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SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS

Guide for addressing accessibility in standards

ITU-T H-series Recommendations – Supplement 17

ITU-T



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Supplement 17 to ITU-T H-series Recommendations

Guide for addressing accessibility in standards

Summary

Supplement 17 to the ITU-T Series of Recommendations provides guidance to standards developers on addressing accessibility requirements, and recommendations in standards that focus, directly or indirectly, on systems (i.e., products, services and built environments) used by people. To assist standards developers to define accessibility requirements and recommendations, the Supplement presents:

- a summary of current terminology relating to accessibility;
- issues to consider in support of accessibility in the standards development process;
- a set of accessibility goals (used to identify user accessibility needs);
- descriptions of (and design considerations for) human abilities and characteristics;
- strategies for addressing user accessibility needs and design considerations in standards.

This supplement is technically aligned with ISO/IEC Guide 71 (2014). It includes the following modifications: Deletion of terminological entry 2.19 "accessible design", deletion of Note 2 in entry 2.18 "universal design", and amended paragraph 7 of the Introduction.

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

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Introduction

The purpose of this supplement is to assist standards developers (e.g., technical committees or working groups) to address accessibility in standards that focus, whether directly or indirectly, on any type of system that people use. It provides guidance for developing and writing appropriate accessibility requirements and recommendations in standards. However, while its intended audience are standards developers, this guide contains information that can also be useful to other people, such as manufacturers, designers, service providers and educators.

The second edition of this guide, retitled "*Guide for addressing accessibility in standards*," builds upon the edition published in 2001, titled "*Guidelines for standards developers to address the needs of older persons and persons with disabilities*". This edition takes account of developments in thinking and practice which have taken place since 2001 and takes a more inclusive approach. This edition also sets out to improve the usability and adoption of the guide itself. This guide, like its predecessor, is intended to be part of the overall framework that standards bodies can use in their efforts to support the development of systems that suit the needs of diverse users.

It is an important goal for the whole of society that all people, regardless of their age, size or ability, have access to the broadest range of systems. Issues of accessibility to and usability of systems have become more critical as the number of people (such as older persons, children, persons with reduced abilities and persons with disabilities) with diverse user accessibility needs has increased.

Based on their individual abilities and characteristics, people's accessibility needs vary substantially and change throughout the course of their lives (i.e., as they advance from childhood to adulthood and on into old age). Impairments can be permanent, temporary or vary on a daily basis, and sometimes they are not fully recognized or acknowledged. In addition, although some limitations can be minor in nature, combinations of limitations can pose significant problems for individuals attempting to interact with systems. This is the case particularly where user accessibility needs and accessibility requirements were not recognized during development of those systems. Standards that include accessibility requirements can support development of systems that can be used by more users.

While much progress has been made worldwide in the development of accessibility standards relating to information and communications technology and the built environment, the development of accessibility standards related to other sectors has not always kept pace. However, the requirements of national and international anti-discrimination legislation have become increasingly stringent. Additional recommendations are contained in the United Nations Convention on the Rights of Persons with Disabilities^[Ref-36] particularly in Articles 4, 9, 21 and 30), in the UN Committee of the rights of persons with disabilities, General Comment 2^[Ref-37] and emerging national and regional procurement regulations.

International Standards of ISO and IEC and ITU-T Recommendations can play an important part in avoiding market fragmentation and achieving harmonized accessible systems rather than those that meet only national standards and are incompatible with those produced in other nations.

The *IEC/ISO/ITU Joint Policy Statement on Standardization and Accessibility*^[Ref-25] sets out the basic principles for ensuring that the needs of older persons, children and persons with disabilities are incorporated in the standards development process, providing justification on human rights and economic grounds. One of the core points of the Joint Policy Statement aims at ensuring that products, systems, services, environments and facilities can be used by persons from a population with the widest range of characteristics and abilities. In this second edition, the guide is intended to supplement the Joint Policy Statement by providing a set of accessibility goals and describing human abilities and characteristics to assist standards developers in identifying accessibility needs of diverse users in diverse contexts of use.

The guidance provided in this supplement is general. The guide recognizes the principle that standards should normally not be design-restrictive. The guide therefore suggests ways of determining user

accessibility needs without providing specific solutions. It is important to realize that one-size-fits-all solutions seldom meet every person's needs and that accessible features can benefit the majority of the population. Optimal solutions vary greatly depending on the specific users and contexts of use. Additional sector-related guides might need to be developed for specific product or service sectors.

Supplement 17 to ITU-T H-series Recommendations

Guide for addressing accessibility in standards

1 Scope

This supplement provides guidance to standards developers on addressing accessibility requirements and recommendations in standards that focus, whether directly or indirectly, on systems (see clause 2.1) used by people. To assist standards developers to define accessibility requirements and recommendations, the supplement presents:

- a summary of current terminology relating to accessibility;
- issues to consider in support of accessibility in the standards development process;
- a set of accessibility goals (used to identify user accessibility needs);
- descriptions of (and design considerations for) human abilities and characteristics;
- strategies for addressing user accessibility needs and design considerations in standards.

This supplement is technically aligned with ISO/IEC Guide 71 (2014). It includes the following modifications: Deletion of terminological entry 2.19 "accessible design", deletion of Note 2 in entry 2.18 "universal design", and amended paragraph 7 of the Introduction.

2 Terms and definitions

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

2.1 system: Product, service or built environment, or any combination of them with which the user interacts.

2.2 user: Individual who accesses or interacts with a system.

2.3 diverse users: Individuals with differing abilities and characteristics or accessibility needs.

2.4 user accessibility need: User need related to features or attributes that are necessary for a system to be accessible.

NOTE – User accessibility needs vary over time and across contexts of use.

2.5 impairments: Problems in body function or structure related to a significant deviation or loss.

NOTE – Impairments can be temporary or permanent; progressive, regressive or static; intermittent or continuous. [SOURCE: ICF 2001, WHO, Clause 6, section 4.1].

2.6 activity limitations: Difficulties an individual can have in executing activities. [SOURCE: ICF 2001, WHO]

2.7 context of use: Physical and social environments in which a system is used, including users, tasks, equipment and materials. [SOURCE: ISO 9241-11:1998, 3.5, modified – the structure of the sentence has been changed.]

2.8 diverse contexts: Differing contexts of use and differing economic, cultural and organizational conditions.

2.9 effectiveness: Accuracy and completeness with which users achieve specified goals. [SOURCE: ISO 9241-11:1998, 3.2]

2.10 efficiency: Resources expended in relation to the accuracy and completeness with which users achieve goals. [SOURCE: ISO 9241-11:1998, 3.3]

2.11 satisfaction: Freedom from discomfort, and positive attitudes towards the use of the product. [SOURCE: ISO 9241-11:1998, 3.4]

2.12 usability: Extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use. [SOURCE: ISO 9241-11:1998, 3.1]

2.13 multiple means of presentation: Different ways of presenting information.

NOTE – Presenting information in different ways can improve the accessibility of systems.

2.14 multiple means of operation: Different ways of manipulation and control.

NOTE – Providing different ways of manipulation and control can improve the accessibility of systems.

2.15 assistive product: Any product (including devices, equipment, instruments and software), especially produced or generally available, used by or for persons with disability for participation, to protect, support, train, measure or substitute for body functions/structures and activities, or to prevent impairments, activity limitations or participation restrictions. [SOURCE: ISO 9999:2011, 2.3]

2.16 assistive technology: Equipment, product system, hardware, software or service that is used to increase, maintain or improve capabilities of individuals.

NOTE 1 – Assistive technology is an umbrella term that is broader than assistive products.

NOTE 2 – Assistive technology can include assistive services, and professional services needed for assessment, recommendation and provision.

2.17 standards body: Standardizing body recognized at national, regional or international level, that has as a principal function, by virtue of its statutes, the preparation, approval or adoption of standards that are made available to the public.

NOTE 1 – A standards body may maintain standards committees, working groups or other entities to undertake standardization in various subject fields.

NOTE 2 – A standards body may also have other principal functions.

[SOURCE: ISO/IEC Guide 2:2004, 4.4, modified – Note 1 has been added]

2.18 Universal Design: Design of products, environments, programmes and services to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design.

NOTE – Universal Design shall not exclude assistive devices for particular groups or persons with disabilities where this is needed.

[SOURCE: United Nations Convention on the Rights of Persons with Disabilities, Art. 2]

3 Accessibility

3.1 General

This guide utilizes the term *accessibility* from an inclusive perspective, recognizing that accessibility generally benefits everyone.

In the context of standardization, several definitions for the term *accessibility* exist but in general, the term is used with a broad understanding. A widely-accepted definition refers to the "extent to which products, systems, services, environments and facilities can be used by people from a population with the widest range of characteristics and capabilities to achieve a specified goal in a specified context of use" (reference: ISO 26800,^[Ref-13] and, similarly, ISO/TR 9241-100^[Ref-3] and ISO/TR 22411^[Ref-11]).

"Accessibility" and "usability" overlap and some standards define the term *accessibility* as "usability of a product, service, environment or facility by individuals with the widest range of capabilities" (reference: ISO 9241-171,^[Ref-5] ISO/IEC 25062^[Ref-21] and ISO/IEC 29136.^[Ref-22] This perspective emphasizes that accessibility involves both ease of use (which can affect task efficiency and user satisfaction) and success of use (i.e., system effectiveness).

3.2 Accessibility and standards

Standards can greatly influence system designs and can therefore contribute significantly to increasing accessibility and minimizing the presence of systems that limit accessibility. If accessibility considerations are included in standards, system designers might recognize the need for accessibility features earlier in the design process. Addressing user accessibility needs earlier rather than later in the design process enables producers, possibly at little or no extra cost, to design and produce systems that are accessible.

Government legislation based on accessibility standards can influence public policies, procedures and practices.

A number of global trends have contributed to increasing the importance of accessibility in standards development. These are summarized in Annex A.

It is important for standards developers to recognize that no two people have exactly the same abilities and characteristics. Differences among people can be influenced by their gender, age, size, health condition, impairment, training and experience.

Accessible systems are particularly helpful when environmental context of use conditions (such as light intensity, noise or busy activity of nearby people) are unfavourable. Accessibility might be perceived to be in conflict with safety issues. However, it should be kept in mind that features designed to ensure usability and safety should strike a balance with accessibility in order to prevent the exclusion or harm of any user. Standards developers should ensure that systems with safety provisions address the needs of the full range of diverse users.

4 Accessibility in the standards development process

4.1 General

This clause outlines how accessibility can be addressed in the standards development process:

- 4.2 contains general considerations for standards bodies related to making the standards development process accessible;
- 4.3 provides guidance for each of the respective stages of the standards development process to ensure accessibility is given adequate consideration.

4.2 Considerations by standards bodies

Standards bodies should develop a process for determining whether projects would benefit from applying this guide.

Standards bodies should ensure that all stages of the standards development process are accessible. This includes documentation and any information produced by the standards development committee, the means of access to these resources, as well as the physical or remote access (e.g., through teleconferencing or web-conferencing tools) to the standards development committee meetings. This is because membership of standards development committees and people wishing to comment on drafts can have specific accessibility needs.

Standards bodies should encourage and facilitate the participation of relevant stakeholders in the standards development process. Stakeholders should include older persons and persons with disabilities from organizations representing these populations and those persons with a knowledge of the accessibility needs of children and gender-related groups¹.

¹ Further information relating to the involvement of users and potential users can be found in ISO Guide 82^[1] and ISO 26000:2010^[12], 4.5 and 5. Also of relevance is ISO 9241-210^[6]. In some regions there may be specific regulations to ensure participation by relevant stakeholders, such as European Union Regulation 1025/2012^[30].

Standards bodies should commission training for their staff and their committee officers (secretaries and chairpersons of standards development committees), in accordance with appropriate international specifications, to enable them to understand the importance of accessibility and to alert them to aspects in standards projects where accessibility considerations should be addressed.

Standards bodies should take necessary steps to make their buildings, services and facilities accessible. This could include but would not be limited to: developing an accessibility policy and action plan for the standards body; ensuring that the organization's website is fully accessible; having policies and procedures in place to address accessibility needs; making accessibility improvements to the organization's building; and establishing an accessibility user group to advise the standards body on accessibility on an ongoing basis.

