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Ergonomic requirements for office work with visual display terminals (VDTs) —

Part 11:
Guidance on usability

Exigences ergonomiques pour travail de bureau avec terminaux à écrans de visualisation (TEV) —

Partie 11: Lignes directrices relatives à l'utilisabilité

ISO 9241-11:1998(E)

Contents

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 9241-11 was prepared by Technical Committee ISO/TC 159, *Ergonomics*, Subcommittee SC 4, *Ergonomics of human-system interaction.*

ISO 9241 consists of the following parts, under the general title *Ergonomic requirements for office work with visual display terminals (VDTs):*

— *Part 1: General Introduction*
— *Part 2: Guidance on task requirements*
— *Part 3: Visual display requirements*
— *Part 4: Keyboard requirements*
— *Part 5: Workstation layout and postural requirements*
— *Part 6: Environmental requirements*
— *Part 7: Requirements for display with reflections*
— *Part 8: Requirements for displayed colours*
— *Part 9: Requirements for non-keyboard input devices*
— *Part 10: Dialogue principles*
— *Part 11: Guidance on usability*
— *Part 12: Presentation of information*
— *Part 13: User guidance*
— *Part 14: Menu dialogues*
— *Part 15: Command dialogues*
— *Part 16: Direct manipulation dialogues*
— *Part 17: Form-filling dialogues*

Annexes A to E of this part of ISO 9241 are for information only.

Introduction

The objective of designing and evaluating visual display terminals for usability is to enable users to achieve goals and meet needs in a particular context of use. ISO 9241-11 explains the benefits of measuring usability in terms of user performance and satisfaction. These are measured by the extent to which the intended goals of use are achieved, the resources that have to be expended to achieve the intended goals, and the extent to which the user finds the use of the product acceptable.

ISO 9241-11 emphasizes that visual display terminal usability is dependent on the context of use and that the level of usability achieved will depend on the specific circumstances in which a product is used. The context of use consists of the users, tasks, equipment (hardware, software and materials), and the physical and social environments which may all influence the usability of a product in a work system. Measures of user performance and satisfaction assess the overall work system, and, when a product is the focus of concern, these measures provide information about the usability of that product in the particular context of use provided by the rest of the work system. The effects of changes in other components of the work system, such as the amount of user training, or the improvement of the lighting, can also be measured by user performance and satisfaction.

The term usability is sometimes used to refer more narrowly to the attributes of a product which make it easier to use (see Annex D). Requirements and recommendations relating to the attributes of the hardware, software and environment which contribute to visual display terminal usability, and the ergonomic principles underlying them, are provided in other parts of ISO 9241.

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ISO 9241-11:1998(E)

Ergonomic requirements for office work with visual display terminals (VDTs) —

Part 11:
Guidance on usability

1 Scope

ISO 9241-11 defines usability and explains how to identify the information which is necessary to take into account when specifying or evaluating usability of a visual display terminal in terms of measures of user performance and satisfaction. Guidance is given on how to describe the context of use of the product (hardware, software or service) and the relevant measures of usability in an explicit way. The guidance is given in the form of general principles and techniques, rather than in the form of requirements to use specific methods.

The guidance in ISO 9241-11 can be used in procurement, design, development, evaluation, and communication of information about usability. ISO 9241-11 includes guidance on how the usability of a product can be specified and evaluated. It applies both to products intended for general application and products being acquired for or being developed within a specific organization.

ISO 9241-11 also explains how measures of user performance and satisfaction can be used to measure how any component of a work system affects the whole work system in use.

The guidance includes procedures for measuring usability but does not detail all the activities to be undertaken. Specification of detailed user-based methods of measurement is beyond the scope of ISO 9241-11, but further information can be found in Annex B and the bibliography in Annex E.

ISO 9241-11 applies to office work with visual display terminals. It can also apply in other situations where a user is interacting with a product to achieve goals. ISO 9241 parts 12 to 17 provide conditional recommendations which are applicable in specific contexts of use. he guidance in this Part of ISO 9241 can be used in conjunction with ISO 9241 Parts 12 to 17 in order to help identify the applicability of individual recommendations.

ISO 9241-11 focuses on usability and does not provide comprehensive coverage of all objectives of ergonomic design referred to in ISO 6385. However, design for usability will contribute positively to ergonomic objectives, such as the reduction of possible adverse effects of use on human health, safety and performance.

ISO 9241-11 does not cover the processes of system development. Human-centred design processes for interactive systems are described in ISO 13407.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this part of ISO 9241. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this part of ISO 9241 are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 6385:1981, *Ergonomic requirements in the design of work systems.*

3 Definitions

For the purposes of this part of ISO 9241, the following definitions apply:

3.1 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.

NOTE —   See Annex D for other approaches to usability.

3.2 effectiveness: Accuracy and completeness with which users achieve specified goals.

