A dialogue is capable of individualization when users can modify interaction and presentation of information to suit their individual capabilities and needs."

ISO 9241-110:2020, 5.5 recognizes that individualization is a major component of controllability and thus combines individualization within its principle of "controllability".

ISO 9241-110:2020, 5.5 combines suitability for individualization and controllability into the principle of "controllability", which it describes thus: "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."

NOTE ISO/IEC Guide 71:2014, 6.2.7 transforms this principle into a goal it calls "controllability", which it describes thus: "A system is controllable if the user is able to initiate and complete the interaction(s) required to accomplish the task." It also retains a goal based on "suitability for individualization" that it calls "support for individualization", which it describes thus: "A system supports individualization if its components, functions or operations can be tailored to meet the needs of individual users."

ISO 9241-110 provides general design recommendations related to controllability, including guidance on:

— interruption by the user;

— flexibility;

— individualization.

ISO 9241-920 provides ergonomic guidance on the design of tactile or haptic controls.

ISO 9241-129 provides ergonomic guidance on software individualization.

5.3.6 Use error robustness

ISO 9241-110:2020, 5.6 goes beyond error tolerance, which was a principle in ISO 9241-110:2006, and renames it "use error robustness", which it describes thus: "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."

NOTE ISO/IEC Guide 71:2014, 6.2.9 transforms this principle into a goal it calls "error tolerance", which it describes thus: "A system has error tolerance if despite predictable errors, diverse users can complete the intended task or activity with either no, or minimal, corrective action or negative consequences."

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1) Cancelled and replaced by ISO 9241-110:2020.

ISO 9241-110 provides general design recommendations related to use error robustness, including guidance on:

— use error avoidance;

— use error tolerance;

— use error recovery.

5.3.7 Approachability

ISO 9241-110:2020, 5.7 goes beyond this avoidance of barriers and introduces the principle of "user engagement", which it describes thus: "The interactive system captures the users' attention and motivates the users to continue to use the interactive system."

NOTE ISO/IEC Guide 71:2014, 6.2.4 includes a goal it calls "approachability", which it describes thus: "A system is approachable if diverse users can overcome any physical or psychological barriers and physically or remotely access it to accomplish the task."

ISO 9241-110 provides general design recommendations related to user engagement, including guidance on:

— motivating the user;

— trustworthiness;

— increasing user involvement.

5.4 Additional specialized principles in the ISO 9241 series

5.4.1 Principles from ISO 9241-112

ISO 9241-112:2017 includes the following design principles for the presentation of information:

— Detectability: Presented information is detectable if the information is presented so that it will be recognized as present (see ISO 9241-112: 2017, 6.1.1).

— Freedom from distraction: Presented information is free from distractions if the information is presented so that required information will be perceived without other presented information interfering with its perception. Distractions from a user's point of view can result from both distracting events and information overload (see ISO 9241-112: 2017, 6.2.1).

— Discriminability: Presented information is discriminable if: 1) the information is presented such that discrete items or groups of items can be accurately differentiated; and 2) the items of information are presented in a manner that supports their association with or differentiation from other items or groups of items (see ISO 9241-112: 2017, 6.3.1).

— Interpretability: Presented information is interpretable if it is comprehended as intended (see ISO 9241-112: 2017, 6.4.1).

— Conciseness: Information presentation is concise if only the necessary information is presented (see ISO 9241-112: 2017, 6.5.1).

— Consistency (internal and external): Presented information is consistent if items of information with similar intent are presented similarly and items of information with different intent are presented in a different style and form within and across the interactive systems and the user's environment (see ISO 9241-112: 2017, 6.6.1).

All of these principles are important in meeting various accessibility needs.

ISO 9241-112 also includes general guidance related to these principles.

ISO 9241-125 provides ergonomic guidance on the visual presentation of information.

ISO/TS 9241-126 provides ergonomic guidance on the auditory presentation of information.

ISO 9241-920 provides ergonomic guidance on the tactile or haptic presentation of information.