4.3 Considerations related to the standards development process

The standards development process is typically organized as a sequence of the five stages listed below. For each stage, the key participants are identified and a list of key actions is given to take into account accessibility considerations.

4.3.1 Stage 1: Define the standards project and determine the applicability of this guide

Key participants

Proposer of standards project

Members of the standards development committee

Key actions [KA]

KA 1.1 Determine, with due diligence, whether the proposed standard focuses on a system or systems with which humans interact as users, either directly or indirectly. If this is not thought to be the case, then this guide is generally not likely to be applicable.

If a standards development committee is unsure if this guide applies to the specific standard it is developing, the committee should use the guide until such a time that it determines that the guide does not apply to its standard. Sometimes a standards committee will initially decide that this guide does not apply, only to find out later, as the draft standard evolves, that the system will involve direct or indirect interaction with humans. In these cases, the standards committee should begin using the guide at that point and review the work already done.

KA 1.2 Identify the ways in which humans are likely to interact with the system, directly or indirectly.

KA 1.3 Identify potential users and determine or identify diversity of abilities and characteristics.

KA 1.4 Identify key sources of relevant information – such as existing regulations, standards, and research results – that should be collected and considered during the standards development process.

KA 1.5 Determine relevant accessibility aspects that should be addressed by the standard.

Outcomes of this stage

A decision has been made as to whether this guide is applicable. Initial sources of additional information about accessibility have been identified.

4.3.2 Stage 2: Ensure the standards development committee is well equipped to implement an accessible process with equitable participation

Key participants

Standards body

Standards development committee chair and secretary

Key actions [KA]

KA 2.1 Ensure standards development committee membership includes adequate target stakeholder group input.

KA 2.2 Establish processes to ensure the accessibility of information, communications and meeting facilities (including teleconferences and online communications) used during the development of the standard.

Outcomes of this stage

Individuals and organizations with knowledge in accessibility are involved in the project. Accessibility requirements are addressed in the operations of the committee and organization of meetings.

4.3.3 Stage 3: Develop the content of the standard

Key participants

Standards development committee chair and secretary

Experts

Standards development committee members

Key actions [KA]

KA 3.1 Define the issues: Use this guide (and other relevant documents) to determine or verify user accessibility needs (see clause 6) and/or design considerations (see clause 7) regarding accessibility.

KA 3.2 Develop candidate requirements and recommendations: Determine potential ways (see clause 8) in which each user accessibility need or design consideration could be met by requirements and recommendations within the standard, considering how flexible or alternative options could provide users with the ability to achieve accessibility in the way that best fits the context of use.

KA 3.3 Evaluate the feasibility of potential requirements and recommendations, taking into account constraints and trade-offs.

KA 3.4 Incorporate resulting requirements and recommendations in the standard.

KA 3.5 Confirm requirements and recommendations: Consult stakeholders to confirm that accessibility is appropriately and adequately addressed in the standard.

KA 3.6 Repeat some of the previous steps in this stage, if necessitated by stakeholder feedback.

KA 3.7 Reference: Include a citation for this guide on the reference list in the standard.

Outcome of this stage

Requirements and recommendations regarding accessibility for the widest range of users impacted by the standard have been addressed and are reflected in the draft standard.

4.3.4 Stage 4: Issue the draft standard for public review and vote and revise the standard as needed

Key participants

Standards body and stakeholders

Key actions [KA]

KA 4.1 Ensure all draft documents are prepared and published in accessible format(s).

KA 4.2 Ensure links to all draft documents are disseminated widely in order to collect feedback from diverse stakeholders.

KA 4.3 Ensure that all commenting and voting tools are accessible.

Outcome of this stage

The draft has been disseminated to a wide audience, including diverse users in a diverse range of contexts of use.

4.3.5 Stage 5: Publish the standard

Key participants

Standards body

Key actions [KA]

KA 5.1 Ensure the standard is published in accessible format(s).

KA 5.2 Ensure information about the new standard is disseminated to a wide range of relevant stakeholders, organizations and standards committees.

KA 5.3 National standard bodies are encouraged to translate Guide 71 to national language(s) to facilitate use by relevant stakeholders, organizations and standards committees.

Outcome of this stage

Standard is available for use by all interested parties.

5 How to apply the guide

5.1 Two approaches to addressing accessibility in standards

This supplement identifies two complementary approaches to addressing accessibility in a specific standard:

- an *accessibility goals approach* (see clause 6), which can be used to identify user accessibility needs that can, in turn, be used to identify accessibility requirements and recommendations for a standardization project;
- a *human abilities and characteristics approach* (see clause 7), which can be used to identify design considerations that can, in turn, also be used to identify accessibility requirements and recommendations for a standardization project.

Standards developers should use these approaches to address accessibility in applicable standards. The use of both approaches can result in the creation of the most appropriate set of standard-specific requirements and recommendations. The extent to which either approach is relied on can vary with the scope and context of use of the particular standard being developed.

Clause 6 provides information on accessibility goals that can support accessibility. The clause discusses how standards developers can use questions (based on these goals) within the context of their specific standard to identify standard-specific user accessibility needs.

Clause 7 provides information on human abilities and characteristics and the consequences of impairments, including respective design considerations for accessibility.

Clause 8 provides strategies for developing standards requirements and recommendations based on the outputs of the two approaches, and includes examples of requirements and recommendations that result from the application of each strategy.

This guide also recognizes the value of using a range of other sources of accessibility-related information.

Figure 1 provides a graphical summary of how this guide can be used.

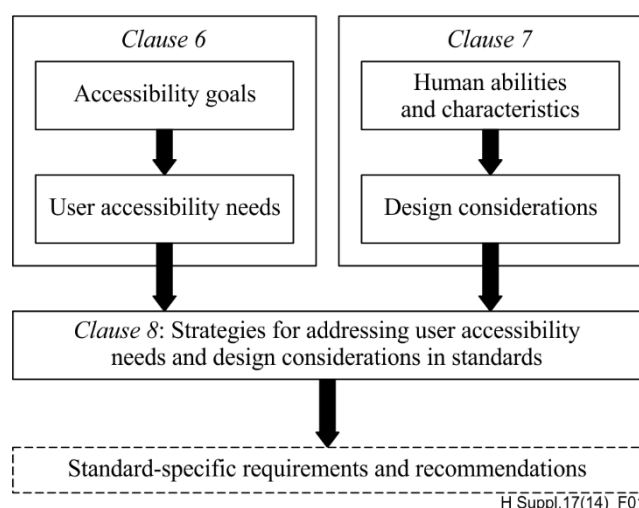


Figure 1 – Two approaches to address accessibility in standards

Figure 1 is a visual representation of the two approaches presented in the guide for addressing accessibility in standards. The first approach is discussed in clause 6, which contains a set of accessibility goals that are used to identify user accessibility needs. The second approach is discussed in clause 7, which contains categories of human abilities and characteristics as well as design considerations for each category. The results of taking either or both approaches in clauses 6 and 7 can be applied to develop standard-specific requirements and recommendations, following one or more of the strategies discussed in clause 8.

5.2 Other sources of information

A wide variety of other sources of information can be used by standards developers, within the scope of a particular standard, to identify user accessibility needs, design considerations and/or accessibility-related requirements and recommendations.

It is recognized that different sectors (i.e., products, services and built environments) and their various subsectors have more specialized user accessibility needs than are presented in this guide. The committees responsible for developing standards for these sectors and subsectors are encouraged to produce more detailed sector-specific guidance to assist standards developers within their domains. One way of assisting standards developers is to create a collection of user accessibility needs that apply specifically to the particular sector (see e.g., ISO/IEC/TR 29138-1^[Ref-23] and IEC/TR 62678^[Ref-27]).

Other potential sources of information on user accessibility needs, design considerations and/or accessibility related requirements can be found in government regulations. These can be used directly by standards developers but it is important to consider differences in regulations across the various jurisdictions intended to use the standard.

ISO/TR 22411^[Ref-11] provides an expansion on the various human abilities and characteristics and design considerations presented in clause 7 of this guide. It also provides ergonomic data that can be used in developing specific requirements and recommendations.

The World Health Organization's *International Classification of Functioning, Disability and Health* (ICF)^[Ref-39] is a source of information that can be used in standards to describe people and their functioning. Adopted by over 190 member states, the ICF provides a resource for a unified, standard language and framework, which is consistent, clearly defined and unambiguous. It is available in the majority of the world's major languages. Annex B provides an overview on how to use the ICF as a resource for terminology that can be used in some parts of standards to describe people and their functioning.

The number of standards that focus on accessibility within certain sectors is increasing (e.g., ISO 9241-171^[Ref-5] and ISO 21542^[Ref-10]). Where applicable accessibility standards exist, they can be used as normative references (i.e., other standards can either require that they be used in their entirety or that particular clauses within them be used).

It is useful to get feedback relating to user accessibility needs directly or indirectly from potential users of the systems to be developed using the standard. An effective method to identify user accessibility needs is the use of comprehensive surveys on user experiences. Often (e.g., in product development) companies have a significant amount of information that can help them identify accessibility needs (customer complaints, accident data, marketing data, usability testing results, etc.).

This supplement can also be used in conjunction with other ISO/IEC guides, including:

- ISO/IEC Guide 37, *Instructions for use of products by consumers*,^[Ref-15]
- ISO/IEC Guide 41, *Packaging – Recommendations for addressing consumer needs*,^[Ref-16]
- ISO/IEC Guide 50, *Safety aspects – Guidelines for child safety*,^[Ref-17]
- ISO/IEC Guide 51, *Safety aspects – Guidelines for their inclusion in standards*,^[Ref-18]
- ISO/IEC Guide 59, *Code of good practice for standardization*,^[Ref-19]
- ISO/IEC Guide 76, *Development of service standards – Recommendations for addressing consumer issues*.^[Ref-20]

5.3 Verifying and validating that accessibility is adequately addressed

Standards developers should verify and validate that accessibility has been adequately addressed in the standard.

It is preferable that verification and validation be conducted, using this guide and any other appropriate resources, by external standards developers not involved in drafting the standard.

Verification should confirm that the accessibility requirements and recommendations in the standard are consistent with the sources from which they were developed.

Validation should qualitatively confirm that the accessibility requirements and recommendations meet the needs of the stakeholders affected by systems that comply with the standard. Validation should involve input from representatives of various affected accessibility stakeholder groups and accessibility experts with knowledge of the domain of the standard.

6 Accessibility goals

6.1 General

6.1.1 Structure of the goals

Accessibility goals provide one approach to the identification and development of specific accessibility-related requirements and recommendations to be included in standards. This approach is referred to in this guide as the accessibility goals approach. The goals can be applied to the design and evaluation of a variety of systems and thus could be included within the accessibility guidance in a variety of standards.

Each of the 11 goals is introduced by its name and presented in the same structure:

1. **The goal:** The basic goal statement.
2. **Discussion:** An elaboration on the basic goal statement.
3. **Background:** Sources from which the goal is derived.
4. **Common user accessibility needs:** User accessibility needs related to the goal.
5. **Questions to consider:** Questions for applying the goal.

The goals presented in this guide are based on principles used in a variety of existing accessibility guidance documents (including ISO 9241-171,^[Ref-5] ISO/IEC 40500^[Ref-24] and *Principles of Universal Design*^[Ref-32]) and other sources of related information (including ISO 9241-11,^[Ref-2] ISO 14915-1,^[Ref-8] ISO 26800^[Ref-13]). Standards developers can benefit from consulting the original sources of information that were used to derive the goals and which are listed in the bibliography. While many of the sources used in their derivation come from the information and communication technology (ICT) domain, these goals are intended to be a broad set of goals that can be applied across all domains. It is recognized that some goals can be more applicable to some domains than others.

The accessibility goals in this section can help standards developers identify ways in which the standard they are developing could enhance or inhibit the accessibility of the systems on which the standard focuses and especially meet the user accessibility needs of diverse users in diverse contexts of use.

6.1.2 Identifying user accessibility needs

The typical user accessibility needs provided in this clause give standards developers an indication of the needs that can be identified by considering the goals and answering the questions.