3.3 efficiency: Resources expended in relation to the accuracy and completeness with which users achieve goals.

3.4 satisfaction: Freedom from discomfort, and positive attitudes towards the use of the product.

3.5 context of use: Users, tasks, equipment (hardware, software and materials), and the physical and social environments in which a product is used.

3.6 work system: System, consisting of users, equipment, tasks and a physical and social environment, for the purpose of achieving particular goals.

NOTE —   The context of use consists of those components of the work system which are treated as given when specifying or measuring usability.

3.7 user: Person who interacts with the product.

3.8 goal: Intended outcome.

3.9 task: Activities required to achieve a goal.

NOTE 1   These activities can be physical or cognitive.
NOTE 2   Job responsibilities can determine goals and tasks.

3.10 product: Part of the equipment (hardware, software and materials) for which usability is to be specified or evaluated.

3.11 measure (noun) : Value resulting from measurement and the process used to obtain that value.

4 Rationale and benefits

Usability is an important consideration in the design of products because it is concerned with the extent to which the users of products are able to work effectively, efficiently and with satisfaction.

The usability of products can be improved by incorporating features and attributes known to benefit the users in a particular context of use. In order to determine the level of usability achieved, it is necessary to measure the performance and satisfaction of users working with a product. Measurement of usability is particularly important in view of the complexity of the interactions between the user, the goals, the task characteristics and the other elements of the context of use. A product can have significantly different levels of usability when used in different contexts.

Planning for usability as part of the design and development of products involves the systematic identification of requirements for usability, including usability measures and verifiable descriptions of the context of use. These provide design targets which can be the basis for verification of the resulting design.

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The approach adopted in ISO 9241-11 has benefits which include:

— The framework can be used to identify the aspects of usability and the components of the context of use to be taken into account when specifying, designing or evaluating the usability of a product.

— The performance (effectiveness and efficiency) and satisfaction of the users can be used to measure the extent to which a product is usable in a particular context.

— Measures of the performance and satisfaction of the users can provide a basis for the comparison of the relative usability of products with different technical characteristics which are used in the same context

— The usability planned for a product can be defined, documented and verified (e.g. as part of a quality plan).

5 Specifying and measuring the usability of products

5.1 Framework for specifying usability

5.1.1 Purpose

The framework describes the components of usability and the relationship between them.

5.1.2 Components of usability

In order to specify or measure usability it is necessary to identify the goals and to decompose effectiveness, efficiency and satisfaction and the components of the context of use into sub-components with measurable and verifiable attributes. The components and the relationships between them are illustrated in figure 1.
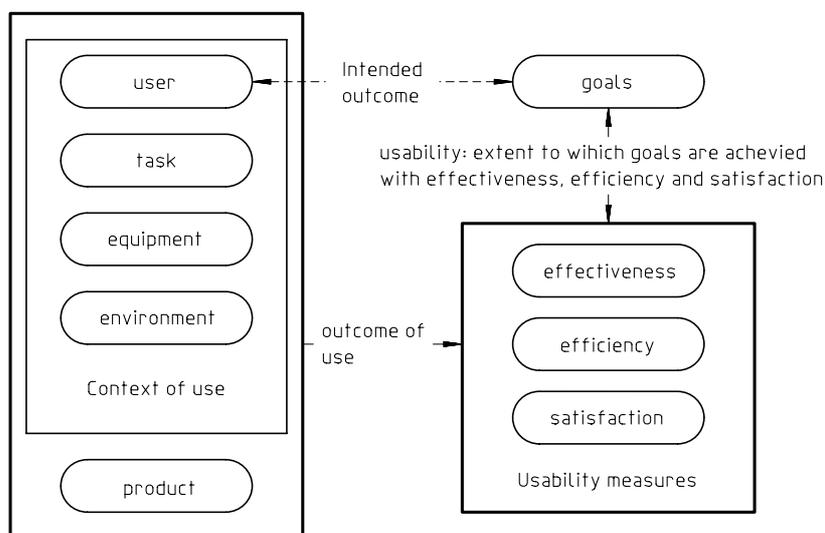

Figure 1 — Usability framework

5.1.3 Information needed

When specifying or measuring usability, the following information is needed:

— a description of the intended goals;

— a description of the components of the context of use including users, tasks, equipment, and environments. This may be a description of an existing context, or a specification of intended contexts. The relevant aspects of the context and the level of detail required will depend on the scope of the issues being addressed. The description of the context needs to be sufficiently detailed so that those aspects of the context which may have a significant influence on usability could be reproduced;

— target or actual values of effectiveness, efficiency, and satisfaction for the intended contexts.