5.4.2 Principles from ISO 9241-400

ISO 9241-400:2007 includes the following design principles for physical input devices:

— Appropriateness: The design shall be appropriate for the intended user, the intended tasks being performed and the intended use environment. An appropriate input device or combination of devices enables the user to achieve the required level of effectiveness and is efficient and satisfactory for the intended user population and the intended use (see ISO 9241-400:2007, 4.2.1).

— Operability: An input device shall be operable, i.e. its intended use is obvious, predictable and consistent (see ISO 9241-400:2007, 4.2.2.1).

— User compatibility: An input device shall be user compatible, i.e. its design accommodates the characteristics of the intended users, e.g. anthropometric and biomechanical capabilities (see ISO 9241-400:2007, 4.2.3).

— Feedback: An input device shall provide effective feedback, i.e. the user is given immediately perceptible and easily understandable indication that the device is responding to user actuation (see ISO 9241-400:2007, 4.2.4).

— Controllability of physical input devices: The operation of an input device shall be controllable. This means that the device shall be responsive and its use shall not interfere with its functionality. The design of the device shall give the user adequate and reliable access. The design shall prevent unintended loss of control during intended use, e.g. slipping for hand-operated devices (see ISO 9241-400:2007, 4.2.5.1).

— Biomechanical load: The biomechanical load shall be minimized, taking into consideration the postures of the entire body and the part of the body relevant for the use of the input device (see ISO 9241-400:2007, 4.2.6.1).

5.4.3 Principles from ISO 9241-500

ISO 9241-500:2018 includes the following design principles for environments of interactive systems:

— Fit for the intended user population: This concerns the extent to which the equipment [e.g. work chairs, work surfaces, information and communications technology (ICT)] can accommodate individual users' needs within the intended user population. 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 (see ISO 9241-500:2018, 4.2.2).

— Versatility and flexibility: This concerns the extent to which the environment enables the intended user population to perform a range of tasks. An environment should be planned to enable the intended user population to perform a range of tasks comfortably and efficiently (see ISO 9241-500:2018, 4.2.3).

— Freedom from interference between task and environment: This 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. 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 (see ISO 9241-500:2018, 4.2.4).

— Postural change: This 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. The organization of the workspace and the furniture utilized should encourage active postural changes and movement (see ISO 9241-500:2018, 4.2.5).

— Maintainability: This concerns the extent to which the environment provides access to parts of the interactive system for its installation, dismantling, replacement, reconfiguration and maintenance. The environment should provide access for maintenance that can be accomplished easily and minimize disruption to ongoing task performance (see ISO 9241-500:2018, 4.2.6).

— Adaptability: This concerns the extent to which the workplace can adapt to changing requirements. The environment should facilitate the ability of furniture and equipment to adapt in response to changing requirements and circumstances (see ISO 9241-500:2018, 4.2.7).

5.5 Principles of human-centred design from ISO 9241-210

ISO 9241-210:2019 includes the following principles of human-centred design:

— The design is based upon an explicit understanding of users, tasks and environments (see ISO 9241-210:2019, 5.2).

— Users are involved throughout design and development (see ISO 9241-210:2019, 5.3).

— The design is driven and refined by user-centred evaluation (see ISO 9241-210:2019, 5.4).

— The process is iterative (see ISO 9241-210:2019, 5.5).

— The design addresses the whole user experience (see ISO 9241-210:2019, 5.5).

— The design team includes multidisciplinary skills and perspectives (see ISO 9241-210:2019, 5.6).

ISO 9241-210 also provides guidance on planning human-centred design and human-centred design activities.

6 Accessibility-focused design activities within projects

6.1 General

The activities described in this clause provide a framework for activities in design and development projects to achieve design solutions that can be used by the widest range of users, including users with disabilities. It does not assume any particular design process, nor does it describe the methods that can be used. It is complementary to existing design methodologies and provides an approach for accessibility that can be integrated into different design and development processes that is appropriate to the particular context.