Diverse users can have a large number of differing user accessibility needs. However, it is important to recognize that different users can have different user accessibility needs in different contexts of use, and that specific user needs might not be user accessibility needs for different people in different circumstances. The user accessibility needs of some users might also conflict with the user accessibility needs of other users. Standards developers should ensure that the requirements and recommendations that they include in a standard are sufficient to meet the full set of user accessibility needs that are appropriate to the standard. Rather than disregarding some user accessibility needs in creating requirements and recommendations for a standard, it is important to ensure that the user accessibility needs of diverse users are accommodated in diverse ways.

6.1.3 Applying user accessibility needs to generate requirements and recommendations

Standards developers should identify user accessibility needs relating to the particular standard they are developing. It is recognized that not all of the typical user accessibility needs identified in this clause might be relevant to all standards. Standards developers can apply the goals (either directly or via the questions that are presented with them) within the specific context of their standard to identify specific user accessibility needs. It is also recognized that the typical user accessibility needs listed in this clause should be specialized to suit a particular standard, and that standards developers should identify important user accessibility needs that are not listed here. Some of the goals might be easier to apply than other goals when developing a particular standard. However, often the less obviously applicable goals can be used to identify user accessibility needs that would otherwise be missed.

In most cases there will not be a one-to-one correspondence between requirements or recommendations and user accessibility needs. For example, multiple requirements and recommendations could combine to meet a single user accessibility need; and a single requirement or recommendation could be used to meet (or partially meet) more than one user accessibility need. It does not matter which goal or goals lead to the identification of a user accessibility need. Some of the goals might overlap or conflict with one another, requiring trade-offs to be made. Once the set of user accessibility needs has been identified, overlaps and potential conflicts can be dealt with appropriately. Overlaps will generally not require action; however, in the case of conflicts there could be a need for trade-offs in the development of accessibility-related requirements.

The questions provided with goals in this clause are general questions that standards developers can use to help them to identify important issues and user accessibility needs relating to the goal. A copy of these questions is contained in Annex C to support their ease of use. Standards developers can use these questions to assist them in achieving this goal. Standards developers are encouraged to

customize the set of questions by tailoring the existing questions and/or adding further questions in order to better suit the particular standard being developed.

NOTE – In this clause, the term "deliverable" is used to describe all types of documents that are produced taking into account the accessibility goals in this clause, such as standards, technical specifications, technical reports, publicly available specifications, guides, ITU Recommendations or workshop agreements.

6.2 The goals

6.2.1 Suitability for the widest range of users

6.2.1.1 The goal

A system is suitable for the widest range of users if it meets the needs of diverse users in diverse contexts.

6.2.1.2 Discussion

This goal recognizes that the widest range of users involves both diverse users and diverse contexts as defined in this guide. While all the potential users might not always be readily known, it is important to ensure that persons, who could be appropriate users, if they were provided accessible means of doing so, are not excluded.

6.2.1.3 Background

This goal is derived from the various definitions of accessibility as discussed in clause 3.1 and from the principle of "suitability for the widest range of use" in ISO 9241-171. ^[Ref-5]

6.2.1.4 Common user accessibility needs

User accessibility needs include:

- to be included as system users through the provision of accessible modes and methods of use;
- to have the system accessible to users with combinations of impairments and in adverse environmental conditions.

6.2.1.5 Questions to consider

- a) Who are the potential users of systems that will be addressed by or who will relate to this deliverable?
- b) Which potential users, if any, might be excluded by the requirements and recommendations in this deliverable?
- c) What are all the contexts of use in which systems that relate to this deliverable could be used?
- d) Which contexts of use might be excluded by the requirements and recommendations in this deliverable?

6.2.2 Conformity with user expectations

6.2.2.1 The goal

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.

6.2.2.2 Discussion

This goal recognizes that failure to conform to user expectations can be confusing for diverse users and can lead to errors. Users can have expectations with regards to a number of aspects of a system including: terminology, actions, responses and communications. User expectations are based upon an

individual's past experience and can be changed or enhanced (e.g., via the provision of information or training) and expectations can evolve over time. User expectations are often determined by the current context of use and can change across different contexts. When a user is in a new context, expectations will be based on similar contexts with which the user is familiar. This goal encourages that interaction with or operation of systems to be predictable. New systems might require users to learn new knowledge or skills. When people are required to modify familiar practices or habits, difficulties can result. This is especially significant because some users have considerable difficulties (that can extend to inabilities) in dealing with contradictory methods of performing actions that they understand as being similar to one another.

NOTE – It is not the intent of this goal to preclude the development of new expectations. However, it advocates consistency with user's existing expectations wherever possible.

6.2.2.3 Background

This goal is derived from the principles of "conformity with user expectations" from ISO 9241-110^[Ref-4] and "simple and intuitive use" from *Principles of Universal Design*.^[Ref-32]

6.2.2.4 Common user accessibility needs

User accessibility needs include:

- not to be surprised by the results of interactions with the system;
- to be able to apply personal knowledge and experience to interact successfully with the system;
- to receive instruction or training directed at preparing them for new knowledge needed to interact successfully with the system;
- to obtain immediate and easily accessible help or further instructions, where such help can be provided by the system.

6.2.2.5 Questions to consider

- a) What are the expectations/user experiences of the diverse users of systems that relate to this deliverable?
- b) Is there any available information on frustrated or confirmed user expectations with products affected by deliverables in this domain?
- c) What conflicts with potential user expectations could result from using this deliverable?
- d) What new user expectations will be created by using this deliverable?

6.2.3 Support for individualization

6.2.3.1 The goal

A system supports individualization if its components, functions or operations can be tailored to meet the needs of individual users.

6.2.3.2 Discussion

This goal recognizes that a single system design is seldom optimal in meeting the needs of every user and context of use and it can be important to provide users with choices in how to interact with a system. While various types of systems or system components (e.g., the built environment) are not modifiable by users, individualization can be accomplished if the users can individualize the way in which they interact with the system.

Individualization focuses on providing each user with means of obtaining the best possible solution for that user. This can be accomplished by providing users with a choice in their methods of

interacting with a system (such as alternative sets of operations or interactions, alternate modalities of interacting or operating, or cognitive strategies) and/or by providing alternative means or formats of interaction matched to that individual's needs in that context or by implementing other accessibility strategies.

6.2.3.3 Background

This goal is derived from the principles "suitability for individualization" from ISO 9241-110^[Ref-4], "flexible in use" from ISO 9241-171,^[Ref-5] and "flexibility in use" from *Principles of Universal Design*.^[Ref-32]

6.2.3.4 Common user accessibility needs

User accessibility needs include:

- to be provided with (and to be able to choose) the way of interacting with a system that best works for them (including activating and deactivating built-in accessibility features);
- to be provided with information on available options for interacting with a system on which to base a choice of interaction methods;
- to be provided an accessible means to choose individualization features, which will be maintained for future uses of the system, until changed by the user.

6.2.3.5 Questions to consider

- a) What aspects of user interaction with systems that relate to this deliverable should the user be able to individualize?
- b) What aspects of user interaction with systems that relate to this deliverable could present barriers for some users if they cannot be individualized?
- c) What recognized or innovative sets of individual options or preferences could be recommended by the deliverable for potential implementation within systems?
- d) How could the context in which the deliverable is used affect the identified individual options or preferences that are needed?

6.2.4 Approachability

6.2.4.1 The goal

A system is approachable if diverse users can overcome any physical or psychological barriers and physically or remotely access it to accomplish the task.

6.2.4.2 Discussion

This goal recognizes that a lack of approachability can create a barrier to use for some users. Access routes, spaces, sizes, designs, the layouts of control mechanisms, and the use of processes for interacting with systems are important for diverse users in diverse contexts of use. This involves being able to navigate to and within a system (as appropriate) and being able to get into positions and/or contexts needed to successfully interact with the system and to be able to leave the system. The system could be approachable directly (e.g., by touch, by voice), via remote means (e.g., by using telecommunications), or through the use of assistive products and assistive technology.

This goal recognizes that physical or psychological barriers can inhibit or prevent users from accessing a system. This goal recognizes the importance of taking into account those barriers that can be reasonably identified and removed or controlled but that, within certain environments, some barriers might have to remain where alternative systems will need to be used.

6.2.4.3 Background

This goal is derived from the principle of "size and space for approach and use" from *Principles of Universal Design*.^[Ref-32]

6.2.4.4 Common user accessibility needs

User accessibility needs include:

- to have adequate room to fit themselves and their assistive products or assistive technology;
- to have system controls located within close reach;
- to have interaction options clearly presented;
- to have appropriate levels of privacy and security;
- to be able to use the system remotely as well as directly.

6.2.4.5 Questions to consider

- a) How could this deliverable ensure that resulting systems that relate to this deliverable be physically and psychologically approached by diverse users so that they can perform their tasks?
- b) How could this deliverable ensure that systems that relate to this deliverable be remotely approached by diverse users to perform their tasks?
- c) How could this deliverable avoid limits to physical, psychological or remote approachability for diverse users in diverse contexts of use?

6.2.5 Perceivability

6.2.5.1 The goal

A system is perceivable if diverse users in diverse contexts can sense the information and functionalities it presents.

6.2.5.2 Discussion

This goal recognizes that perceivability is focused on the human physical capability to sense information in the sensory modality in which it is presented. Making use of multiple modalities (i.e., more than one of: visual, auditory, tactile, olfactory or taste) can provide perceivability for more diverse users and contexts. Providing information in a single sensory modality can exclude some users in some contexts from perceiving information and functionalities.

6.2.5.3 Background

This goal is derived from the principles of "perceptible information" from ISO 9241-171^[Ref-5], "suitability for perception and understanding" from ISO 14915-1^[Ref-8], "perceivable" from ISO/IEC 40500 (WCAG 2.0^[Ref-24]) and "perceptible information" from *Principles of Universal Design*.^[Ref-32]

6.2.5.4 Common user accessibility needs

User accessibility needs include:

- to use a specific sensory modality (or a set of specific modalities) to perceive information;
- to control various presentation attributes of a modality;
- to be able to distinguish among the individual elements of information that are being presented;

- to control the physical environment (to the extent reasonable) so that it does not interfere with perceiving the information.

6.2.5.5 Questions to consider

- Within the scope of this deliverable, what information should be presented by systems to users?
- How could this deliverable ensure that diverse users in diverse contexts can perceive the information presented in systems that relate to this deliverable?
- How could this deliverable limit the modalities that a system uses to present information to users?

6.2.6 Understandability

6.2.6.1 The goal

A system is understandable if its information and functionalities are interpretable by diverse users.

6.2.6.2 Discussion

This goal recognizes that understandability depends on the human cognitive ability to correctly interpret the meaning of the information that has been perceived. This goal recognizes that it is important for a system to minimize the need and effort required for diverse users to learn and to remember.

Different users can have different styles of thinking that can influence their ability to understand presented information. Some users work best with models and concepts (e.g., goals, principles) and will have difficulties working with details that are not related to a model or concept. Some users work best with explicit procedures, details, or examples and will have difficulties working with complex or abstract models or concepts. Different users will have different needs related to their understanding how to interact with a system.

Some users might have the knowledge and cognitive skills to understand a situation and make the correct decision, while other users might need constant assistance or regular retraining to be able to understand the same situation. Some users could benefit from tools that help them to analyse the information they are being given in a manner that aids in its understanding.

Language and culture can affect understanding. It is important that the use of linguistic and cultural aspects of presented information be considered with respect to the widest diversity of users in the widest diversity of contexts.

6.2.6.3 Background

This goal is derived from the principles of "self-descriptiveness" from ISO 9241-110^[Ref-4], "understandable" from ISO 9241-171:2008,^[Ref-5] Clause 5, "suitability for perception and understanding" from ISO 14915-1^[Ref-8], "understandable" from ISO/IEC 40500^[Ref-24] and "simple and intuitive use" from *Principles of Universal Design*.^[Ref-32]

6.2.6.4 Common user accessibility needs

User accessibility needs include:

- to be able to obtain an overview of the system and its components and functionalities;
- to be able to understand information presented by the system;
- to have information that supports their cognitive abilities;
- to have the steps for completing tasks minimized and clearly explained;
- to have cues to assist them in completing tasks;

- to have feedback that shows users the results of their actions;
- to be able to control the pace of interaction with the system;
- to be able to access help when needed.

