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Ergonomics of human-system interaction —

Part 11:
Usability: Definitions and concepts

Ergonomie de l'interaction homme-système —

Partie 11: Utilisabilité — Définitions et concepts

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Foreword

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

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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

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

This second edition cancels and replaces the first edition (ISO 9241-11:1998), which has been technically revised.

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

— the scope has been extended to include systems and services (consistent with other parts of ISO 9241 including ISO 9241-210, and with ISO 26800 and ISO 20282);

— a wider range of goals is considered, including personal outcomes and organizational outcomes;

— *efficiency* has been defined in relation to the results achieved rather than in relation to accuracy and completeness with which users achieve goals.;

— *satisfaction* has been clarified to include a wider range of issues.

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

Introduction

The objective of designing and evaluating systems, products and services for usability is to enable users to achieve goals effectively, efficiently and with satisfaction, taking account of the context of use. This document explains how usability can be interpreted in terms of user performance and satisfaction, and emphasizes that usability is dependent on the specific circumstances in which a system, product or service is used.

This document explains how to interpret each component in the definition of usability: "the extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use".

NOTE 1   In this document, usability relates to the outcome of interacting with a system, product or service. Usability, as defined in this document, is not an attribute of a product, although appropriate product attributes can contribute to the product being usable in a particular context of use.

NOTE 2   Usability is a more comprehensive concept than is commonly understood by "ease-of-use" or "user friendliness".

Usability is relevant to:

— regular ongoing use, to enable users to achieve their goals effectively, efficiently and with satisfaction;

— learning, to enable new users to be become effective, efficient and satisfied when starting to use a system, product or service;

— infrequent use, to enable users to be effective, efficient and satisfied, with the system on each reuse;

— use by people with the widest range of capabilities;

— minimizing the risk and the undesirable consequences of use errors; and

— maintenance, in that it enables maintenance tasks to be completed effectively, efficiently and with satisfaction.

Usability is relevant when designing or evaluating interactions with a system, product or service for the purposes of:

— development;

— procurement;

— review or comparison; and

— marketing and market research.

Annexes A and B in this document give an explanation of the relationship of usability to other concepts and disciplines such as human-centred design, ergonomics, human factors, human-centred quality, user experience and quality (as used in systems and software engineering), and explain how usability can be considered for different scopes of contexts of use and provide examples of usability measures.

Ergonomics of human-system interaction —

Part 11:
Usability: Definitions and concepts

1 Scope

This document provides a framework for understanding the concept of usability and applying it to situations where people use interactive systems, and other types of systems (including built environments), and products (including industrial and consumer products) and services (including technical and personal services).

NOTE   In this document, the phrase "object of interest" refers to the system, product or service for which usability is being considered (see 8.1).

This document:

— explains that usability is an outcome of use;

— defines key terms and concepts;

— identifies the fundamentals of usability; and

— explains the application of the concept of usability.

It does not describe specific processes or methods for taking account of usability in design development or evaluation.

The intended users of this document include:

— usability/ergonomics/human factors professionals;

— designers and developers of systems, products and services;

— quality assurance personnel;

— public and corporate purchasers; and

— consumer organizations.

The most common applications of this document are in design and evaluation.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1 Usability

3.1.1
usability
extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use

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

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

[SOURCE: ISO 9241-210:2010, 2.13, modified — Notes 1 and 2 were added.]

3.1.2
product
item that is made or created by a person or machine

3.1.3
consumer product
product that is intended to be acquired and used by an individual for personal rather than professional use

[SOURCE: ISO 20282-1:2006, 3.2]

3.1.4
system
combination of interacting elements organized to achieve one or more stated purposes

Note 1 to entry: A system is sometimes considered as a product or as the services it provides.

Note 2 to entry: A complete system includes all of the associated equipment, facilities, material, computer programs, firmware, technical documentation, services and personnel required for operations and support to the degree necessary for self-sufficient use in its intended environment.

Note 3 to entry: A system can be composed of a product, service, built environment or combination thereof, and people.

[SOURCE: ISO/IEC 15288:2015, 4.1.46, modified — Notes 2 and 3 have been replaced.]

3.1.5
interactive system
combination of hardware and/or software and/or services and/or people that users interact with in order to achieve specific goals

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

[SOURCE: ISO 9241-210:2010, 2.8, modified]

3.1.6
service
means of delivering value for the customer by facilitating results the customer wants to achieve

Note 1 to entry: Services can include both human-system interactions (e.g. accessing a word processor through the web) and human-human interactions (e.g. a citizen interacting with a clerk at the post office counter).

Note 2 to entry: The "customer" is a user, and does not necessarily have a financial relationship.

[SOURCE: ISO/IEC 20000-1:2011, 3.26, modified — The notes have been replaced.]

3.1.7
user
person who interacts with a system, product or service

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

[SOURCE: ISO 26800:2011, 2.10, modified — Note 1 has been replaced and Notes 2 and 3 were deleted.]

3.1.8
user group
subset of intended users who are differentiated from other intended users by characteristics of the users, tasks or environments that could influence usability

[SOURCE: ISO/TS 20282-2:2013, 4.24, modified — The wording of the definition has been modified and the note omitted.]

3.1.9
stakeholder
person or organization that can affect, be affected by, or perceive themselves to be affected by a decision or activity

Note 1 to entry: Stakeholders can include: users, purchasers, systems owners or managers and people who are indirectly affected by the operation of a system, product or service.

Note 2 to entry: Different stakeholders can have different needs, requirements or expectations.

[SOURCE: ISO 31000:2009, 2.13, modified — The original note has been replaced by Notes 1 and 2.]

3.1.10
goal
intended outcome

3.1.11
task
set of activities undertaken in order to achieve a specific goal

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

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

3.1.12
effectiveness
accuracy and completeness with which users achieve specified goals

3.1.13
efficiency
resources used in relation to the results achieved

Note 1 to entry: Typical resources include time, human effort, costs and materials.

3.1.14
satisfaction
extent to which the user's physical, cognitive and emotional responses that result from the use of a system, product or service meet the user's needs and expectations

Note 1 to entry: Satisfaction includes the extent to which the user experience that results from actual use meets the user's needs and expectations.

Note 2 to entry: Anticipated use can influence satisfaction with actual use.

3.1.15
context of use
combination of users, goals and tasks, resources, and environment

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

3.2   Related concepts and disciplines

3.2.1
human-centred quality
extent to which requirements for usability, accessibility, user experience and avoidance of harm from use are met

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

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

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

[SOURCE: ISO 9241-220:—[1], 3.11]

3.2.2
accessibility
extent to which products, systems, services, environments and facilities can be used by people from a population with the widest range of user needs, characteristics and capabilities to achieve identified goals in identified contexts of use

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

3.2.3
user experience
user's perceptions and responses that result from the use and/or anticipated use of a system, product or service

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

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

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

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

[SOURCE: ISO 9241-210:2010, 2.15, modified — The definition has been reworded for clarification, Note 3 to entry has been replaced and Note 4 to entry has been added.]