5.2 Description of goals

The goals of use of a product should be described. Goals may be decomposed into subgoals which specify components of an overall goal and the criteria which would satisfy that goal. For example, a telephone sales clerk might have the goal to "Maintain customer orders". This overall goal might then be decomposed into subgoals such as:

— "Make accurate record of all orders placed by customers";

— "Provide information rapidly in response to customer inquiries about orders placed".

The level at which the overall goal is set is a function of the boundary of the work system which is under consideration and which provides the context of use. In the example above, the work system under consideration consists of clerks taking telephone orders.

5.3 Context of use

5.3.1 Description of users

Relevant characteristics of the users need to be described. These can include knowledge, skill, experience, education, training, physical attributes, and motor and sensory capabilities. It may be necessary to define the characteristics of different types of user, for example users having different levels of experience or performing different roles.

5.3.2 Description of tasks

Tasks are the activities undertaken to achieve a goal. Characteristics of tasks which may influence usability should be described, e.g. the frequency and the duration of the task.

Detailed descriptions of the activities and processes may be required if the description of the context is to be used as a basis for the design or evaluation of details of interaction with the product. This may include description of the allocation of activities and steps between the human and technological resources. Tasks should not be described solely in terms of the functions or features provided by a product or system. Any description of the activities and steps involved in performing the task should be related to the goals which are to be achieved.

For the purposes of evaluating usability, a set of key tasks will typically be selected to represent the significant aspects of the overall task.

NOTE — User tasks and subtasks can be identified by task analysis (for more information see the bibliography in Annex E).

5.3.3 Description of equipment

Relevant characteristics of the equipment need to be described. The description of the hardware, software and materials associated with a visual display terminal may be in terms of a set of products (or system components), one or more of which may be the focus of usability specification or evaluation, or it may be in terms of a set of attributes or performance characteristics of the hardware, software and other materials.

5.3.4 Description of environments

Relevant characteristics of the physical and social environment need to be described. Aspects which may need to be described include attributes of the wider technical environment (e.g. the local area network), the physical environment (e.g. workplace, furniture), the ambient environment (e.g. temperature, humidity) and the social and cultural environment (e.g. work practices, organisational structure and attitudes).

5.3.5 Examples

Annex A gives examples of how the components of the context of use can be described in terms of characteristics which may be relevant to usability.

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5.4 Usability measures

5.4.1 Choice of measures

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

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

If it is not possible to obtain objective measures of effectiveness and efficiency, subjective measures based on the user's perception can provide an indication of effectiveness and efficiency.

5.4.2 Effectiveness

Measures of effectiveness relate the goals or subgoals of the user to the accuracy and completeness with which these goals can be achieved.

For example if the desired goal is to accurately reproduce a two-page document in a specified format, then accuracy could be specified or measured by the number of spelling mistakes and the number of deviations from the specified format, and completeness by the number of words of the document transcribed divided by the number of words in the source document.

5.4.3 Efficiency

Measures of efficiency relate the level of effectiveness achieved to the expenditure of resources. Relevant resources can include mental or physical effort, time, materials or financial cost. For example, human efficiency could be measured as effectiveness divided by human effort, temporal efficiency as effectiveness divided by time, or economic efficiency as effectiveness divided by cost.

If the desired goal is to print copies of a report, then efficiency could be specified or measured by the number of usable copies of the report printed, divided by the resources spent on the task such as labour hours, process expense and materials consumed.

5.4.4 Satisfaction

Satisfaction measures the extent to which users are free from discomfort, and their attitudes towards the use of the product.

Satisfaction can be specified and measured by subjective rating on scales such as discomfort experienced, liking for the product, satisfaction with product use, or acceptability of the workload when carrying out different tasks, or the extent to which particular usability objectives (such as efficiency or learnability) have been met. Other measures of satisfaction might include the number of positive and negative comments recorded during use. Additional information can be obtained from longer-term measures such as rate of absenteeism, observation of overloading or underloading of the user's cognitive or physical workload, or from health problem reports, or the frequency with which users request transfer to another job.

5.4.5 Further examples

Further examples of measures that can be used for assessing usability are included in Annexes B and C.

5.5 Interpretation of measures

Care should be taken in generalizing the results of any measurement of usability to another context which may have significantly different types of users, tasks or environments. If measures of usability are obtained over short periods of time, the values may not take account of infrequent events which could have a significant impact on usability, for example intermittent system errors.

For a general-purpose product, it will generally be necessary to specify or measure usability in several different representative contexts, which will be a subset of the possible contexts and of the tasks which can be performed. There may be differences between usability in these contexts.

6 Specification and evaluation of usability during design

6.1 Specification of the intended context of use for a product

Information about the characteristics of users, their goals and tasks and the environments in which the tasks are carried out provides important information for use in the specification of overall product requirements, prior to development of specific usability requirements.