6.2.6.5 Questions to consider

- a) For systems within the scope of this deliverable, what information and functionalities should be presented that would need to be understood by users?
- b) How could this deliverable assist in ensuring that the information and functionalities of the system are understandable for diverse users?
- c) How could this deliverable support diverse users to be able to learn how to use the information and functionalities of systems that relate to it?
- d) How could this deliverable ensure that systems avoid making unnecessary cognitive demands on potential users?

6.2.7 Controllability

6.2.7.1 The goal

A system is controllable if the user is able to initiate and complete the interaction(s) required to accomplish the task.

6.2.7.2 Discussion

This goal recognizes that it is important that diverse users can control their interactions with systems. This depends on the ability of users to interact with different control mechanisms that require different interaction modalities (e.g., by touch, gesture, voice) to use a system. Providing multiple means of operation can improve controllability.

6.2.7.3 Background

This goal is derived from the principles of "controllability" from ISO 9241-110^[Ref-4], "operable" from ISO 9241-171^[Ref-5], "suitability for exploration" from ISO 14915-1,^[Ref-8] and "operable" from ISO/IEC 40500.^[Ref-24]

6.2.7.4 Common user accessibility needs

User accessibility needs include:

- to be able to use a specific interaction modality (or a set of specific interaction modalities) to interact with the system;
- to be able to perform the task using various parts of the body and specific types of actions;
- to be able to perform tasks one step at a time;
- to be able to interact with the system at one's own pace.

6.2.7.5 Questions to consider

- a) For systems within the scope of this deliverable, what control actions should users need to be able to initiate and complete?
- b) How could this deliverable ensure that diverse users in diverse contexts of use are able to initiate and complete the actions that are required to accomplish their tasks?
- c) How could this deliverable avoid limiting the modalities that a user can use to initiate and complete the actions that are required to accomplish their tasks?

6.2.8 Usability

6.2.8.1 The goal

A system is usable if it supports diverse users in their diverse contexts to accomplish their tasks with effectiveness, efficiency and satisfaction.

6.2.8.2 Discussion

If the minimum level of usability for a user in a context is not provided, then the user might not consider the system to be accessible enough to use. This goal recognizes that inadequate usability can discourage users from accessing a system. System effectiveness, efficiency and user satisfaction can vary greatly depending on the specific users and context of use.

6.2.8.3 Background

This goal is derived from the definitions of accessibility in terms of usability (see clause 3.1) and the principles of "suitability for the task" from ISO 9241-110^[Ref-4], "suitability for the communication goal" from ISO 14915-1^[Ref-8], "ease of operation" from ISO 20282-1^[Ref-9] and 'low physical effort' from *Principles of Universal Design*.^[Ref-32] It recognizes that usability is a prerequisite to the successful use of a system and that usability will vary across diverse users and diverse contexts of use.

6.2.8.4 Common user accessibility needs

User accessibility needs include:

- to be able to avoid making mistakes in completing tasks;
- to perform tasks with a minimum of physical and cognitive exertion;
- to be able to complete tasks in an efficient manner relative to one's own abilities (i.e., what is efficient for one user will not necessarily be equally efficient for other users);
- to be able to complete tasks within the available time;
- to be able to complete tasks with the available resources;
- to be satisfied with the outcome of interacting with the system;
- to have confidence that using the system will not involve any negative consequences or unacceptable risks;
- to be satisfied that the system is worth using;
- to have a positive physical and psychological experience using the system.

6.2.8.5 Questions to consider

- a) How could a system that relates to this deliverable assist diverse users in diverse contexts to effectively accomplish their tasks?
- b) How could a system that relates to this deliverable assist diverse users in diverse contexts to accomplish their tasks in a manner that is efficient to each of them?
- c) How could a system that relates to this deliverable assist diverse users in diverse contexts to accomplish their tasks in a manner that is satisfactory to each of them?
- d) How could a system that relates to this deliverable avoid limiting the usability of the system for some users?

6.2.9 Error tolerance

6.2.9.1 The goal

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.

6.2.9.2 Discussion

This goal recognizes the importance of minimizing the potential for error and that where errors cannot be avoided it is important to minimize their impact on users. Diverse users and diverse contexts can sometimes create situations in which a wide variety of errors can occur and where the effects of these errors can prevent the users from accomplishing their tasks.

6.2.9.3 Background

This goal is derived from the principles of "error tolerance" from ISO 9241-110^[Ref-4], "error tolerant" from ISO 9241-171^[Ref-5], "help users avoid and correct mistakes" from ISO/IEC 40500 (WCAG 2.0^[Ref-24]) and "tolerance for error" from *Principles of Universal Design*.^[Ref-32]

6.2.9.4 Common user accessibility needs

User accessibility needs include:

- to be able to explore a system without unintentionally activating components or their functionality;
- to be able to successfully operate a system with limited body control (e.g., strength, tremors);
- to be able to detect when errors have been made;
- to be able to recover from errors made from interacting with the system (whenever possible);
- to reset a system to an earlier or original condition as a means to responding to errors;
- to avoid errors by having negative consequences be obvious, easy to avoid, and difficult to trigger.

6.2.9.5 Questions to consider

- a) How could a system that relates to this deliverable assist in minimizing the adverse consequences of errors?
- b) How could a system that relates to this deliverable assist in preventing errors?
- c) How could a system that relates to this deliverable assist in minimizing errors?
- d) How could this deliverable assist the resulting system in enabling users to recover from errors?

6.2.10 Equitable use

6.2.10.1 The goal

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.

6.2.10.2 Discussion

This goal recognizes that it is important to avoid situations that could discriminate against certain users or groups of users based on their accessibility needs. It expects that all potential users can be provided with a means to access and use the same system information and functionalities.

6.2.10.3 Background

This goal is derived from the principles of "equitable use" from ISO 9241-171^[Ref-5] and "equitable use" from *Principles of Universal Design*.^[Ref-32]

6.2.10.4 Common user accessibility needs

User accessibility needs include:

- to be able to use a system that relates to this deliverable in a manner that is as similar as possible to other users;
- to be able to use a system that relates to this deliverable in a manner that is different from but equivalent to that of other users;
- to have available alternate ways of interacting with a system that relates to this deliverable.

6.2.10.5 Questions to consider

- a) How could a system that relates to this deliverable ensure that diverse users can interact with the system in an identical or equivalent manner?
- b) Are there elements of the system that some users might not be able to interact with in an identical or equivalent manner?
- c) How could systems that relate to this deliverable segregate, stigmatize or discriminate against some users?
- d) Will requirements and recommendations in this deliverable promote social integration by treating all groups with equal or equivalent access?

6.2.11 Compatibility with other systems

6.2.11.1 The goal

A system provides compatibility if it allows diverse users to use other systems as a means to interact with it to accomplish the task.

6.2.11.2 Discussion

This goal recognizes that in some cases some users might not be able to use a system without the assistance of some intermediary system. While it is not feasible to make all systems directly accessible to all people, the provision of compatibility can make it possible for diverse users to use assistive products or assistive technology to utilize the system.

NOTE – In the IT domain compatibility is often referred to as *interoperability*.

6.2.11.3 Background

This goal is derived from the principles of "robustness" from ISO 9241-171^[Ref-5] and "robust" from ISO/IEC 40500.^[Ref-24]

NOTE – See also the additional information in clause 3.2.

6.2.11.4 Common user accessibility needs

User accessibility needs include:

- to be able to use their own assistive products or assistive technology to interact with all the functionalities of the system;
- to have the system not interfere with their assistive products or assistive technology.

6.2.11.5 Questions to consider

- a) How could this deliverable ensure that diverse users can utilize their own assistive products or assistive technology (when needed) with any system that relates to it?
- b) How could this deliverable avoid limiting the ability of users to utilize their own assistive products or assistive technology (when needed) with any system that relates to it?
- c) How could this deliverable ensure that the systems that relate to it will be compatible with other systems across a range of contexts of use to facilitate accessibility by diverse users?

7 Human abilities and characteristics

7.1 General

7.1.1 Description

This clause provides information on human abilities and characteristics as well as associated design considerations. Standards developers can approach accessibility for system users by identifying the required user activities and the related human abilities and characteristics. The design considerations can inform the requirements and recommendations in standards.

The information on abilities and characteristics is organized according to the human body structures, human body functions, associated impairments and the consequences for overall functioning in terms of activity limitations and participation restrictions.

This clause provides general design considerations for system designs that maximize accessibility for users but does not identify the full range of design considerations to address all accessibility issues.

NOTE – For further information about human abilities and characteristics refer to ISO/TR 22411.^[Ref-11]

In this clause terminology used to describe human abilities and characteristics that is directly from the World Health Organization's International Classification of Functioning, Disability and Health (ICF) is followed by the ICF reference code "ICF: bxxx" for Human Body Functions, or "ICF: sxxx" for Human Body Structures. Annex B provides an overview on how to use the ICF as a resource for terminology to describe people and their functioning.

7.1.2 Diversity of human abilities and characteristics

The abilities and characteristics of people change as they advance from childhood to old age and vary substantially among individuals in any particular age group. Activity limitations and participation restrictions can be experienced by all people and can be the result of unsuccessful interaction between individuals with impairments or health conditions and barriers such as personal and environmental factors. Health conditions (e.g., circulatory, respiratory, neurological), impairments in body functions and structures and related limitations can be temporary or permanent, not visible and generally increase with age. It is important to recognize that sensory, physical and cognitive limitations vary from comparatively minor (such as mild hearing loss, mild seeing impairment, mild mobility impairment or mild memory loss) to significant limitations (such as deafness, blindness, paralysis or significant memory loss).

Although some impairments are minor in nature, combinations of impairments can impose significant limitations, as is often the case in ageing. While not all older persons have impairments, the prevalence of disability or limitations is highest among this demographic group. It is also important to recognize that children with impairments can have specific requirements based on their disabilities; they also have general needs and preferences that are similar to those of other children.

7.2 Sensory abilities and characteristics

7.2.1 General

Sensory functions in this section include:

- seeing functions (see clause 7.2.2);
- hearing functions (see clause 7.2.3);
- touch functions (see clause 7.2.4);
- taste and smell functions (see clause 7.2.5).

In general, sensory abilities decrease with age.

7.2.2 Seeing functions

7.2.2.1 Description

Seeing functions (ICF: b210) relate to sensing the presence of light and sensing the form, size, shape, contrast and colour of visual stimuli, as well as discriminating the location, distance and speed of objects. The seeing function comprises a variety of aspects such as visual acuity, near and distant vision, accommodation to changes in focus, field of vision, perception of colour and distance (or depth), adaptation to changes in light levels and sensitivity to light.

7.2.2.2 Impairments and limitations

Impairments and limitations can range from slight seeing impairments to complete blindness. Effects of impairments and limitations include:

- reduced ability to see images distinctly;
- reduced ability to change focus from near to distant objects, and vice versa;
- reduced ability to see things in one part of the field of vision (i.e., to the side, top, bottom or centre);
- reduced ability to distinguish colours, including effects due to age-related yellowing of the lens of the eye;
- increased sensitivity to glare;
- increased sensitivity to flashing lights or flickers;
- reduced ability to see contrast;
- reduced ability to judge distances and speed;
- reduced ability to see while the eye adjusts to different lighting levels;
- reduced sensitivity to light so that more light is needed to see.

Persons with blindness are considered to have very limited or no useful visual abilities and can rely on other sensory functions, such as hearing and touch, to obtain information.

Persons with seeing impairments can receive insufficient or distorted visual information and rely on auditory and tactile stimuli. Factors such as size, clarity (per se as well as in relation to surrounding factors including positioning and prominence in relation to field of vision), luminance and colour contrast can affect perception. Persons with significant seeing impairments (low vision) often require a higher contrast and can prefer light text on a darker background rather than darker text on a light background. They use other sensory functions such as hearing and touch functions to supplement visual information.

Adverse environmental conditions, such as poor lighting, smoke and fog, can reduce visibility and present many of the same types of effects listed above for many persons.