3.2.4
harm from use
negative consequences regarding health, safety, finances or the environment that result from use of the system

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

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1)   Under preparation. (Stage at the time of publication: ISO/FDIS 9241-220.)

[SOURCE: ISO 9241-220:—, 3.9]

3.2.5
ergonomics
human factors
scientific discipline concerned with the understanding of interactions among human and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance

[SOURCE: ISO 26800:2011, 2.2, modified — The note has been omitted.]

3.2.6
human-centred design
HCD
approach to system design and development that aims to make interactive systems more usable by focussing on the use of the system; applying human factors, ergonomics and usability knowledge and techniques

Note 1 to entry: The term "human-centred design" is used rather than "user-centred design" in order to emphasize that this document also addresses impacts on a number of stakeholders, not just those typically considered as users. However, in practice, these terms are often used synonymously.

Note 2 to entry: Usable systems can provide a number of benefits including improved productivity, enhanced user well-being, avoidance of stress, increased accessibility, and reduced risk of harm.

[SOURCE: ISO 9241-210:2010, 2.7, modified]

3.3   Other definitions

3.3.1
built environment
external and internal environments and any element, component or fitting that is commissioned, designed, constructed and managed for use by people

[SOURCE: ISO 21542:2011, 3.10]

3.3.2
requirement
condition or capability that must be met or possessed by a system, system component, product, or service to satisfy an agreement, standard, specification, or other formally imposed documents

[SOURCE: ISO/IEC 24765:2010, 3.2506 definition 2, modified — The note has been omitted.]

3.3.3
use error
user action or lack of user action while using the system, product or service that leads to a different result than that intended by the manufacturer or expected by the user

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

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

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

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

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

[SOURCE: IEC 62366-1:2015, 3.21, modified — The term *medical device* was replaced by *interactive system*, Notes 4 and 5 have been replaced and Note 6 was omitted.]

4   Rationale and benefits of usability

Usability is the effectiveness, efficiency and satisfaction of the user's interaction with the object of interest.

When designing a system, product or service:

— where usability is lower than expected, the intended users might not be able or willing to use the system, product or service;

— where usability is sufficient, the system, product or service will provide the intended personal, social and economic benefits for users, employers and suppliers;

— where usability is higher than expected, the system, product or service can have a competitive advantage (e.g. customer retention, or customers who are willing to pay a premium).

Specific benefits provided by appropriate usability include the following:

— contributing to meeting targets for the operational efficiency of organizations;

— making systems, products and services easier to understand and to learn how to use, thus increasing uptake and reducing support costs such as help desks;

— increasing usability for people with a wider range of capabilities (see 6.6.2);

— improving the user experience (see 6.6.3);

— contributing towards sustainability objectives (see ISO 26000 and ISO 27500);

— reducing the risks of the undesirable personal, social or business consequences (see A.6.4);

— providing a competitive advantage, for example by improving brand image.

This document provides a basis for identifying the relevant components of effectiveness, efficiency and satisfaction, and the components of the context of use. When specifying, designing or evaluating the usability that results from use of a system, product or service, the objective is to achieve the intended level of effectiveness, efficiency and satisfaction. The estimation of the potential impacts of particular levels of usability (whether these are business, organizational, personal or social impacts) can be used to justify the development efforts needed (see ISO 9241-210 and ISO 9241-220).

NOTE   Reference[32] provides information on cost-justification of the development effort for usability.

5   Usability in a context of use

5.1   Concept of usability

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

Figure 1 shows the system, product or service, which represents the object of interest. The object of interest is shown within the context of use, which is composed of the users, the goals and tasks, the resources, and the environment. Usability, which is composed of effectiveness, efficiency and satisfaction, is shown as an outcome of use. There are also other outcomes of use that include accessibility, user experience and avoidance of harm from use.

NOTE   The components of usability are described in detail in 6.2, 6.3, and 6.4, and the other outcomes in 6.6.
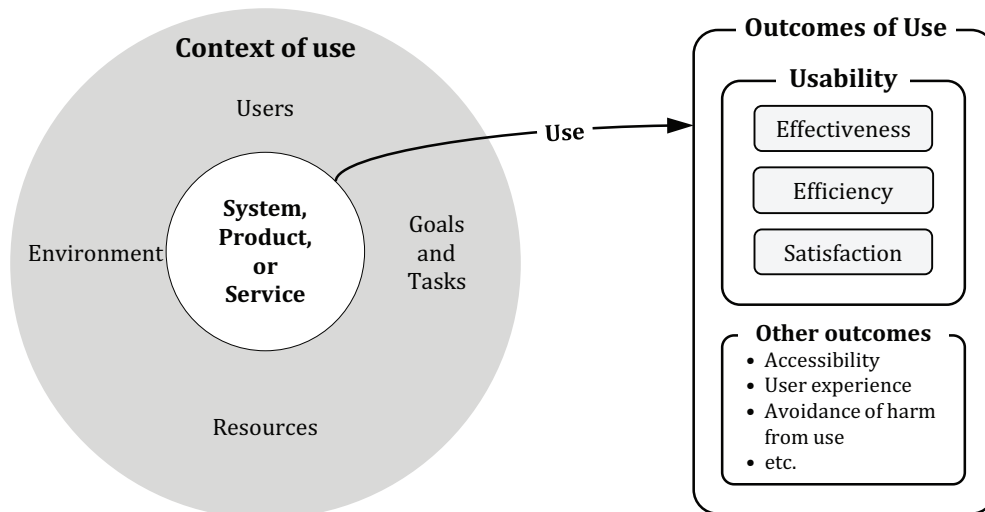
Figure 1 — Usability that results from use of a system, product or service in a context of use

The extent to which usability is achieved will vary depending on the characteristics of:

— the system, product or service;

— the goals;

— the tasks;

— the users;

— the resources;

— the use environment.

Use of the same system, product or service can result in significantly different levels of usability depending on the goals, the types of users and other components of the context of use. Usability will be influenced by the users' characteristics, capabilities and other individual differences, and by the characteristics of the tasks that they perform, and can depend on the physical, social, cultural and organizational environments.

Usability is typically considered in relation to a system, product or service that is being designed or evaluated in a given context of use (i.e. for given user groups, tasks and environment).

EXAMPLE 1   A software application that supports advanced statistical analyses has high levels of usability for experienced statisticians, but has low levels of usability for students taking a first year statistics module.

Usability can also be used to consider the suitability of a component of the context of use (see 8.2).

EXAMPLE 2   The level of ambient lighting (part of physical environment) needed for a specific product to be usable in an (otherwise) specified context of use.