The activities represent an extension of the approach to accessibility as part of human-centred design of interactive systems, which is described in ISO 9241-210.

NOTE The content of this clause in this document is structured to be compatible with EN 17161:2019, Annex C.

6.2 Activities and their inputs

Developing products and services that are accessible for the widest range of users, including persons with disabilities, involves the following four interlinked activities:

1) Identify the intended users and the context of use.

2) Analyse, understand and describe the needs, characteristics, capabilities and preferences of the users so that they can be incorporated into the requirements specification.

3) Produce solutions to meet the user requirements.

4) Evaluate solutions against the users' needs, characteristics, capabilities and preferences and against the user requirements.

The order in which the activities are listed does not imply a linear process. They are carried out as part of an iterative process in which each activity has a role in each stage of development and feeds into the other activities to inform and revise their outputs.

Table 1 lists the four design activities and provides examples of the outputs for the 'design for all' approach.

Table 1 — Design activities and examples of outputs

Activity	Outputs from design activities
1) Identify the intended users and the context of use	a) All the potential users who are to be part of the intended user population are identified.[a] b) Users with the most diverse needs, characteristics, capabilities and preferences are included to the greatest extent possible. c) Variation in the relevant characteristics and capabilities of the users is described. d) Other aspects of the context of use (goals, tasks and environment, including the end-to-end chain of use) are identified and described.[b]
2) Analyse, understand and describe the needs, characteristics, capabilities and preferences of the intended users, so that they can be incorporated into the requirements specification	a) User needs, characteristics, capabilities and preferences are comprehensively identified.[c] b) Existing problems and deficiencies that need to be addressed are identified. c) Applicable regulations and design guidance relating to accessibility that should be followed are identified. d) User requirements are specified that, if met, will satisfy the needs, characteristics, capabilities and preferences of the whole user population.

[a] The intended user population includes people not currently using the product or service because it presents barriers to use, as well as people who are already using the product or service.

[b] Achieving accessibility at the point of need is typically dependent on sequential delivery in the end-to-end chain on which use depends. These dependencies are identified as part of the context of use.

[c] User needs, characteristics, capabilities and preferences include those related to accessing (including physical access), understanding and using a product or service, where 'use' should provide both ease of use and enjoyment. For example, a person who prefers captions to sign language should be able to enjoy captions.

[d] Prototypes (that can be of varying sophistication) can provide an effective basis for evaluation by users.

Table 1 *(continued)*

Activity	Outputs from design activities
3) Produce solutions to meet the user requirements	a) The overall structure and strategies that will accommodate the widest range of users are decided. b) The ways in which multiple means of information presentation and operation will be provided are identified. c) Decisions are made about whether and where a single solution can be adopted without potential for adjustment and where individualization to meet specific user needs will be implemented. d) Existing information and data are used to develop design solutions. e) Specific candidate solutions, including prototypes that are testable, are implemented and evaluated from the perspective of diverse users and by involving users to the greatest extent possible.[d] f) Iteration and improvement take place in response to feedback from evaluation(s).
4) Evaluate solutions against the users' needs, characteristics, capabilities and preferences and against the user requirements	a) Evaluation from the perspective of the widest range of users takes place, starting at the earliest stages of design (concepts) and continues as design develops. b) Users are involved directly in evaluation. c) Feedback from evaluation is used to drive iteration of the design. d) Evaluation is used to demonstrate conformity with user requirements for the widest range of users.

[a] The intended user population includes people not currently using the product or service because it presents barriers to use, as well as people who are already using the product or service.

[b] Achieving accessibility at the point of need is typically dependent on sequential delivery in the end-to-end chain on which use depends. These dependencies are identified as part of the context of use.

[c] User needs, characteristics, capabilities and preferences include those related to accessing (including physical access), understanding and using a product or service, where 'use' should provide both ease of use and enjoyment. For example, a person who prefers captions to sign language should be able to enjoy captions.