7.2.2.3 Design considerations

Design considerations that can facilitate accessibility include the following:

- multiple means of information presentation such as auditory or tactile to supplement or substitute for visual information;
- appropriate size, contrast, form, luminance, lighting and viewing distance in relation to context of use;
- avoidance of glare;
- redundant forms of coding to supplement or substitute for information conveyed with colour coding, e.g., shape or texture coding;
- appropriate physical construction and properties of fonts such as size, spacing, with or without serif, upright form or italics, and light, medium or bold appearance within a specific context of use;
- visual information and controls placed in a prominent position, or a positioning that is flexible, adjustable or duplicated;
- avoidance of flicker rates with flashing or blinking text, objects or video screens, especially those that can trigger visually induced seizures;
- distinctive form to facilitate identification of a product/environment and/or parts of a product/environment (including orientation, e.g., top/bottom, front/back, entrance/exit);
- coloured floor markings that draw attention to steps and potentially dangerous places;
- tactile floor indicators that draw attention to stairs, platform edges and pedestrian crossings;
- traffic lights equipped with acoustic signals to indicate when pedestrians can cross streets safely;
- accommodation of and compatibility with relevant assistive products and assistive technology.

NOTE – Examples of assistive products, assistive technology and supports for persons with seeing impairments and blindness are guide dogs, guide assistants, talking global positioning systems (GPS) devices, computers with dedicated computer software add-ons (e.g., screen reading software which simulates the human voice reading the text on computer screen or renders hard-copy output into Braille), talking clocks and thermometers, specialized bar code scanners, hand-held computers and tablets.

7.2.3 Hearing functions

7.2.3.1 Description

Hearing functions (ICF: b230) relate to sensing the presence of sounds including speech and discriminating the location, pitch, loudness and quality of sounds.

7.2.3.2 Impairments and limitations

Impairments and limitations can range from slight hearing impairment to complete deafness. Effects of impairments and limitations include:

- reduced ability to detect the full range of sound frequencies, in particular higher frequencies;
- reduced ability to localize sound;
- reduced ability to detect low volume sound, especially when the ambient noise level is high or the distance between the sound source and the listener is large;
- reduced ability to discriminate sounds or speech especially when there is a high surrounding noise level or a large distance between the sound source and the listener;
- reduced ability to adapt to sudden changes in volume;

- reduced ability to discriminate and follow speech when two or more people are speaking at the same time;
- reduced ability to tolerate some frequencies and volumes (hyperacusis);
- reduced ability to separate speech, including instructions, from background sounds in recorded audio.

Persons with deafness can rely on other sensory functions to obtain information such as seeing and touch functions. Some people with deafness have difficulty understanding both written and spoken language.

Persons with hearing impairment can receive insufficient or distorted auditory information. The volume, frequency, and clarity of any sound can be important factors that affect audibility. Some persons with hearing impairments can also have difficulty assimilating auditory information that is presented at a rapid rate. They can use other sensory functions, such as seeing and touch, to obtain information.

Adverse environmental conditions such as noise (e.g., train stations, bars, restaurants) and voice messages in a foreign language can reduce audibility and present many of the same type of effects listed above for many persons.

7.2.3.3 Design considerations

Design considerations that can facilitate accessibility include the following:

- multiple means of information presentation such as visual (text or pictures) or tactile to supplement or substitute for auditory information;
- appropriate volume, pitch and frequency of spoken announcements, warnings and warning sounds in relation to context of use;
- adjustable volume over a wide range and with multiple frequencies;
- avoidance of sudden changes in volume of auditory signals;
- constant signal-to-noise ratio between the level of an announcement and that of the background noise;
- group assistive listening devices or communication systems such as induction loops, infrared or radio systems;
- emergency announcements that are visual with text, and where appropriate, in sign language, as well as of an appropriate volume and pitch decrease risk for persons with hearing impairment;
- a good acoustic environment, that reduces background sounds and promotes sound that is important to be heard;
- accommodation for and compatibility with relevant assistive products, assistive technology and supports.

NOTE – Assistive products, assistive technology and supports for persons with hearing impairments and deafness include sign language, communication assistants, assistive listening devices (ALDs), visual communications technologies, live captioning, telecommunications devices for the deaf (TDD/TTY), text telephones, speech recognition technology, alerting devices with visual signals or vibration, hearing aids (traditional hearing aids and/or implants).

7.2.4 Touch functions

7.2.4.1 Description

Touch functions (ICF: b265) relate to sensing surfaces and their texture or quality. Included are functions of being sensitive to temperature, vibration, shaking, or oscillation, superficial pressure, deep pressure, and other stimuli.

7.2.4.2 Impairments and limitations

Impairments and limitations due to reduced and/or distorted touch function can vary.

Effects of impairments and limitations include:

- reduced ability to feel the difference between objects, surfaces, textures, etc.;
- reduced ability to feel temperatures and noxious stimuli (e.g., sharp edges, corrosive substances);
- reduced ability to handle and manipulate objects and controls;
- reduced ability to use touch screens or similar types of control devices.

Persons with impairments of touch functions can rely on other sensory functions, such as seeing and hearing, to obtain information. Persons with hypersensitive touch can be injured by stimuli which might cause only discomfort to other people. Persons who lack touch sensitivity are more likely to be injured by stimuli such as sharp edges and extremely hot/cold surfaces than are people whose greater sensitivity to touch allows them to take action to prevent injury in the presence of such stimuli.

Adverse environmental conditions, such as low ambient temperature, can present many of the same type of effects listed above for many persons.

7.2.4.3 Design considerations

Design considerations that can facilitate accessibility include the following:

- multiple means of information presentation such as visual or auditory information to supplement or substitute for tactile information or biometric controls;
- multiple means of control such as eye and voice control, sensors and automatic or remote controls;
- avoidance of sharp and uneven points/edges/surfaces;
- avoidance of excessively hot or cold surfaces which can be touched (even inadvertently);
- distinctive form to facilitate identification of a product and its parts, which in turn can facilitate use/handling/assembly.

7.2.5 Taste functions and smell functions

7.2.5.1 Description

Taste (ICF: b250) relates to sensing five basic qualities, through receptors on the tongue: bitter, sweet, sour, salt and savouriness (umami). Smell (ICF: b255) relates to the use of receptors in the nose to sense odours and smells. The two senses of taste and smell are used together to identify the odours and flavours which can normally be distinguished.

7.2.5.2 Impairments and limitations

Impairments and limitations due to reduced and / or distorted taste and smell functions can vary.

Effects of impairments and limitations include:

- reduced ability to distinguish odours and flavours;

- reduced ability to identify dangerous or toxic substances such as detecting when food has deteriorated or hazards such as smoke.

Some persons with impairments or limitations of taste and smell functions rely on other sensory functions, such as seeing, hearing and touch, to obtain information.

Adverse conditions such as having a common cold can present many of the same type of effects listed above for many persons.

7.2.5.3 Design considerations

Design considerations that can facilitate accessibility include the following:

- multiple means of information presentation to supplement or substitute for information gained by taste and smell functions;
- information in labelling on ingredients, use by and expiration dates;
- visual and auditory signals to alert people to the presence of smoke or dangerous chemicals;
- information or labelling to warn about strong smell or taste;
- provision of minimal odours and taste, except where necessary (e.g., odours and taste are expected in foods).

7.3 Immunological system functions

7.3.1 Description

Immunological system functions (ICF: b435) of the body are related to protection against foreign substances, including infections, by specific and non-specific immune responses.

7.3.2 Impairments and limitations

Impairments related to immunological system functions such as allergies (immunological reaction to a substance) and hypersensitivities (non-specific response to a substance) vary and can cause reactions that range from mild or annoying to life-threatening. These impairments are generally divided into three categories: contact, food and respiratory. For the purposes of this clause, hypersensitivities related to chemicals in the physical environment are included.

Effects of impairments related to immunological system functions include reduced ability to tolerate exposure to, contact with, and/or ingestion of substance/s to which a body reacts. Such substances can act as barriers to the person's capacity to use systems.

7.3.3 Design considerations

Some design considerations that can facilitate accessibility include the following:

- avoidance of inclusion of allergens, sensitizing substances and chemicals known to cause hypersensitivities in products, foodstuffs and environments;
- appropriate information and labelling of ingredients/contents (including allergens, sensitizing and chemical substances known to cause hypersensitivities) in accessible format, the provision of this information being mostly subject to national or international regulation and which can include:
 - a list of ingredients,
 - a separate statement that declares any major allergens or sensitizing substances included, and
 - warnings such as information regarding any change in composition of significance related to allergens and sensitizing substances;
- ventilation systems that filter out respiratory allergens;

- prevention of mould growth, e.g., by controlling level of indoor humidity, and following appropriate cleaning routines;
- avoidance of dust-collecting furnishings in public areas;
- availability of "allergy-free" areas such as smoke-free and allergy-free rooms in hotels, and animal-free areas in public transportation.

7.4 Physical abilities and characteristics

7.4.1 General

Activity limitations can result from various characteristics and impairment of physical abilities and result from interacting with systems that do not facilitate accessibility.

Physical abilities and characteristics in this section include:

- body size (see clause 7.4.2);
- upper and lower body movement (see clauses 7.4.3 and 7.4.4);
- strength and endurance (see clause 7.4.5);
- voice and speech functions (see clause 7.4.6).

7.4.2 Body size

7.4.2.1 Description of human body size, shape and related needs

Human body size is represented by sets of anthropometric data values for mass (weight) and a range of static linear dimensions of people measured when standing, sitting, and with arms relaxed or outstretched (arm reach). Significant variability in human size exists across age and gender, and in different regions of the world.

Human body size and shape can also differ significantly across a range of impairments or disabilities such as; amputation, short stature, natural height of a human in an upright position, tall stature and obesity. Old age generally causes a decline in stature.

Different anthropometric values are not normally directly proportional (e.g., body shape and mass cannot be calculated from stature). Multiple interrelated human size values affect the considerations related to accessibility.

Requirements for additional space can be associated with the presence of accompanying persons, service animals (any guide dog, signal dog, or other animal trained to provide assistance to an individual with a disability), assistive products, assistive technology and equipment. Associated equipment that effectively increases human size can include products such as protective clothing, orthotics, personal mobility aids, a child's stroller, and luggage.

The range of dimension and mass values for the smallest and the largest people and their equipment that will be interacting with the system can be used to determine design requirements and recommendations related to size, space and load. Systems that do not accommodate the size, shape or mass of some people can be very inconvenient, potentially hazardous and can completely restrict access.

7.4.2.2 Impairments and limitations

Impairments and variations in body size and space requirements vary and can cause difficulties ranging from slight inconvenience to significant activity limitations. Effects of impairments and variations in body size and space requirements as associated with accessibility can include:

- reduced ability to move around and control or interact with systems due to impairments that affect body size or shape such as amputations, growth variations, and body orientations such as seated postures;
- reduced ability to reach, see, step on to or otherwise interact with systems due to very small or short body size and shape characteristics;
- reduced ability to access, fit comfortably or otherwise interact with systems and / or to move across distances due to very large or tall body size and shape characteristics;
- reduced ability to be present in an environment and interact with systems due to lack of additional space for necessary caregivers, service animals and / or equipment.

7.4.2.3 Design considerations

Design considerations for size, space and load capacities of systems that can facilitate accessibility include the following:

- additional space in built environments;
- space for clothing and personal protective equipment;
- multiple size offerings and / or adjustability;
- height clearance for tall persons;
- width clearance for large persons;
- step heights and reach distances for small persons;
- space for assistive products, assistive technology, service animals and accompanying persons;
- load capacities of system components appropriate for larger mass (weight) requirements;
- systems with a clear line of sight to important components for seated or standing users;
- systems with a comfortable reach to all components for seated or standing users;
- grip sizes in systems components that accommodate variations in user sizes and shapes.

7.4.3 Movement: Functions of upper body structures and fine hand use abilities

7.4.3.1 Description

Upper extremities (ICF: s730) structures include shoulder, upper arm, elbow, forearm and hand.

Fine hand use relates to dexterity and manipulation, and includes:

- picking up, grasping, manipulating and releasing objects and performing the coordinated actions of handling objects;
- picking up, manipulating and releasing objects using one's hand, fingers and thumb, such as when lifting objects off a table or turning a dial or knob.