There is no single intrinsic measure of the usability of a system, product or service because effectiveness, efficiency and satisfaction depend on the users, goals and other components of the context of use for which usability is being considered.

5.2   System, product or service

Usability is considered in relation to an identified object of interest (a system, product or service). Systems, products or services can be considered at various levels of specificity from highly complex systems to individual parts of a system, product or service.

NOTE 1   Usability results from interaction between a user and an object of interest. The object of interest with which the user interacts (e.g. a system or service) can include other people.

NOTE 2   Different objects of interest to which the concept of usability can be applied are discussed in 8.1.

5.3   Consideration of usability for "specified" circumstances

5.3.1   General

The "specified" users, goals and other aspects of the context of use refer to the particular combination of users, goals and other aspects of the context of use that are "specified" for the purpose of considering the usability that results from use of an identified object of interest.

NOTE 1   Users, goals, and other aspects of the context of use can be "specified" for purposes of considering usability, whether or not they have been considered in the specifications that were used for purposes of systems development.

NOTE 2   The usability that results from use of an object of interest can be significantly different for different combinations of specified users, goals and tasks, resources and environments.

5.3.2   Specified users

The "specified" users are the users who are identified for the purpose of considering usability. The characteristics of the users will influence usability (see 7.2).

NOTE   The specified users are one or more user groups that are typically, but not necessarily, part of the set of intended groups of users for whom the system, product or service was developed.

5.3.3   Specified goals

It is important to clearly identify the "specified" goals for which usability is being considered, because not all identified goals might be selected to be specified goals (see 7.3).

The specified goals (intended outcomes) for which usability is considered, could be those intended by the user, by the management or by the manufacturer.

NOTE 1   In many situations, usability is considered for a set of goals rather than only for a single goal.

NOTE 2   There can be conflicts between goals that will result in a trade-off between achieving usability for one specified goal with achieving usability for another specified goal.

EXAMPLE   When booking a ticket for travel, there could be conflicts between the goal to have the shortest travel time, the goal to be comfortable, the goal to pay the lowest price, and the goal to configure the trip in detail.

5.3.4   Specified contexts of use

It is important to clearly identify the "specified contexts of use" for which usability is being considered. The "specified" contexts of use are typically a subset of all possible combinations of contexts of use.

6   Outcomes of use

6.1   Usability as an outcome

Usability focuses on the effectiveness, efficiency and satisfaction of the user's interaction with the object of interest.

Effectiveness (see 6.2), efficiency (see 6.3) and satisfaction (see 6.4) are each composed of more specific components.

The relative importance of effectiveness, efficiency and satisfaction and their components will depend on the reason that usability is being considered and the specified context of use.

EXAMPLE   For a trained clinical user of a medical device, the most important considerations might be effectiveness (accuracy and completeness) and efficiency (time used).

NOTE 1   The user could be effective without being efficient or satisfied, or satisfied without being effective or efficient.

NOTE 2   Provision of the necessary technical functionality is a prerequisite for usability.

NOTE 3   Effectiveness, efficiency and satisfaction can each be considered, specified or evaluated as measures of the observable outcome and/or of the user's perception of the outcome (see Annex B).

Other outcomes of use that are important because they are additional components of human-centred quality (see A.6) are accessibility (see 6.6.2), user experience (see 6.6.3) and the potential harm that could result from use (see 6.6.4).

NOTE 4   The outputs of a computer system are not the same as the outcomes of its use. A system can produce a variety of outputs, not all of which are relevant to the intended outcomes of use. Some outputs directly support the achievement of an intended outcome, some outputs can interfere with achieving an intended outcome, and some might have no influence on an intended outcome.

NOTE 5   The extent to which requirements for usability, accessibility, user experience and avoidance of harm from use are met, is referred to as human-centred quality.

6.2   Effectiveness

6.2.1   General

Effectiveness is the accuracy and completeness with which users achieve specified goals.

NOTE 1   Effectiveness represents the extent to which actual outcomes match intended outcomes.

NOTE 2   Lack of effectiveness can result in outcomes that could cause harm from use (see 6.6.4).

6.2.2   Accuracy

Accuracy is the extent to which an actual outcome matches an intended outcome.

The basis for accuracy will depend upon the specificity of the intended outcome(s). In some cases, accuracy is based on whether or not the outcome is correct.

EXAMPLE 1   The user successfully recorded the intended TV programme on a personal video recorder (PVR).

In other cases, accuracy is based on achieving some acceptable level of match with intended outcomes.

Causes of lack of accuracy can include the following.

a)   Use errors or difficulties.

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EXAMPLE 2   A person selects a valid ticket from a train ticket machine, but buys a higher-class ticket than intended, not realizing the double fare (price).

b) Unnecessary system outputs that interfere with the user's task.

EXAMPLE 3   A person purchases a train ticket from a machine. In addition to the printed train ticket, the machine produces several receipts and offers. The person has difficulties finding the ticket among the many pieces of paper produced by the machine.

c) Inappropriate decisions made on the basis of inaccurate or incomplete outputs.

EXAMPLE 4   A user decides to purchase a product from Web Shop A because it is offered at a lower price than on Web Shop B. The information that A doesn't have the product in stock (which results in considerably longer delivery time) is not displayed to the user.

6.2.3   Completeness

Completeness is the extent to which users of the system, product, or service are able to achieve all intended outcomes.

NOTE 1   There can also be additional positive unintended outcomes.

EXAMPLE 1   Goal: Prior to setting out to visit a museum, an intending visitor checks the website to find out the price of entrance, but discovers that it is closed on that day.

NOTE 2   The relative importance of outcomes can affect the extent of completeness.

NOTE 3   It is possible that individual outcomes can be accurate without the outcomes being fully complete.

EXAMPLE 2   Goal (intended outcome): Obtain all the items needed for a recipe. An online shopping site accepts an order for the items, and all items are delivered except one that is out of stock. The individual items that are delivered are correct, however the items needed for the recipe are not complete.

NOTE 4   It is possible that outcomes can be complete without all the outcomes being fully accurate.

EXAMPLE 3   The goal of a user is to apply for insurance using an online form. The user has filled in all the fields but inappropriate layout leads the user to misinterpret one of the questions resulting in an incorrect answer to that question.

6.3   Efficiency

6.3.1   General

Efficiency is the resources used in relation to the results achieved.

These resources include: time, human effort, money and materials. These resources are considered as expendable resources in the context of use (see 7.5.3).

The use of a system product or service could be efficient in using few resources but not be effective in achieving intended outcomes, or could be very effective in achieving outcomes while being inefficient in expending high levels of resources.

EXAMPLE 1   A user manually enters the specific formula to calculate the total at the end of each row of a spreadsheet, not knowing that a formula in one row can be copied to apply to the other rows. The user is effective but relatively inefficient.