[d] Prototypes (that can be of varying sophistication) can provide an effective basis for evaluation by users.

Each activity is also integrated into the overall design process that is in use, as appropriate.

6.3 User input to activities

The focus on the user is central to the conduct of the activities.

Representatives of the intended user population are an important resource contributing to the design activities. Examples of potential roles include:

— as a source of information about the current use (and non-use) of products and services; information can be gathered about problems and difficulties and about positive experiences;

— contributing to the identification of the user needs, characteristics, capabilities and preferences and the specification of user requirements;

— providing feedback on proposed solutions, starting at the very earliest stages of development, when ideas and concepts can be evaluated, and proceeding through the evaluation of increasingly mature prototypes until the finished product or service is delivered.

Other resources that allow the users' interests to be addressed can be found from existing sources of information, such as:

— customer profiles;

— help desk reports;

— data sets, based on research, providing information about the variation in the characteristics and capabilities of users;

— standards and guidelines supporting a design-for-all approach for accessibility;

— expert advisors and consultants.

6.4 Understand and identify the users and the context of use

6.4.1 Scoping

Each project needs to identify its scope based on the organization's strategic approach to an accessible outcome.

6.4.2 The importance of users

When implementing human-centred design to achieve accessibility, the focus is on the identification of the intended users, including the identification of current non-users who should be included. This is to ensure that the diverse range of needs, characteristics, capabilities and preferences of the widest range of users, and the identification and description of their diversity and their range of capabilities and characteristics, are taken into account.

6.4.3 User groups

The users who need to be considered are the people who are going to interact with the product or service that is being designed. These users include potential users who are not currently using the product or service.

The users can be:

— users producing an output;

— users not producing an output, but who use the output that is produced (a typical example is use of a service output);

— support users, where users have a role in ensuring that products and services continue to function (e.g. in delivering support, administration, training or maintenance);

— other users, persons who can be impacted by the use of the product or service but do not interact with it directly or indirectly (e.g. people who are in the environs when the products or services are being used).

All the different roles that people can have in relation to the product or service should be identified and included within the population of users whose needs have to be satisfied by the design.

Users should be classified into groups based on their different goals, tasks and roles, and the different environments in which they are using the product or service. User groups should be described in terms of their needs and preferences and the ranges of their characteristics and capabilities; these include physiological and psychological capabilities and individual differences, and physical, sensory, psychological and social factors. In all user groups the diversity of users should be represented. It is

important to clearly identify what is relevant for accessibility and usability in the description of each user group, taking account of the widest range of characteristics and capabilities in each group. This information, together with the rest of the information about context of use, forms the basis of the user requirements specification.

NOTE It is important when considering the widest range of users to recognize that users with disabilities can have the same needs, characteristics, capabilities and preferences as other users.

6.4.4 Requirements specification

The analysis of the diverse user needs should be translated into user requirements specifications. The user requirements are based on the intended outcomes of interaction for the identified user groups in specified contexts of use.

The user requirements specification provides an explicit statement that is developed in conjunction with, and forms part of, the overall requirements specification.

The user requirements should be reviewed by the interested parties, including representatives of the intended user groups.

6.5 Produce solutions to meet the user requirements

6.5.1 High-level approach

Decisions about the architecture of the solution depend upon trade-offs between many factors, including:

— organisational policies for achieving accessibility outcomes;

— market opportunities;

— technical options;

— specific legislative issues;

— end-to-end chain accessibility issues;

— cost considerations.

Depending on the scale and complexity of the design problem, the development of solutions can go through a series of phases.

The phases involve expanding the understanding of the context of use; understanding the diversity of the users' needs, capabilities, characteristics and preferences; developing more detailed requirements based on the strategic solutions adopted to meet high-level requirements; and user-focused evaluation of proposed solutions, to provide feedback that can be used to refine the design.

Activities involved in developing the strategic approach to the solution that will accommodate the widest range of users should determine the architecture of the solution.