7.4.3.2 Impairments and limitations

Impairments in movement-related functions of upper body structures can affect the person's balance, coordination, sensation, and movement of head, hands and body. Effects of impairments and limitations include:

- reduced ability to turn and bend objects and other impairments in range of motion of hands;
- reduced ability to bring thumbs and fingers close together or an inability to separate them very far;
- reduced ability in complex operations, such as pushing and turning objects;

- reduced ability in tasks that involve coordination and precision, such as opening packaging, dealing with fastenings, threading a needle;
- inadvertent or involuntary movement (e.g., tremor) that interferes with fine hand use;
- reduced ability to reach distant objects, or objects on the floor due to limited range of motion of shoulder joint and/or elbow joint;
- reduced ability to manage heavy or bulky objects due to weakness or musculoskeletal temporal injury in the upper body;
- reduced ability caused by use of non-dominant hand (left or right).

7.4.3.3 Design considerations

Design considerations that can facilitate accessibility include the following:

- manufacturing materials of lighter weight or lower density to reduce the weight of products;
- products shaped to facilitate easy grasping, lifting and carrying with either or both hands;
- manual controls that allow a comfortable grip, avoid the need for twisting of the wrist, and offer minimal resistance;
- controls that avoid the need to manipulate multiple controls at the same time;
- non-slippery surface that aids gripping and manipulating for people with limited dexterity;
- textured surfaces, to increase friction, and facilitate the application of force;
- design and spacing of controls that guard against inadvertent activation of a control other than the one intended;
- containers that allow easy opening and closing with reasonably low attainable operating force;
- simple and straightforward sequences for opening of packaging and assembling, installing or operating a product;
- avoidance of simultaneous double movements, e.g., pushing and twisting;
- alternative controls for accommodation of upper body movement impairments.

NOTE – When accurate positioning of an object is required, consideration is taken so that the hand(s) can hold it properly and comfortably with a clearly perceived spatial orientation (taken from ISO/TR 22411:2008^[Ref-11], 7.3.1.1).

7.4.4 Movement: Functions of lower body structures

7.4.4.1 Description

Lower extremity (ICF: s750) structures include:

- hip, thigh, knee, lower leg, ankle and foot.

Movements of lower body structures include:

- maintaining and changing the body position and transferring oneself from one area to another;
- walking, climbing stairs, and moving around which might involve using any equipment and/or assistive products such as wheelchairs or walkers;
- moving objects with lower extremities such as pushing and kicking.

7.4.4.2 Impairments and limitations

Impairments in movement-related functions of lower body structure can affect a person's balance, coordination, sensation, and movement of body, thigh, leg, ankle and foot. Effects of impairments and limitations include:

- reduced ability to walk, move around, climb stairs or ladders, and transfer from one place to another;
- reduced ability to drive or otherwise make use of transportation means;
- reduced ability to control the body when turning, bending, or maintaining balance;
- difficulty in kneeling, sitting down, rising, standing, walking, and /or climbing stairs or ladders;
- reduced ability to perform coordinated actions aimed at moving objects by using legs and feet;
- increased potential for slipping, tripping, or other balance disturbances that can cause falls;

NOTE – Balance disturbances sometimes require rapid responses in joint rotations and limb movements, placing extraordinary demands on the balance control system. Even very small bumps and protrusions can cause tripping. Impairments in vestibular nerve function can also cause disturbances to balance.

- an increased fear of falling due to balance impairment.

Adverse conditions such as wearing shoes that are heavy or have slippery soles or high heels can impair movement.

7.4.4.3 Design considerations

Design considerations that can facilitate accessibility include the following:

- slip-resistant, threshold-free layout, e.g., in buildings and paved outdoor environments;
- avoidance of sudden changes in surface level, obstacles, bumps or protrusions;
- equipment, such as elevators and other lifting systems;
- ramps with appropriate slopes and adequate space to allow for approach and manoeuvring, and use of wheelchairs, walking frames, or walking aids;
- stairs with appropriate dimensions and banisters or hand grips alongside;
- ample time for persons with mobility limitations to pass through automatic doors and to use pedestrian crossings.

7.4.5 Muscle power and muscle endurance

7.4.5.1 Description

Muscle power (ICF: b730) functions relate to the force generated by the contraction of a muscle or muscle group.

Muscle endurance (ICF: b740) functions relate to sustaining muscle contraction for the required period of time.

Related activities include lifting and climbing that can involve whole body functions.

7.4.5.2 Impairments and limitations

Impairments in muscle strength in the body can have a considerable impact on activities of daily living and on the quality of life. Effects of impairments and limitations include:

- reduced muscle power and endurance;
- reduced grip strength making it difficult or painful to operate a system against resistance or torque;
- fatigue when use of a system requires prolonged activity;
- reduced control of passive movement (i.e., when an external force such as gravity causes the motion) resulting in difficulties, e.g., lowering a heavy object to the ground or sitting down on a chair.

Adverse conditions, such as slippery or uneven surfaces, wearing shoes that are heavy, have slippery soles or high heels, present many of the same type of effects listed above for many persons.

7.4.5.3 Design considerations

Design considerations that can facilitate accessibility include the following:

- use of power grip (whole hand) which requires less effort than pinch grip (between thumb and index or middle finger);
- appropriate handling characteristics (e.g., size and weight) for systems that involve lifting, holding, carrying or opening;
- avoidance of long handling time and unnecessary repetition of operations;
- avoidance of long service lines that cause people to stand unsupported for long periods of time;
- alternative means of control in vehicles to accommodate lower body movement.

7.4.6 Voice and speech

7.4.6.1 Description

Voice relates to the sound produced by the vocal organs, usually as speech (ICF: s398).

The voice function (ICF: b310) comprises a variety of aspects such as articulation, volume, fluency, speed, melody and rhythm.

Impairments include voicelessness (aphonia), defective use of the voice (dysphonia), rough and harsh voice (hoarseness), stammering and stuttering.

Related activities include speaking and conversing.

7.4.6.2 Impairments and limitations

Impairments in voice and speech can affect a person's ability to communicate and convey information with speech. Effects of impairments and limitations include:

- reduced social interaction;
- reduced participation in activities;
- reduced ability to interact with systems that use voice input.

Adverse environmental conditions, such as high levels of ambient noise, can present the same type of effects.

7.4.6.3 Design considerations

Design considerations that can facilitate accessibility include the following:

- alternative forms of communication such as via text, facial expressions, hand movements or signs, body postures, and other forms of body language;
- augmentative and alternative communication based on symbols, aids, techniques, and/or strategies;
- support for the use of assistive products such as speech synthesizers and communication amplifier and video communication;
- provision of alternative means to interact with interactive voice systems and intercom systems, such as real-time text.

7.5 Cognitive abilities

7.5.1 Description

Cognition is the understanding, integrating and processing of information which includes abstraction, organization of ideas, reasoning, analysis and synthesis (ICF: b164). Cognition is complex and dependent on a number of mental functions (ICF: b1) including:

- 1) global mental functions such as intellect, consciousness, energy and motivation;
- 2) specific mental functions, such as
 - perception (ability to recognize and interpret stimuli),
 - attention (ability to sustain, shift, divide, and/or share attention),
 - learning,
 - memory (ability to register, store and/or retrieve information as needed),
 - language (ability to produce and understand),
 - reasoning,
 - problem solving,
 - decision making, and
 - reading;
- 3) affective (emotional) functions.

7.5.2 Impairments and limitations

Impairment of global mental, specific mental and/or affective function (listed above) can occur and cause limitations for any person including those with average and high intellectual functioning.

Cognitive impairments can be related to limitations such as reduced capacity to carry out activities and/or difficulties with social participation.

Impairments and related limitations can affect:

- ability to plan, initiate, carry out and terminate activities;
- ability to organize thoughts and activities;
- ability to sustain attention, concentrate on important stimuli/information and ignore distractions;
- ability to multi-task (i.e., to divide attention among several operations, tasks or individual task elements);
- ability to maintain skills (e.g., how to drive a car);
- speed in performing tasks/activities and in responding in a timely manner;
- ability to store and retrieve information (e.g., remember episodes in relation to time, recall facts);
- ability to perceive information (e.g., accurate and fluid word recognition);
- ability to learn;
- ability to make generalizations and associations;
- ability to solve problems including recognizing the problem, identifying, choosing and implementing solutions, and evaluating outcomes;
- ability to understand and/or express oneself (e.g., comprehension, communication, speech, fluency, writing, repetition, naming, signs, symbols);
- capacity for self-control and self-motivation (including increased irritability, rigidity, lower stress tolerance, confusion, disorientation, anxiety, loneliness and depression);

- preference for different learning or information understanding styles such as text-based vs. graphics-based styles.

Adverse environmental conditions, such as high levels of environmental stimuli (e.g., flashing lights, crowds of people), can overwhelm or confuse many persons and present the same type of effects listed above for many persons.

7.5.3 Design considerations

Design considerations that can facilitate accessibility include the following:

- information about time and place;
- schedules, structures, signals to indicate start and termination of activities;
- an overview that informs the user what to expect before providing any details;
- appropriate feedback/cues/reminders that hold the user's attention and give support through a process;
- feedback that is adjustable to the needs and preferences of users;
- environments and presentations that are stimulating but also avoid distractions;
- systems and procedures that adapt to individual situations, abilities and preferences;
- similar arrangement/layout and design of feedback and control logic on products of a similar type;
- similar design of feedback and control logic on products of a similar type;
- error-tolerant operating sequences;
- flexible time period for assimilation of information and response;
- simple and straightforward sequences for opening of packaging and assembling, installing or operating a product;
- information provided in multiple formats, e.g., text is read out, diagrams are provided in addition to text;
- information and instructions that are easy to understand in the language of the user;
- explicit information on expectations placed on the user;
- systems that can be used (as far as possible) without an instruction manual;
- procedures that facilitate learning (learning by doing is generally easier than memorizing instructions, repetitions);
- multiple means of information presentation (e.g., text is read out, widely recognized symbols);
- emergency evacuation routes designed so that they are intuitive and easy to follow which clearly designate any alternative routes that accommodate for persons with disabilities;
- accommodation for/compatibility with relevant supports and assistive products and assistive technology.

NOTE – Examples of assistive products, assistive technology and supports for persons with cognitive impairments are assistants, computers with dedicated computer software, hand-held computers and tablets. Design considerations that accommodate persons with varying cognitive impairments are also advantageous for most people because they reduce cognitive load (e.g., facilitate memory, decrease errors, and facilitate solving complex problems).

8 Strategies for addressing user accessibility needs and design considerations in standards

8.1 General

Whether standards developers identify user accessibility needs using the accessibility goals approach or design considerations using the human abilities and characteristics approach, these needs and considerations can be translated into specific accessibility requirements and recommendations in standards. This clause provides eight strategies that standards developers can apply in order to write specific accessibility requirements and recommendations in standards.

The strategies represent the potential means by which a specific identified user accessibility need or design consideration might be met. Standards developers should consider and select the strategy or strategies that can best be applied to transform the needs and considerations into requirements and recommendations given the context and particulars of the standard they are developing. In some instances multiple strategies will be needed to meet a single identified user accessibility need or design consideration, and sometimes the application of a single strategy will be able to address multiple needs or considerations. Furthermore, these strategies are applicable to the design of user interactions, tasks and activities, as well as to the design of the system itself. The strategies presented are those widely used to address user accessibility needs and design considerations, and do not constitute an exhaustive set.

Following the presentation of each strategy are one or more examples describing requirements/recommendations that might result from the application of that strategy in a particular standard's context. These examples are for illustrative purposes only and are not intended to represent guidance that exists in actual standards. In practice, standards differ widely in the depth and level of detail of their requirements and recommendations.

8.2 Developing standard-specific requirements and recommendations based on user accessibility needs and design considerations

8.2.1 Provide multiple means of information presentation and user interaction

8.2.1.1 General

Consider using more than one means of presentation by which users can perceive the same information and multiple means by which users can interact with the system to achieve a given objective, whether it is to perform a task, engage in an activity, or to obtain or use a service.

8.2.1.2 Provide multiple means of information presentation

Providing more than one means of presentation by which users can perceive the same information entails 1) presenting information via more than one sensory modality (as in Example 1 below) and/or 2) providing information in more than one form within the same sensory modality (as in Example 2 below). This basic strategy is sometimes called alternative formats. Thus, the same information might be provided to users through the auditory and the visual senses, the visual and the tactile senses, or the auditory and the tactile senses. In some less common instances, other sensory modalities (e.g., taste, smell) can be used in combination with visual, auditory or tactile senses.