A user could be efficient regardless of satisfaction or could be satisfied regardless of efficiency.

What constitutes efficiency depends upon the goals for which usability is being considered.

EXAMPLE 2   Expending time or human effort for pleasure (e.g. playing a game) can be a goal. In this case, where the goal is to consume time and/or human effort, they become inappropriate measures of efficiency, leaving only other resource (such as the cost of the entertainment) to be relevant resources to be considered.

6.3.2 Time used

The time used is the time expended in attempting to achieve a goal.

NOTE   Time used can be:

— the time taken to achieve intended outcome(s) (including time used when errors are made;

— the time taken to achieve intended outcome(s) plus the time involved in prerequisite activities, e.g. training and learning, that need to be accomplished before the object of interest can be used to achieve the intended outcome(s); or

— the total elapsed time from start to termination of the activities associated with achieving the intended outcome(s).

6.3.3 Human effort expended

The human effort used is the mental and physical effort expended to complete specified tasks.

NOTE   Human effort deals with the mental and physical impact on the individual user. Expenditure of human effort can involve both excessive demands and underload, either of which can cause negative consequences.

6.3.4 Financial resources expended

Financial resources include the costs of using the system, product or service, such as paying wages, or the cost of energy or connectivity. Financial costs can also include the costs of disposal of used equipment or waste.

NOTE   This can include some proportion of financial costs for reusable resources acquired in order to use it, such as equipment, facilities, information or expertise (see 7.5.2).

6.3.5 Materials expended

Materials are physical items (e.g. raw materials, water, paper) used as input to the task (including maintenance tasks) and processed by the system, product or service.

6.4 Satisfaction

6.4.1 General

Satisfaction is the extent to which the user's physical, cognitive and emotional responses that result from use of a system, product or service meet user's needs and expectations.

NOTE 1   Satisfaction influences user behaviours and accomplishments.

NOTE 2   Satisfaction is typically assessed based on ratings given by users.

The components of satisfaction that are important will depend on the reasons for considering usability.

6.4.2 Physical responses

Feelings of comfort or discomfort represent physical components of satisfaction. They result from the physical experience of using the object of interest.

EXAMPLE 1   When viewing a screen, glare causes discomfort.

EXAMPLE 2   Prolonged periods of use of a notebook without an external mouse causes muscular discomfort.

6.4.3   Cognitive responses

Attitudes, preferences and perceptions represent cognitive components of satisfaction. They result from the experience of use of the object of interest, and can also be influenced by the experience of using similar systems and by the opinions of other people.

EXAMPLE   A user says that it "takes forever" to reserve a car on a car rental website.

NOTE   Attitudes and perceptions can include trust, perceived degree of safety, perceived degree of security, and perceived extent of privacy.

6.4.4   Emotional responses

Emotional responses represent affective components of satisfaction. They result from experience while using the object of interest. These responses can be influenced by the experience of using similar systems and by the opinions of other people.

NOTE 1   Emotions can produce or result from physiological responses.

NOTE 2   Some interactive systems intentionally create rich emotional responses to the use of the system, such as excitement and fun in games, or trust in a web shop. As far as such responses are part of the specified goals (see 5.3.3), the degree of their achievement is an aspect of effectiveness.

NOTE 3   Emotional responses can be assessed by physiological responses such as skin conductance, facial expression, as well as by self-assessment using rating scales.

6.5   Specific uses of the concept of usability

Usability as an outcome of use has specific interpretations in certain contexts of use. The following are common examples.

a)   Maintainability

Maintainability can be considered in terms of the effectiveness, efficiency and satisfaction with which the goals of maintaining a system, product or service are achieved.

b)   Learnability

Learnability can be considered in terms of the effectiveness, efficiency and satisfaction with which the goals of learning to use system, product or service are achieved.

NOTE   ISO/IEC 25010 identifies product attributes that contribute to achieving maintainability and learnability. ISO 9241-110 describes how the principle of suitability for learning can be applied in the design and evaluation of interactive systems.

6.6   Other outcomes of use

6.6.1   General

Other outcomes of use include accessibility, user experience and avoidance of harm from use, which, together with usability, are collectively known as human-centred quality (see A.6).

NOTE   These components of human-centred quality are not independent, but focus on the outcomes of use from different perspectives.

6.6.2   Accessibility

Accessibility is the extent to which products, systems, services, environments and facilities can be used by people from a population with the widest range of user needs, characteristics and capabilities to achieve identified goals in identified contexts of use. The aim in designing for accessibility is to widen

the target population, thus making products, systems, services, environments and facilities more accessible to more people in more diverse contexts of use (see A.6.2).

6.6.3 User experience

User experience is the user's perceptions and responses that result from the use and/or anticipated use of a system, product or service. User experience focuses on the nature of these responses before, during and after use (see A.6.3).

6.6.4 Avoidance of harm from use

Avoidance of harm from use minimises the risk of negative consequences that could result from inadequate effectiveness, efficiency or satisfaction, or lack of accessibility and/or a negative user experience. The negative consequences can include harm to:

a) the user or other persons, including physical harm, emotional harm, or financial harm, or harm to privacy;

b) the organization using the system, including harm to finance, security, the environment, reputation or brand image;

c) the organization developing, supplying, or acquiring a system, including the system not meeting intended targets for usability and the economic or reputational consequences.

See A.6.4 for more details.

7   Context of use

7.1   Components of the context of use

The context of use comprises a combination of users, goals, tasks, resources, and the technical, physical and social, cultural and organizational environments in which a system, product or service is used.

NOTE 1   The context of use can include the interactions and interdependencies between the object of interest and other systems, products or services.

The usability that results from use of a system, product or service depends on the particular characteristics of each of these components. Therefore, it is important to identify the relevant characteristics and their variability in the actual or intended context(s) of use. Differences between contexts of use can result in differing usability for the same system, product or service in each different context of use.

NOTE 2   The impact on usability of changes in a particular characteristic of the context of use can range from none to a major impact.

It is important to identify the specific context(s) for which usability is being considered and the characteristics that could affect usability. The context of use can evolve during the process of interaction (e.g. as the user's goals change, or users become more skilled), influencing the achievement of usability in relation to the evolved context of use.

The relevant components of the context and the level of detail required will depend on the scope of the issues being addressed. ISO/IEC 25063 identifies the information items to be included in a description of context of use.

The usability that results from use of a system product or service can be considered in relation to different contexts of use depending on the range of situations that need to be covered.

7.2   Users within the context of use

The users for whom usability is being considered can be people who interact with different parts of an identified object of interest, including:

— people who operate the object of interest (including people who interact with each other using the object of interest);

— people who use the output of the object of interest, but are not involved with the production of that output;

> EXAMPLE   A bank customer who receives a paper or electronic statement, visits a branch, or carries out telephone banking using a call centre is a user of the output produced by the bank's system.