EXAMPLE There are high levels of diversity within the user groups and they differ from each other in terms of the ways in which they will use a product; for example, a population of young people, including young people who rely on carers, but all of whom want to be as independent as possible, and a population of retired people who wish to maintain their independence. The decision has to be made as to whether to develop a single product line which will meet the needs of the intended users, or whether to treat them as different market segments whose needs are met by separate products based on a common core.

6.5.2 Developing the solution

Having identified the strategic form of the solution(s), decisions can be made about how to implement it. These include:

— making decisions about the extent to which a solution based on fixed parameters, without potential for adjustment, will be adopted, and making decisions about how the extent of potential for individualization to meet individual user needs will be implemented (see ISO 9241-129);

EXAMPLE 1 The sound volume of spoken instructions used on consumer products is adjustable in order to accommodate individual differences in hearing and differences between and within the auditory environments in which the products will be used. The range of adjustment that is required is based on determining the required signal-to-noise ratio that will accommodate 95 % of 80-year-olds in the noisiest environment to set the maximum volume, and the signal-to-noise ratio that will meet the needs of the 10th percentile of 20-year-olds in the quietest environment to set the minimum volume.

— identifying the multiple forms of interaction that will be supported in the solution.

NOTE Any interactive system will include, within the user groups for which it is designed, people with very different physical, sensory and cognitive abilities and needs. Providing solutions that support multiple means of interaction increases the probability of making a product, system or service accessible to the greatest extent possible. (See ISO 9241-171 and ISO TR 22411.)

EXAMPLE 2 An online document presented on screen can be used by a screen reader (assistive technology enabled by the user) to generate braille or to generate output in the form of synthesized speech. Any images in the document are accompanied by a textual description of the image. The textual description is embedded in the software using the 'alt text' or 'long desc' tag in HTML code.

EXAMPLE 3 In addition to offering a banking service online, based on the presentation of information on screen (interoperable with screen readers) and data entry via a keyboard, other options are available, including a telephone-based person-to-person service and a paper-based service that relies on surface mail.

6.5.3 Detailed design decisions

After the decisions about implementation, more detailed design decisions can be made. These decisions are based on existing information and data, including standards, guidance and input from users.

EXAMPLE The design of a ticket machine uses anthropometric data that shows the limits of comfortable reach for the 5th and 95th percentiles of the adult population up to the age of 90, for wheelchair users and for 8-year-old children, all of whom are expected to use the machine. A decision is made to accommodate the variation in comfortable reach by duplicating the controls that need to be reached at two different heights.

6.5.4 Evaluation as design progresses

As potential solutions are developed, they should be evaluated from the perspective of the diversity of users.

NOTE Intended users can participate in evaluations, starting at the earliest stages with mock-ups and using prototypes that increase in fidelity, until working versions of the design are available for evaluation.

6.5.5 Iteration

As designs develop, the iterations are refined and improved on the basis of feedback from evaluation.

6.6 Evaluation

6.6.1 Evaluation from the earliest stages

Evaluation from the perspective of the widest range of users takes place, starting at the earliest stages of design (when concepts are being developed and compared) and continues as the design develops up to and including evaluation of the design once it is in use.

6.6.2 Focus on evaluation from the user's perspective

Two widely used approaches for evaluation from the perspective of users are:

a) user involvement;

b) inspection-based evaluation (audit-based).

Evaluation based on user involvement can take place at any stage of development. User-based evaluation, in addition to identifying problems, can demonstrate the positive aspects of and degree of satisfaction with the design and contribute to the development of new ideas.

Inspection-based evaluation uses general guidance on accessibility and usability, heuristics, best practice, guidelines and standards and relevant regulations to provide criteria against which judgements are made.

Inspection should be carried out by people with expertise and experience in accessibility and usability, and in the contexts in which use will take place. Inspection can be used to identify major issues and it focuses on identifying problems.

6.6.3 Iteration and feedback

Feedback from evaluation is used to drive iterations of the design by identifying areas that need to change to meet user needs. It can identify opportunities for improvement and even help to satisfy needs that had not previously been identified.