EXAMPLE 1 A standard for paging systems could require that the pager signal be presented through the vibration of the pager as well as through an auditory or visual display.

EXAMPLE 2 A standard for video recorder instruction manuals could require that a visual illustration of a video recorder and its controls be provided, along with a textual description of the same information.

8.2.1.3 Provide multiple means of user interaction

It is important that people have more than one way to complete a task or activity or to interact with a system to achieve the same objective(s). Standards developers can specify in their standards that these multiple means be provided.

EXAMPLE 1 A software standard could require that the user be able to enter data into the system using a keyboard or voice input, with both options being available.

EXAMPLE 2 A standard for a home appliance could require that users be able to operate the controls of the appliance with either the right or the left hand. The controls are to be oriented to be equally usable by either hand.

EXAMPLE 3 A customer service standard could require that users be able to initiate contact with customer service via either a telephone call or an e-mail message.

EXAMPLE 4 A building standard could specify that both stairs and an elevator be provided by which users can move from one level of a building to another.

8.2.2 Set fixed parameters to accommodate the widest range of users

When there is a need to fix a design parameter at some value, for example the minimum door width in a public building, consider setting that value so that it minimizes the number of people whose accessibility might be limited by it.

Many design parameters can only be set to one specified value. There can only be one width for a conventional door in a given building, for example, and the weight of a given consumer product like a tablet computer has a specific value. In these cases standards developers should consider whether the chosen value for the design parameter is the best choice in order to accommodate the widest range of users.

Finally, it is desirable to question whether a design parameter being considered as fixed could actually be adjustable to meet more accessibility needs, as illustrated in Example 3 below.

EXAMPLE 1 A standard's requirement for an auditory signal for a laundry dryer to indicate that the laundry is dry could mandate that the signal be composed of multiple frequencies with the centre frequency between 400 Hz and 2 000 Hz. The standards developer has considered whether this specification is appropriate for meeting the need for the widest range of users to be able to hear the signal.

EXAMPLE 2 A public building standard specifies a suitable minimum door width to accommodate the passage of large persons and/or wheelchair users.

EXAMPLE 3 In health care, examination tables in clinics often have a fixed height. Having evaluated the user accessibility needs and design considerations from the patient and the examiner perspective, the standard developer recognizes that examination tables need to be height-adjustable. In this case, what was a fixed design parameter becomes an adjustable parameter, and requirements in the standard are written to reflect that.

EXAMPLE 4 A postal service standard could limit the weight of packages for delivery (e.g., to 18 kg, rather than 27 kg), so that a greater percentage of postal workers will be able to lift and carry any package that is sent.

8.2.3 Set adjustable parameters to accommodate the widest range of users

Consider whether the range of adjustability for adjustable parameters is sufficient to enable access for the largest number of users.

Providing adjustability is one of the strategies most commonly used for addressing some accessibility needs, particularly when those needs vary widely with respect to a particular design parameter.

EXAMPLE 1 An automobile's control for forward/backward seat adjustment is designed so that drivers with the shortest and longest legs can be comfortably accommodated, as well as people who require additional space between their spine and the steering wheel.

EXAMPLE 2 The range of volume settings provided for a set of headphones can accommodate as many hearing disabilities as possible.

8.2.4 Minimize unnecessary complexity

8.2.4.1 General

The greater the complexity of user tasks and activities and the systems with which those tasks are performed, the more likely it is that some people will experience accessibility problems, and the more likely they will be to make errors that prevent them from achieving their objectives. There are cases in which complexity is necessary, and also cases in which complexity is desirable. Nevertheless, it is important to simplify and streamline many designs to eliminate unnecessary and/or undesirable levels of complexity to enable the greatest number of people to perform tasks, to access and receive services, and to use products and navigate or otherwise use the built environment. It is also important that complex systems with many features are designed so that they do not obscure basic system functionality.

There are many aspects of design that affect overall complexity, and thus many means (i.e., "sub-strategies") that can be considered by standards developers for reducing unnecessary complexity, as illustrated below.

8.2.4.2 Simplify the language

Systems involving user instructions that employ jargon, poor sentence construction, and terminology that exceeds the language comprehension of the user can interfere with users' understanding and use of the system. Using well-constructed sentences and commonly used vocabularies, as well as avoiding jargon, will increase accessibility.

EXAMPLE A standard about the design of instructional materials for home appliances specifies that all instructional materials should be written at the reading level of a 12-year-old child.

8.2.4.3 Simplify the performance requirements of user activities and tasks

Systems that require users to perform long sequences of steps to accomplish a task, and require that those steps be executed in a particular order, increase the chance of errors and decrease the chance that some users will be able to achieve their objectives. When unnecessary steps can be eliminated or when users have flexibility in executing steps (such as pausing or saving and resuming later) accessibility can be increased.

NOTE – Sometimes this strategy can involve re-allocating certain task steps or activities to technology to execute.

EXAMPLE A standard for cellular phones specifies that the cellular phone user should be able to initiate a call simply by saying the name or touching the name or picture of the person as displayed in the contact list. This eliminates the task of entering the phone number when making a call, which can be problematic for people who have difficulty correctly reading and remembering phone numbers, as well as for those who have difficulty with physically entering the numbers on the phone.

8.2.4.4 Ensure that basic functionality is easily accessible

An accessibility problem can occur when optional features are implemented in such a way that they obscure the basic functionality of the system. In that case, they can become a barrier to the access and use of the primary system functionality intended. A way of avoiding this problem is to ensure that the basic system functionality is easily accessible and usable — i.e., it is not obscured by the optional

features that only serve to distract or confuse some users. There are many ways in which this strategy can be applied in practice, some of which can involve the use of other strategies introduced in this clause.

EXAMPLE A A standard for the design of consumer product instructions requires that instructions regarding the use of the basic functionality be presented first, while discussion of optional or advanced features is contained in a later section, clearly separated from those for the primary system functionality. For complex products, it also specifies that a "Quick Start" guide be provided, addressing only the basic operation of the product.

8.2.4.5 Provide unambiguous options for using information and making decisions

Decisions can be difficult for users if they do not understand the options available at any given point in a task or activity and at any point during the use of a system. Supporting users in their use of information and in decision-making will help to increase accessibility and ensure that all users can achieve their objectives. Nonverbal means of communication (audio, video, icons etc.) should be provided.

EXAMPLE 1 A standard for voice messaging systems specifies that the system should provide a feature that allows users to query the system at any point about the options that are currently available to them in the system.

EXAMPLE 2 A hospital design standard includes specific requirements for visual and tactile markings intended to guide visitors to the major departments within a hospital.

8.2.5 Provide individualized access to a system

Individualization involves meeting user accessibility needs as determined by an individual user. Using this strategy ensures that an individual's specified needs are met. In order to do this, the individual's specific needs must be identifiable. Systems that are controlled by or have embedded information and communication technologies (ICT) lend themselves particularly well to individualization because of the relative ease of access to an individual's requirements (which might be stored or accessed electronically) and the ease of adaptability of many such systems. Many services can also be easily individualized where individual user accessibility needs can be identified.

Reasons to adopt this strategy include personal security, confidentiality, commercial convenience, preservation of dignity or conflicting individual needs.

EXAMPLE 1 A standard relating to a tablet operating system specifies a data model format for storing a set of individual accessibility preferences in the cloud so as to enable use of the same set of preferences on multiple devices.

EXAMPLE 2 A university learning management system delivers online educational content matched to each individual learner's accessibility preferences and the characteristics of the device on which the content is being delivered at the time. The system follows a national standard that specifies that learning content must meet an individual's needs and preferences represented in a format that is specified by a particular international standard for preferences.

EXAMPLE 3 A standard specifies how a credit and debit card payment system can identify and access accessibility preferences stored separately from the card. This enables devices such as automatic teller machines and payment terminals to adapt to the same set of individual preferences in different contexts of use. Another part of the same standard specifies how a set of accessibility preferences can be created, edited and stored.

EXAMPLE 4 A quality standard relating to the provision of support services stipulates that a college administration system should make bookings for sign-language interpreters for particular students for particular lessons and transcription services that provide a written record of what the lecturer said. Where possible interpreters are matched to individual students to provide continuity. It

recommends that transcription should be provided where individual user accessibility needs require it.

8.2.6 Eliminate unnecessary limits or constraints on user interactions with a system

People engage in tasks and activities in different ways. By limiting the ways in which a user can engage or interact with a system, accessibility can be decreased or even made impossible for some users. One of the most frequently encountered, and often unnecessary, types of design constraints is the constraint on the time a user has to complete a task or activity. Everyone does not do things at the same pace, and standards developers can consider removing time-based constraints as a means of increasing accessibility. Systems that allow users to extend the time available can increase accessibility.

Other types of constraints also exist (e.g., space constraints, knowledge-based constraints) that standards developers can consider eliminating if it would increase accessibility for users.

EXAMPLE A A standard on phone-based customer service requires account numbers to be entered using a telephone keypad. The standard does not limit the amount of time the user has to enter the account number, but specifies that the software will continue to process keystrokes until the entire account number is entered, regardless of the pace of those keystrokes.

8.2.7 Provide compatibility with assistive products and assistive technology

In situations in which users might need to use assistive products and assistive technology to access a system, the responsibility of standards developers is to ensure that the system provides compatibility with commonly used assistive products and assistive technology so that users can achieve their goals.

EXAMPLE 1 A standard for a software product specifies that all information presented by the application shall be available to screen-reading software.

EXAMPLE 2 A hospital building design standard specifies which areas of the hospital shall be wheelchair-accessible.

8.2.8 Provide alternative versions of a system

Although it is highly likely that companies will have made decisions about alternative versions of a system (called product lines in some contexts) long before standards are written, they may not have done so based on accessibility considerations. It is quite possible that the standard development activity itself will identify the need for a revision of the design or, as a last resort, an additional version of the system based on accessibility considerations. Thus, this strategy is included here and can be considered by standards developers who are addressing user accessibility needs or design considerations that have not been identified or met during the design process. Obviously, the strategy itself can only be implemented by designers, and the standards developers' role is to identify the need for a design approach to enhance accessibility and to provide to those responsible for design the appropriate guidance to undertake it.

EXAMPLE A A standards committee recognizes during the context of producing a standard on gardening tools that the accessibility needs of people with relatively small hands are not being well met by the design of the gardening tools currently available. In considering how best to address this, the committee decides that an alternative product line is the best and perhaps only way to resolve the issue because of the large differences in the relevant hand dimensions that exist in the user population.

Annex A

(informative)

Global trends supporting accessibility

A.1 General

Significant changes have occurred during the past few decades related to how disability and accessibility are understood and represented. In response to the world's ageing population and global consumer markets becoming increasingly diverse, various models of disability have been created, as well as new laws and regulations, policies, standards and design trends.

A.2 Trends in global demographics and market diversity

According to the *World Report on Disability* (published by the World Health Organization and the World Bank in June 2011, ^[Ref-40]) approximately 15% of the world population (over one billion people) has some type of temporary or permanent disability, and 80 % of these individuals live in developing countries. There are often barriers that prevent individuals from participating fully in society.

With an ageing population, the demand for accessible and usable systems is increasing. In addition, global markets composed of users from different countries, regions, cultures and races make it a necessity to consider users' varying abilities and characteristics, different knowledge bases and expectations in the design of various systems. The requirements for accessibility of systems as perceived and experienced by users is a key driver in system design and development.

A.3 Models of disability

The world's changing attitudes to disability and accessibility have been reflected in the "models of disability" created in the past few decades.

The earliest model was the "medical model," which described disabilities with reference to the medical conditions they were seen to arise from. The focus of disability management was on professionals curing or treating the underlying condition.

Another model, developed in response to the medical model was the "social model" of disability. This revolutionized the understanding of disability by arguing that it was not mainly caused by impairments but by the way society was organized and responded to people with disabilities. In the social model, disability is the product of the physical, organizational and attitudinal barriers present within society.

These models informed the development of the "human rights model" of disability, which typically expressed a moral and political commitment that countries, states and organizations should take with regard to persons with disabilities.