— people who support or maintain the object of interest's continuing operation (for example administration, training or maintenance).

NOTE 1   ISO/IEC 25010 identifies four categories of users: direct, indirect, primary and secondary. These categories are used to classify the different ways in which people interact the object of interest.

Typically, users are classified into groups based on their different needs, goals, tasks, roles, the environment in which they are using the object of interest, or in terms of their characteristics, physiological or psychological capabilities or states or other sources of individual differences. Characteristics include physical, sensory, psychological and social factors.

NOTE 2   The market segments used in market research (see 8.6) are typically based on personal characteristics related to purchase behaviour, rather than use behaviour.

Usability can be considered for any specified subset of the users within the context of use. The set of users within the context of use is often much larger than the set of specified users (see 5.3.2) for whom usability is being considered.

It is important to clearly identify the user groups and the characteristics of the users that are relevant to usability, keeping in mind the widest range of characteristics and capabilities in the user group.

7.3   Goals within the context of use

Goals are the intended outcome(s) to be achieved. Goals are independent of the means used to achieve them. Goals focus on what is to be achieved without necessarily specifying criteria (such as levels of effectiveness, efficiency or satisfaction).

Goals can come from a variety of sources including:

— the users themselves;

— other stakeholders;

— the organization; and

— regulations.

Different users can have different goals.

NOTE 1   Goals can focus on functional, cognitive, affective or psychomotor outcomes.

The context of use includes all the goals from all potential sources.

NOTE 2   If the specified goals and context of use considered for usability originate from stakeholders and not from the users, there is a possibility that usability might not be adequate for the users' goals in the actual context of use (see A.5).

Goals can be decomposed into subgoals that can include intermediate outcomes. Subgoals and intermediate outcomes are also identified as part of the context of use.

NOTE 3   While goals are independent of the means used to achieve them, a task describes a particular means to achieve a goal.

EXAMPLE

Goal: To be in a particular location (different from the current location)

Subgoal: Obtain transportation

Task: Travel to the location by train.

Subgoal: Arrange transportation

Task: Obtain ticket from a vending machine using a credit card.

Subgoal: Understand which trains the ticket is valid for.

Subgoal: Be confident that the credit card details are secure.

Subgoal: To be relaxed while travelling.

Task: Travel first class.

The specified goals for which usability is considered are typically taken from a (potentially much larger) set of goals that exist within the context of use. Identifying goals beyond the specified goals is an important part of analysing the context of use, since these goals can have an influence on the users and the way they use the system, product, or service.

NOTE 4   Externally imposed goals (e.g. by regulations or organizational culture) which are not specified goals for the purpose of determining usability can limit the user's flexibility to achieve usability in using the object of interest.

7.4   Tasks within the context of use

Tasks consist of one or more activities undertaken to achieve a goal. Different combinations of activities can provide different ways of achieving the same goal and can lead to different levels of usability.

EXAMPLE 1   The goal of getting money from a bank could be achieved in a number of ways including: going in person to the bank and making a withdrawal at a counter or using an automatic teller machine at a convenience store.

NOTE 1   When considering tasks as part of the context of use for design, it is important to take account of existing task activities, the ways that tasks could be carried out, and the specification of the task activities to be supported.

Characteristics of the activities that make up tasks, such as frequency, duration, complexity, and relationships such as dependencies and interdependencies, as well as habits, stereotypes and cultural conventions, are part of the context of use. In addition, it is important to identify the extent to which task activities are fixed or flexible, and what discretion users have in whether and how to carry out the task.

NOTE 2   The manner in which a user performs one task might influence how that user performs other tasks, which can affect the usability achieved when carrying out those tasks.

EXAMPLE 2   Users reuse a method that they are familiar with for other tasks, rather than investigating whether there is a more efficient way to carry out the new task.

There can be differences between prescribed ways of carrying out tasks and actual ways that users carry out tasks to achieve a specified goal.

NOTE 3   Mismatches between prescribed and actual ways in which tasks are executed can provide important information about the context of use. When identifying the intended context of use, it is important to confirm there are good reasons for following prescribed ways of executing tasks.

EXAMPLE 3   An organization has a policy that the content of all communications are endorsed by the senior management, but workers find it is more effective and efficient to communicate directly with colleagues in another organization. It is also important to understand any ways in which the task could be carried out which might lead to undesirable outcomes, in addition to the intended outcome.

7.5   Resources

7.5.1   General

The context of use includes any reusable resources and any expendable and/or exhaustible resources that need to be used to achieve specified goals.

7.5.2   Reusable resources

Reusable resources include equipment, applications, information and support that are used in conjunction with the object of interest while the user is carrying out the task and that are integral to its completion.

a)   Equipment and applications include the hardware, software and other physical items (e.g. workstation furniture).

   NOTE   Items used in conjunction with the object of interest could include furniture, personal protective equipment, or a battery charger. (Some of these items might be expendable if reuse is not possible.)

b)   Information includes data (e.g. a street sign or a recipe) that the user has access to (whether provided by hardware, software or physical means such as paper), which aids the completion of each task.

c)   Support includes any service (human-based or system-based), including assistive technologies, which can be accessed by the user for achieving specific goals.

7.5.3   Expendable resources

Expendable resources include available time, human effort, financial resources, and materials (see 6.3).

NOTE 1   This includes expendable resources that are part of the object of interest (e.g. paper in a printer).

Constraints on available expendable resources are an important part of the context of use because they limit what can be expended.

NOTE 2   Energy and connectivity are considered resources that are expendable/exhaustible. Energy (e.g. electrical, chemical or mechanical) and connectivity (e.g. internet, cell network) are resources that can be both, expendable/exhaustible as well as reusable. If connectivity to the Internet is available to users on an unlimited basis, then connectivity is a reusable resource. The provision of access to these resources is part of the technical environment (see 7.6.2).

7.6   Environment

7.6.1   General

The context of use includes the technical, physical and social, cultural, and organizational environments that influence usability.

NOTE   Typically, the environment creates constraints that are identified as part of the context of use.

7.6.2   Technical environment

The technical environment consists of those environmental components that enable or constrain the use of the reusable (see 7.5.2) and expendable (see 7.5.3) resources.

The technical environment typically includes access to resources such as furniture, packages, control devices, energy (e.g. electrical, chemical or mechanical) and connectivity (e.g. Internet, cell network).

7.6.3   Physical environment

The physical environment can include:

— the built environment;

— the spatial, thermal, acoustic and visual conditions, stability and vibration;

— the geographical and topographical features;

— the weather conditions; and

— the time of day, and season.