6.6.4 Conformity assessment

Evaluation data can be used to demonstrate that the object of evaluation meets specified user requirements for accessibility.

Annex A
(informative)

Major sources of international-level accessibility guidelines

A.1 User accessibility needs

ISO/IEC 29138-1 identifies and describes a comprehensive set of user accessibility needs. It can be used as a basis for identifying specific user accessibility needs.

NOTE User accessibility needs identify accessibility needs that "some users need", which are often common across a number of diverse users. Meeting user accessibility needs can improve the accessibility of ICT systems for diverse users (including those not directly identified) in diverse contexts of use.

A.2 Guidance on developing accessible products and services

ISO/IEC 30071-1 provides organization-focused guidance on developing and procuring accessible ICT systems and services.

A.3 Accessibility guidance for software, content and hardware

Software accessibility standards include the following:

— ISO 9241-171 provides guidance on software accessibility.

— ISO/IEC 40500 provides guidance on web content accessibility, available at: http://www.w3.org/TR/WCAG20/.

Hardware accessibility standards include the following:

— ISO/IEC 29136 is the main hardware accessibility standard.

— ISO 9241-971 provides guidance on the accessibility of physical (tactile/haptic) interactions.

Additional software, content and hardware accessibility standards include the following:

— ISO/IEC 20071-11 provides guidance on alternative text for images.

— ISO/IEC TS 20071-15 provides guidance on scanning visual information for presentation as text in various modalities.

— ISO/IEC TS 20071-21 provides guidance on audio descriptions.

— ISO/IEC 20071-23 provides guidance on the visual presentation of audio information (including captions and subtitles).

— ISO/IEC TS 20071-25 provides guidance on the audio presentation of text in videos, including captions, subtitles and other onscreen text.

A.4 Accessibility guidance for development tools

Accessibility standards relating to development tools include the following:

— *W3C WAI Authoring Tool Accessibility Guidelines (ATAG)* (available at: https://www.w3.org/TR/

A.5 Accessibility guidance supporting diverse platforms and assistive technologies

Accessibility standards supporting diverse platforms and assistive technologies include the following:

— *W3C WAI User Agent Accessibility Guidelines (UAAG)* (available at: https://www.w3.org/TR/UAAG20/) can assist in the procurement of accessible development tools.

— ISO/IEC 13066-1 provides guidance on hardware and software interoperability issues that can extend the range of platforms and can aid in ensuring connectivity of assistive technologies.

Accessibility application programming interfaces (accessibility APIs) can aid in making interoperability possible. Guidance on the use of some accessibility APIs (and related technologies) include the following:

— ISO/IEC TR 13066-2 provides a description of the Windows Automation Framework accessibility API.

— ISO/IEC TR 13066-3 provides a description of the IAccessible2 accessibility API.

— ISO/IEC TR 13066-4 provides a description of the Linux/UNIX graphical environments accessibility API.

— ISO/IEC TR 13066-6 provides a description of the Java accessibility API.

— *W3C WAI-ARIA Accessible Rich Internet Applications* (available at: http://www.w3.org/WAI/intro/aria) is especially relevant to improving the accessibility of dynamic web content.

A.6 Personalization guidelines for individualized adaptability

Accessibility standards related to individualization include the following:

— ISO 9241-129 provides guidance on the use of individualization to serve the needs of users.

— ISO/IEC 20071-5[2)] provides guidance on ensuring that accessibility settings are themselves accessible.

A.7 Common industry formats for reporting usability

— ISO/IEC 25062 provides a common industry format (CIF) for usability test reports.

— ISO/IEC 25063 provides a CIF for context of use descriptions.

— ISO/IEC 25064 provides a CIF for user needs reports.

— ISO 25065 provides a CIF for user requirements specifications.

— ISO/IEC 25066 provides a CIF for usability evaluation reports.

2) Under preparation. Stage at the time of publication: ISO/IEC DIS 20071-5:2021.

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