A.4 Trends in regulatory frameworks and governmental policies and standards

The *United Nations Convention on the Rights of Persons with Disabilities* (UNCRPD^[Ref-36]) is the basic international framework addressing the rights of persons with disabilities. The Convention had been signed by end 2014 by 159 States Parties and ratified into national law by 151 States Parties, making progress towards increasing the accessibility of public facilities and services a national obligation.

Partly in response to the UNCRPD, in many countries government procurement rules require that products and services meet certain accessibility requirements as a precondition to qualify to

participate in public procurement. These government measures contribute to the growing size of the market for accessible products and services. The UNCRPD, (in Article 4 (f) General Obligations) promotes Universal Design in the development of standards and guidelines for goods, services, equipment and facilities.^{[Ref-36],[Ref-37]}

Considered globally there is a general trend away from national approaches to accessibility that classify and separate people with disabilities towards more integrated international approaches that recognize users as individuals who have a variety of unique needs. This is demonstrated by the development of initiatives to devise cohesive approaches to accessibility that are inclusive such as W3C Web Content Accessibility Guidelines,^[Ref-38] *Section 508 of the Rehabilitation Act*,^[Ref-35] the work of the ISO/IEC JTC 1 *Special Working Group on Accessibility*,^[Ref-26] Mandates 376, 420 and 473 in Europe^[Ref-29] and many others, including this guide.

A.5 Trends in design

Universal Design and similar concepts (such as: inclusive design and design for all) refer to making systems usable to the widest possible range of users. These concepts go beyond concepts such as barrier-free design, by removing differentiations between persons with and without disabilities and including all persons as potential users within a diverse population. It is the intent of these concepts that "mainstream" systems be usable by as many persons as possible (although this does not mean that all users can be expected to use a system in the same manner).

These concepts recognize that human beings can benefit from accessible systems in various contexts throughout their lives. Features that make products and services usable for persons with disabilities can also make them convenient and easy to use for everyone else. This is particularly helpful when people have temporary difficulties, such as lost glasses, a broken leg or a journey with a pram/stroller or bulky luggage. Increased accessibility and usability often result, therefore, in better products and services for all.

NOTE – There are minor distinctions between what each of these terms mean to the many people and organizations worldwide that use them. However, in recent years terms such as Universal Design, accessible design, design for all, barrier-free design, inclusive design and trans-generational design are often used interchangeably with the same meaning.

Annex B

(informative)

The International Classification of Functioning, Disability and Health (ICF) as a resource for terminology

B.1 Function of the ICF as a resource for terminology

Terminology and associated reference codes from the *World Health Organization's International Classification of Functioning, Disability and Health (ICF) 2001*^[Ref-39] are used in parts of this guide to describe human abilities and characteristics. The ICF classification provides a resource for terminology that can be used in some parts of standards.

ICF terminology is used across broad sectors including health, disability, rehabilitation, community care, insurance, social security, employment, education, economics, social policy, legislation and built environment design and modification.

B.2 ICF resource tools

Standards developers new to the ICF can find Introduction and User Guide resources at the following websites to begin using the ICF. The "ICF Browser" is a word search tool that can be used to view terminology for use in standards.

An ICF Introduction and User Guide tutorial is available at: "ICF Illustration Library"

http://www.icfillustration.com/icfil_eng/top.html

A word search tool to locate ICF terms and codes is available at: "ICF Browser":

<http://apps.who.int/classifications/icfbrowser/>

The ICF Browser search tool can also be found from the World Health Organization main website at: www.who.int

B.3 ICF components terminology and reference codes

The definitions of the ICF component terms and their reference code letters are:

- **Body functions** ('b') are the physiological functions of body systems (including psychological functions).
- **Body structures** ('s') are anatomical parts of the body such as organs, limbs and their components.
- **Activity** ('d') is the execution of a task or action by an individual.
- **Activity limitations** are difficulties an individual may have in executing activities.
- **Participation** ('p') is involvement in a life situation.
- **Participation restrictions** are problems an individual may experience in involvement in life situations.
- **Environmental factors** ('e') make up the physical, social and attitudinal environment in which people live and conduct their lives.
- **Impairments** are problems in body function or structure such as a significant deviation or loss.

ICF reference code letters are followed by a series of code numbers for ICF components. Each additional digit in an ICF code number indicates a more detailed sub-category level of information in the ICF classification. An example of a general ICF category is "b2 Sensory Function" and a sub-category would be "b230 Hearing Function".

B.4 Human abilities and characteristic terms to use as search terms in the ICF

Table B.1 below provides a list of abilities and characteristics terms used in parts of this guide that align with a list of terms that can be used in the "ICF Browser" search box to help to find terminology used in the ICF.

Table B.1 – Human abilities and characteristics in Guide 71 and search terms to use in ICF Browser

Abilities and characteristics terms used in Guide 71	Search terms to enter in the "ICF Browser" search box at: http://apps.who.int/classifications/icfbrowser/
Sensory abilities	Sensory
Seeing function b210	See, Vision, Eye, Watching, Communication
Hearing function b230	Hear, Ear, Sound, Listen, Communication
Touch functions b265	Touch, Skin, Tactile, Vibration, Pressure
Taste and smell b250/255	Taste, Smell, Tongue, Sensing, Odours
Immunological system b435	Immune, Allergic, Sensitivity, Substance
Physical abilities	Structures, Functions
Body size	Neuromusculoskeletal, Weight, Space
Upper body s730	Movement, Joints, Arms, Hand, Reach
Lower body s750	Movement, Mobility, Muscle, Foot, Walk
Strength/Endurance b730	Movements, Muscles, Endurance,
Voice and speech b398/310	Voice, Speech, Pitch
Cognitive abilities	Mental Functions
Global mental b110–139	Orientation, Intellectual, Personality, Energy
Specific mental b140–189	Attention, Memory, Perception, Language

B.5 Additional resources other than the ICF for terminology reference frameworks

When the ICF does not provide appropriate terminology to describe concepts in a standard, the literature suggests considering the following international reference frameworks for terms about personal factors or the built environment:

Terms to describe personal factors can be found in the *Systematized Nomenclature of Medicine - Clinical Terms* (SNOMED-CT), available at: <http://www.ihtsdo.org/snomed-ct/>.

Terms to describe components of the physical and built environment can be found in the frameworks, OmniClass^[Ref-33] and UniClass,^[Ref-34] available at: <http://www.omniclass.org/background.asp>.

Annex C (informative)

Questions to aid in achieving the accessibility goals

Table C.1 provides a checklist to aid standards developers in asking, answering and applying the various questions related to the accessibility goals from clause 6. The questions from clause 6 appear in the left column, entitled "Question". The middle column, entitled "Answer", can be used to record the answer to each of these questions and can include sources that have led to these answers. The right column, entitled "Clause(s)/subclause(s) of deliverable", is used to record the particular sections of the deliverable that would be affected by the answers to the questions.

NOTE – The term "deliverable" is used to describe all types of documents that are produced taking into account the accessibility goals in this clause, such as standards, technical specifications, technical reports, publicly available specifications, guides, ITU Recommendations or workshop agreements.

Table C.1 – Checklist for the questions related to the accessibility goals

Question	Answer	Clause(s)/subclause(s) of deliverable
6.2.1.5 a) Who are the potential users of systems that will be addressed by or who relate to this deliverable?		
6.2.1.5 b) Which potential users, if any, might be excluded by the requirements and recommendations of this deliverable?		
6.2.1.5 c) What are all the contexts of use in which systems that relate to this deliverable could be used?		
6.2.1.5 d) Which contexts of use might be excluded by the requirements and recommendations of this deliverable?		
6.2.2.5 a) What are the expectations / user experiences of the diverse users of systems that relate to this deliverable?		
6.2.2.5 b) Is there any available information on frustrated or confirmed user expectations with products affected by deliverables in this domain?		
6.2.2.5 c) What conflicts with potential user expectations could result from using this deliverable?		

Table C.1 – Checklist for the questions related to the accessibility goals

Question	Answer	Clause(s)/subclause(s) of deliverable
6.2.2.5 d) What new user expectations will be created by using this deliverable?		
6.2.3.5 a) What aspects of user interaction with systems that relate to this deliverable should the user be able to individualize?		
6.2.3.5 b) What aspects of user interaction with systems that relate to this deliverable could present barriers for some users if they cannot be individualized?		
6.2.3.5 c) What recognized or innovative sets of individual options or preferences could be recommended by the deliverable for potential implementation within systems?		
6.2.3.5 d) How could the context in which the deliverable is used affect the identified individual options or preferences that are needed?		
6.2.4.5 a) How could this deliverable ensure that resulting systems that relate to this deliverable can be physically and psychologically approached by diverse users so that they can perform their tasks?		
6.2.4.5 b) How could this deliverable ensure that systems that relate to this deliverable be remotely approached by diverse users to perform their tasks?		
6.2.4.5 c) How could this deliverable avoid limits to physical, psychological or remote approachability for diverse users in diverse contexts of use?		
6.2.5.5 a) Within the scope of this deliverable, what information should be presented by systems to users?		
6.2.5.5 b) How could this deliverable ensure that diverse users in diverse contexts can perceive the information		

Table C.1 – Checklist for the questions related to the accessibility goals

Question	Answer	Clause(s)/subclause(s) of deliverable
presented in systems that relate to a deliverable?		
6.2.5.5 c) How could this deliverable limit the modalities that a system uses to present information to users?		
6.2.6.5 a) For systems within the scope of this deliverable, what information and functionalities should be presented that would need to be understood by users?		
6.2.6.5 b) How could this deliverable assist in ensuring that the information and functionalities of the system are understandable for diverse users?		
6.2.6.5 c) How could this deliverable support diverse users to learn how to use the information and functionalities of systems that relate to it?		
6.2.6.5 d) How could this deliverable ensure that systems avoid making unnecessary cognitive demands on potential users?		
6.2.7.5 a) For systems within the scope of this deliverable, what control actions should users need to be able to initiate and complete?		
6.2.7.5 b) How could this deliverable ensure that diverse users in diverse contexts of use are able to initiate and complete the actions that are required to accomplish their tasks?		
6.2.7.5 c) How could this deliverable avoid limiting the modalities that a user can use to initiate and complete the actions that are required to accomplish their tasks?		
6.2.8.5 a) How could a system that relates to this deliverable assist diverse users in diverse contexts to effectively accomplish their tasks?		

Table C.1 – Checklist for the questions related to the accessibility goals

Question	Answer	Clause(s)/subclause(s) of deliverable
6.2.8.5 b) How could a system that relates to this deliverable assist diverse users in diverse contexts to accomplish their tasks in a manner that is efficient to each of them?		
6.2.8.5 c) How could a system that relates to this deliverable assist diverse users in diverse contexts to accomplish their tasks in a manner that is satisfactory to each of them?		
6.2.8.5 d) How could a system that relates to this deliverable avoid limiting the usability of the system for some users?		
6.2.9.5 a) How could a system that relates to this deliverable assist in minimizing the adverse consequences of errors?		
6.2.9.5 b) How could a system that relates to this deliverable assist in preventing errors?		
6.2.9.5 c) How could a system that relates to this deliverable assist in minimizing errors?		
6.2.9.5 d) How could this deliverable assist the resulting system in enabling users to recover from errors?		
6.2.10.5 a) How could a system that relates to this deliverable ensure that diverse users can interact with the system in an identical or equivalent manner?		
6.2.10.5 b) Are there elements of the system that some users might not be able to interact with in an identical or equivalent manner?		
6.2.10.5 c) How could systems that relate to this deliverable segregate, stigmatize or discriminate against some users?		
6.2.10.5 d) Will requirements and recommendations in this deliverable promote social		

Table C.1 – Checklist for the questions related to the accessibility goals

Question	Answer	Clause(s)/subclause(s) of deliverable
integration by treating all groups with equal or equivalent access?		
6.2.11.5 a) How could this deliverable ensure that diverse users can utilize their own assistive products or assistive technology (when needed) with any system that relates to it?		
6.2.11.5 b) How could this deliverable avoid limiting the ability of users to utilize their own assistive products or assistive technology (when needed) with any system that relates to it?		
6.2.11.5 c) How could this deliverable ensure that the systems that relate to it will be compatible with other systems across a range of contexts of use to facilitate accessibility by diverse users?		

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