7.6.4   Social, cultural and organizational environment

The social, cultural and organizational environment includes:

— other people (including stakeholders);

— the roles and relationships between people;

— organizational structures;

— the language;

— the legislation;

— the norms and values, and work practices;

— the use in isolation or as part of a group, and

— privacy.

8   Applying the concept of usability

8.1   Usability that results from use of various objects of interest

Usability is relevant in all situations that involve human users. The concept of usability can be applied to the use of a wide range of systems, products, and services.

NOTE   The most common applications of the concept of usability are in design, development and evaluation.

In order to apply the concept, it is important to clearly identify the specific object of interest separately from the specified context of use.

Usability can be considered at various levels of scope and complexity (from an entire complex system to individual components of a system, product, service or environment) including the following.

a)   System

— Interactive systems are typically combinations of hardware, software and/or services that receive input from, and communicate output to users.

— A system can be composed of subsystems and nested systems that can include products, services and built environments (e.g. a building or a path for a wheelchair).

— For a built environment, users can interact with the built environment when in it and when entering or leaving it (e.g. using directional signs).

NOTE   More complex systems have many interfaces between the system and the people interacting with the system.

EXAMPLE An industrial complex could have a control room, local control stations, special tools and materials handling equipment, all used by several people to interact with the overall system.

b) Product

— Products are typically stand-alone items.

— Products include physical objects, software products and other intangible products.

— Physical products typically have readily identifiable tangible interfaces (including interfaces that are not interactive, e.g. a cup).

— For complex products, usability can be considered for the whole product or part of the product (e.g. packaging).

c) Service

— A service delivers outcomes of value to its users, and can be composed of sub-services (e.g. customer services for a cell phone contract). The interface between a user and a service can involve other humans, as well as the transfer of information and other intangibles.

NOTE   Although usability is typically considered for constructed systems, products and services, the concept of usability can also be applied to the evaluation of systems that occur naturally in the environment.

EXAMPLE   Usability is considered for different footpaths to a destination, taking account of the gradients of the paths and the capabilities of the users.

Design for, or evaluation of, usability focuses on one or more interactions between the object of interest and its users that lead to accomplishing one or more goals.

8.2   Characteristics of users, tasks and environments needed for usability

Design for and evaluation of usability can also identify the characteristics needed by components of the context of use to enable the intended outcomes to be achieved, including the following:

a) the capabilities and characteristics of the user (e.g. skill or expertise) that are needed;

b) appropriate characteristics of the task(s) needed to achieve the goal(s) (e.g. the complexity of the task or the extent to which the system supports the task);

c) attributes of the resources that are needed (e.g. the speed of internet connection or quality of data available);

d) the characteristics of the environment that are needed (e.g. the temperature, or whether user support or training is needed).

8.3   Achieving usability in design and development

ISO 9241-210 identifies a set of human-centred design activities that can be used to achieve usability:

a) understanding and specifying the context of use identifies what the relevant context(s) of use are, so that the information can be used in a requirements specification and when developing and evaluating design solutions that will be usable in these context;

b) specifying the user requirements includes identifying the relevant usability requirements (i.e. criteria for effectiveness, efficiency and satisfaction in specified contexts of use);

c) producing design solutions includes making use of the context of use and user requirements, in conjunction with ergonomic knowledge and the use of prototypes, to contribute to producing usable design solutions;

d) evaluating design solutions to provide feedback (Table B.1 summarizes different approaches to usability evaluation).

ISO 9241-220 describes the processes by which human-centred design (HCD) is supported and carried out within organizations, with the aim of achieving human-centred quality.

NOTE   Other parts of the ISO 9241 series provide more specific guidance that can be applied to the design of products, systems and services to increase usability, e.g. ISO 9241-110 and ISO 9241-112 provide principles and high level guidance related to software usability. The ISO/IEC 2506x series of Common Industry Formats (CIF) standards define the information items to be included when specifying or evaluating the usability of interactive systems.

8.4   Usability in procurement

Design for and evaluation of usability can provide the following benefits for both organizational and individual procurement:

— enables the required usability to be identified and compared with the actual usability that results from use of systems, products or services that are to be acquired or used (see ISO/IEC 25062 and ISO 20282-2);

— provides a basis for identifying the intended context of use and criteria for effectiveness, efficiency and satisfaction;

— provides a holistic approach that focuses on user needs rather than a comparison based on functions and features out of context.

8.5   Usability in a review or when making a comparison

Design for and evaluation of usability can provide the following benefits when reviewing systems, products or services. It:

— enables an explicit specification of the context of use that is used for the review or comparison (see ISO/IEC 25063);

— provides fair and relevant user-oriented criteria;

— promotes a consumer-oriented perspective;

— provides a basis for comparing new technologies.

8.6   Usability inputs to marketing and market research

Consideration of usability can provide the following benefits in marketing and market research. It can provide a basis for:

— recognizing different user needs for different market sectors; and

— ranking product features or properties.

Annex A
(informative)

Relationship of usability to other concepts

A.1 General

The concept of usability is often used in conjunction with other concepts. Understanding the relationship between these concepts can be important for practitioners coming from different areas who might have a particular perspective on usability.

A.2 Human-centred design

Human-centred design (HCD), which aims to make interactive systems more usable by focusing on the use of the system, is an important application of the concept of usability. Relevant International Standards include:

— ISO 9241-210, which provides an overview of HCD activities;

— ISO 9241-220, which provides detailed guidance on HCD process definition and improvement; and

— ISO/TR 16982, which provides guidance on HCD methods.

Usability is an important driver of HCD, as explained in ISO 9241-210. HCD makes use of the concept of usability (including usability measures) in its activities. The application of HCD achieves a broad range of outcomes and benefits including improving usability, accessibility and the user's experience, and reducing the risk of the product failing to meet stakeholder requirements.

A.3 Ergonomics/human factors

Ergonomics/human factors is a scientific discipline concerned with the understanding of interactions among human and other elements of a system. ISO 26800 explains that the main goal of ergonomics/human factors is to optimize human well-being and overall system performance through the application of scientific understanding of the interactions among human and other elements of a system. This process of optimization includes the specific goals of facilitating task performance and safeguarding the safety, health and well-being of the humans in the system. The principles to be followed are to:

— take a human-centred approach to design;

— identify and understand the target user population (taking account of its diversity);

— take account of the nature of the tasks;

— take account of the environmental context; and

— evaluate a system, product or service against ergonomics criteria.

ISO 26800 explains that taking an ergonomics approach potentially contributes to sustainability and to social responsibility.

ISO-9241-11 provides a more detailed conceptual framework for identification of the target user population, tasks and environments, and for evaluation against criteria for human performance (effectiveness and efficiency) and satisfaction when using systems, products and services.

In addition to its application to design, ergonomics includes the scientific work that develops the ergonomics knowledge about human characteristics and capabilities, and the interactions of humans with other parts of a system.

A.4   Human-centred organization

A human-centred organization recognizes and addresses the improvement of human well-being and total system performance through the following seven principles that are described in ISO 27500.

— Capitalize on individual differences as an organizational strength.

— Make usability and accessibility strategic business objectives.

— Adopt a total system approach.

— Ensure health, safety and well-being are business priorities.

— Value employees and create a meaningful work environment.

— Be open and trustworthy.

— Act in socially responsible ways (as described in ISO 26000).

The need to "make usability and accessibility strategic business objectives" is recognized as being necessary in order to optimize performance, minimize human-based risk of undesirable consequences, maximize well-being within an organization, and enhance relationships with customers.

A.5   Social responsibility

Usability can be applied in ways that support the principles of social responsibility (see ISO 26000).

a) A clear distinction needs to be made between considering usability for the user's intended outcomes and for another stakeholder's intended outcomes (see 5.3.3). Taking account of the user's goals satisfies fundamental human needs and produces designs that respect human dignity.

b) Systems, products and services should be designed to be usable by people with the widest range of capabilities who could potentially use the system, product or service (see 6.6.2).

A.6   Human-centred quality

A.6.1   General

Human-centred quality is a collective term for the intended outcomes of interaction: the extents to which requirements for usability, accessibility, user experience and avoidance of harm from use are met. Usability is one component of human-centred quality, which also includes: accessibility (see A.6.2) and user experience (see A.6.3) while avoiding harm from use (see A.6.4). Human-centred quality is identified in ISO 9241-220 as the objective of human-centred design. It emphasizes the need to consider accessibility and user experience, and to understand how usability, accessibility and user experience can mitigate the risks of potential negative consequences for users and other stakeholders, and maximize the opportunities for positive outcomes.

A.6.2   Accessibility

The objective of designing for accessibility is to enable products, systems, services, environments and facilities to be used by people with the widest range of user needs, characteristics and capabilities in

diverse contexts of use. Accessibility is included as a component of human-centred quality to emphasize its importance as part of human-centred design.

NOTE 1   Guidance that can be used to contribute to accessibility during design and development includes ISO 9241-20, ISO 9241-171, ISO/IEC 13066-1, ISO/IEC 29136, ISO/IEC/TR 29138-1 and ISO/IEC 30071.

Taking account of the need for accessibility when designing products, systems, services, environments and facilities for usability can both widen the range of people who can use them with effectiveness, efficiency and satisfaction, and result in increased usability for all users.

NOTE 2   Usability is one of the 11 "Accessibility Goals" of ISO/IEC Guide 71:2014. ISO/IEC Guide 71:2014 6.2.8.1 describes this goal as "A system is usable if it supports diverse users in their diverse contexts to accomplish their tasks with effectiveness, efficiency and satisfaction."

A.6.3   User experience

User experience is defined as a person's perceptions and responses that result from the use and/or anticipated use of a system, product or service. User experience focuses on the user's preferences, attitudes, emotions and physical and psychological responses that occur before, during and after use (including perception of trust, safety, security, and privacy). A positive user experience can provide value to the user and/or to the organization that provides the interactive system.

As part of human-centred quality, user experience is the extent to which requirements are met for particular perceptions and/or responses resulting from the use of the interactive system (for example sympathetic warning messages intended to alleviate stress).

Satisfaction includes the extent to which the user experience that results from actual use meets the user's needs and expectations. A particular user experience can be a goal (for example "To be relaxed while travelling" in 7.3 Example 1).

NOTE 1   Although anticipated use is outside the scope of satisfaction, anticipations of the use can influence satisfaction when the object of interest is used subsequently.

While usability typically deals with goals shared by a user group, user experience puts more emphasis on individual goals, which can include personal motivations, including needs to acquire new knowledge and skills, to communicate personal identity, and to provoke pleasant memories.

User experience is also concerned with how the experience changes with repeated use.

NOTE 2   The term user experience is sometimes used to refer to all the aspects of users interacting with a system.

A.6.4   Avoidance of harm from use

Lack of usability, lack of accessibility and/or a negative user experience can result in a range of negative outcomes that could arise from inappropriate forms of interaction or inappropriate outputs. Examples of the negative outcomes that could result from inadequate usability that are identified in ISO 9241-220 include the following:

a)   For the user and other people affected by the system, product or service:

— Negative outcomes during interaction including risks to health and safety or risks of stress, fatigue, frustration or lack of empowerment.

— Failing to adequately complete a task, taking too much time, or dissatisfaction resulting in unwillingness to use the system again.

— Inconvenience and/or financial harm that could result from being unable to achieve the purpose for which the system of interest was used.

— Lack of trust, security or privacy.

b) For the organization using a system, product or service:

— Damage to an organization's reputation, brand image or finances resulting from use errors.

— Harm to the environment resulting from use errors.

— Inadequate operational safety or protection of security or privacy.

c) For the organization supplying or acquiring a system, product or service:

— The system, product or service does not meet intended targets for usability, accessibility, and/or user experience.

— The delivered system does not support operational needs in an organization.

— Economic or reputational consequences to the supplying organization resulting from a delivered system not being purchased or a service not being used.

— Financial costs of rework to address shortcomings.

A.7 Relationship of usability to other qualities of systems, products and services

A.7.1 System and software product quality in the ISO/IEC 25000 series

A.7.1.1 General

The ISO/IEC 25000 series of standards for system and software quality requirements and evaluation includes three quality models that include aspects of usability: quality in use, system and software product quality, and service quality.

A.7.1.2 Quality in use

Quality in use is defined in ISO/IEC 25010 as the degree to which a product or system can be used by specific users to meet their needs, to achieve specific goals with effectiveness, efficiency, freedom from risk, and satisfaction in specific contexts of use. Quality in use has a similar definition to the ISO 9241-11 definition of usability with the explicit addition of "freedom from risk". ISO 9241-11 can thus be used to provide an elaboration of the concepts of effectiveness, efficiency, satisfaction and context of use in ISO/IEC 25010.

ISO/IEC 25022 contains examples of measures for quality in use, including measures of effectiveness, efficiency and satisfaction.

A.7.1.3 Product quality model

ISO/IEC 25010 includes a product quality model composed of eight software product quality characteristics (functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability and portability) that relate to both "internal" technical properties of software and dynamic "external" properties of the computer system in operation. Although usability is defined in the same way as in ISO 9241-11 as an intended outcome, in ISO/IEC 25010, the term is also used to refer to the related product attributes that are intended to contribute to achieving usability: appropriateness recognizability, learnability, operability, user error protection, user interface aesthetics, and accessibility. ISO/IEC 25023 contains measures for product quality that include measures for these properties of the product.

A.7.1.4 Service quality

ISO/IEC TS 25011 defines a service quality model that is applicable to the design, deployment, delivery and improvement of services that use or support IT. The service quality model defines seven characteristics: suitability, usability, security, reliability, tangibility, responsiveness, empathy and

maintainability. ISO/IEC TS 25011 also provides guidelines for using the quality in use model that is defined in ISO/IEC 25010 to describe the quality in use of services from a customer perspective.

A.7.2 Hardware quality

The ISO 9241 300 and 400 series deal with ergonomics quality aspect of visual screens (ISO 9241-3xx series) and input devices (ISO 9241-4xx series). The attributes described in these series will contribute to achieving higher usability.

A.7.3 Safety, trust, privacy and security

Usability is one quality related to the use of a system, product or service. Examples of other qualities include trust, safety, privacy and security.

The extent to which trust, perceived degree of safety, perceived degree of security and perceived degree of privacy meet user's needs and expectations is part of satisfaction (see 6.4.3). Products with poor usability can have negative effects on trust, safety, privacy and/or security. Unacceptable levels of trust, safety, privacy or security can inhibit use of a system.

Note 1   Medical devices are an example of systems where usability issues can impact on safety (see ISO 62366). E-commerce systems are an example of systems where usability issues can impact on trust.

Note 2   ISO 9355-1 specifies ergonomic requirements for the design of display and control actuators, stressing the importance of effectiveness and the avoidance of user errors in relation to safety in use.

Annex B
(informative)

Usability measurement

B.1   General

The different approaches to usability evaluation (that can be used for user testing and expert-based evaluation) described in ISO/IEC 25066 can produce measures such as those shown in Table B.1. These include measures of effectiveness, efficiency and/or satisfaction, and measures of attributes of the object of interest that are believed to contribute to achieving usability in a particular context of use.

Table B.1 — Examples of approaches to usability evaluation and measures

Approach	Examples of measures
a) Inspection to identify deviations of the object of evaluation from specified criteria	Extent of conformance to requirements, principles, design guidelines or established conventions
b) Inspection to identify potential usability problems when attempting to complete a task	Number and severity of problems
c) Observing user behaviour to identify actual usability problems in a test environment or actual use	Number and severity of problems
d) Measuring user performance: effectiveness and efficiency in a test environment or actual use	Measures of accuracy and completeness and resource utilization
e) Measuring user satisfaction in a test environment or actual use	Measures resulting from satisfaction scales

Approaches d) and e) directly involve users in order to provide measures of effectiveness, efficiency and satisfaction.

B.2   Measures of effectiveness, efficiency and satisfaction

Measures of effectiveness, efficiency and satisfaction can be obtained from the objective or perceived outcomes when users carry out tasks in a real or simulated context of use.

While objective measures are often the focus of evaluation, asking users about effectiveness, efficiency and satisfaction can provide subjective measures of these components of usability that might differ from the objective measures.

EXAMPLE 1   A usability problem results when users believe they have completed the task correctly and take no further action even though the task has not actually been completed.

NOTE 1   Objective measures of satisfaction can be obtained by observing behaviour (such as reuse of a system).

Because the relative importance of components of usability depends on the context of use and the purposes for which usability is being considered, there is no general rule for how measures should be chosen or combined. It is normally necessary to use at least one measure for each of effectiveness, efficiency and satisfaction.

NOTE 2   Different measures of a component of usability (e.g. effectiveness) can lead to different conclusions about that component of usability.

EXAMPLE 2   When measuring accuracy, a measure of achieving a goal correctly is not the same as a measure of the number of errors that occurred prior to this achievement.

EXAMPLE 3   When measuring cost expended one organization only measures the amount of new money that they expended (considering previous expenditures to be non-recoverable) while another organization also takes into account previous expenditure.

The choice of measures and the level of detail of each measure is dependent on the objectives of the parties involved in the measurement. It is important to consider the relative importance of each measure to the goals. For example, where usage is infrequent, high importance might be given to measures of learning and re-learning.

Measures can be based on counts (such as the frequency of an occurrence) or continuous data (such as task time). Measures and criteria for specific components of usability can be selected based on issues such as:

— the objectives for which usability is being considered;

— the human-centred design activity being conducted;

— the resources available for measurement;

— the feasibility of measurement;

— the precision and reliability required from the measures.

No single measure of a component of effectiveness, efficiency or satisfaction can fully represent overall usability.

NOTE 3   ISO/IEC 25022 contains examples of measures of effectiveness, efficiency and satisfaction in an information/communication technology (ICT) context.

Table B.2 provides examples of potential measures for different goals.

Table B.2 — Examples of usability measures

Goal and object of interest	Effectiveness measures		Efficiency measures		Satisfaction measures	
	Objective	Perceived	Objective	Perceived	Objective	Perceived
Obtain a ticket by purchasing it from a machine	— Correctness of outcome, e.g. whether a valid ticket was purchased — Success rate, e.g. percentage of tickets correctly purchased by a specified user group — Frequency with which users lose money when the machine does not have change	— User's perception of whether the ticket is valid for the intended means of travel — Percentage of users correctly understanding the validity of the ticket purchased	— Time to complete the task — Cost to complete the task	— Perceived time to complete the task — Perceived cost to complete the task	— Observed frequency of reuse	— Satisfaction with the task achievement or with the product — Satisfaction with task time — Measures of trust — Propensity to recommend
Acquire new skill by learning to use an Excel Pivot Table	— Pivot Table applied successfully — Can reuse a week later — Frequency with which incorrect results are obtained because the Pivot table is misunderstood	— Perceived success — Perceived ability to reuse	— Time to complete the task — Cost to complete the task	— Perceived effort to complete the task	— Frequent use of Excel Pivot Tables	— Satisfaction with the learning experience
Exercise by taking an afternoon walk in a park	— Intended walk completed — Intended exercise obtained — Completed in the intended time — Avoid getting lost	— Perception that the intended walk was completed — Perception that the intended exercise was obtained — Perception that the walk was completed in the intended time	— Physical effort to complete the task	— Expectation of calories burned	— Similar walks taken subsequently	— Measures of pleasure — Measures of comfort

B.3   Uses of measures

Measures of usability can be used for the following purposes.

a)   Specifying user requirements

Measures of usability can be used to identify and specify criteria for user requirements and to provide a benchmark for future comparisons.

b)   Evaluating whether requirements have been met

Designs or systems can be evaluated to establish that they meet user requirements.

c)   Making comparisons

Comparisons can be made between the usability that results from use of different systems, products or services, or between different versions, or with an established benchmark.

Effectiveness, efficiency and satisfaction can be specified or measured in an intended context of use. For measures to be reliable, they should be based on representative users carrying out representative tasks in representative contexts of use. ISO/TS 20282-2 is an example of such a test method, and ISO/IEC 25062 is an example of how these types of measures can be documented.

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