6.2 Specification of usability requirements for a product

Prior to development, an organisation seeking to acquire a product specifically adapted to its needs can use the information in ISO 9241-11 as a framework for specifying the usability requirements which the product should meet and against which acceptance testing may be carried out. Specific contexts in which usability is to be measured should be identified, measures of effectiveness, efficiency and satisfaction selected, and acceptance criteria based on these measures established (an example is given in Annex C).

6.3 Product development

The definition and framework for usability can be used by product development teams to establish a common understanding of the concept of usability, and can help product development teams address the breadth of issues associated with product usability.

A developer can use the guidance in ISO 9241-11 to help specify usability targets for the product (see Annex C). At various stages during the development process the developer can measure the usability achieved against these targets. This information enables objective decisions to be taken about the need for design changes to enhance usability, and about trade-offs which may be appropriate between usability and other requirements.

6.4 Specification or evaluation of product attributes

The guidance on context of use can be used to identify the users, tasks and environments so that more accurate judgements can be made about the needs for particular product attributes.

6.5 Usability measurement

ISO 9241-11 provides information to support measurement of usability. For example, description of the characteristics of users can assist with the selection of users to participate in evaluation. Identification of user's goals can assist with the selection of appropriate tasks for usability testing or reviews. The characteristics of the environment in which a product is likely to be used need to be described if that environment has to be simulated to ensure the validity of test results.

ISO 9241-11 also provides a basis from which measures of usability can be generated. Product developers can develop appropriate measures of efficiency, effectiveness, and/or satisfaction (see Annex B).

6.6 Usability input to a quality plan

The activities listed in 6.1 to 6.5 can provide a basis for defining, documenting and verifying usability as a part of a quality plan. Figure 2 outlines the relationship between these activities and the resulting documents and other forms of output. These could be included in a quality plan (e.g. as described in ISO 9000-3).

6.7 Comparative evaluation of products

The guidance in ISO 9241-11 can be used to assist in making a choice between products already available. Having specified the usability requirements in terms of the intended goals, context of use and which measures of effectiveness, efficiency and satisfaction are to be used, the guidance can then be used to specify test conditions and evaluation criteria. The test conditions should be representative of important aspects of the overall context of use.
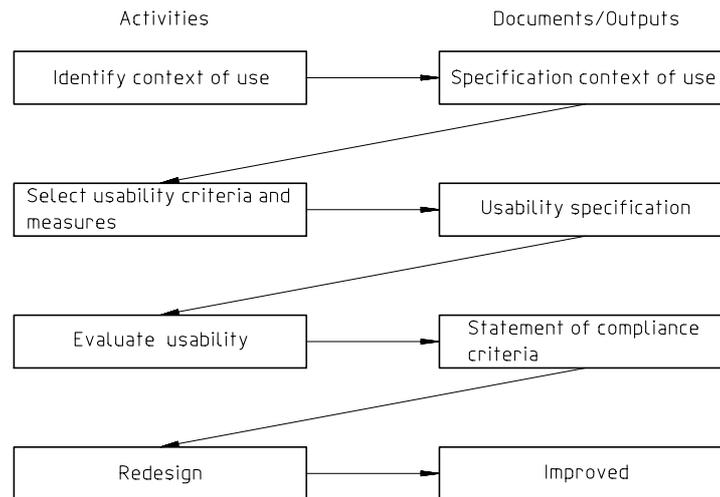
Activities   Documents/Outputs

| Identify context of use | → | Specification context of use |

| Select usability criteria and measures | → | Usability specification |

| Evaluate usability | → | Statement of compliance criteria |

| Redesign | → | Improved |

Figure 2 — Usability activities and associated documents

6.8 Use with other International Standards

Other parts of ISO 9241, such as ISO 9241-14, contain recommendations which are applicable in particular contexts of use. The guidance in ISO 9241-11 can be used to provide a framework for identifying the goals and context of use which is relevant to the design decision to be made. Annex D contains more information on the relationship with other parts of ISO 9241 and other International Standards.

7 Specifying and measuring a work system in use

7.1 Relationship to usability

If the aim is to improve the overall work system, any part of the work system can be the subject of design or evaluation. Measures of effectiveness, efficiency and satisfaction can be used to evaluate any component of the work system. For example, it may be appropriate to consider the amount of user training to be provided, changes in lighting, or re-organisation of the task. In each case the element which is the object of design or evaluation is considered to be subject to potential variation, while the other elements of the work system are treated as fixed. When a product is the focus of concern, these measures provide information about the usability of that product in the particular context of use provided by the rest of the work system.

7.2 Examples of application

7.2.1 Design of a complete work system

When designing a complete work system usability can be optimised by changing components of the context of use of a product, such as the version of the operating system, lighting or amount of user training. In this case measures of effectiveness, efficiency and satisfaction can be used to specify or evaluate the effect of a new version of the operating system, different types of lighting, or different amounts of user training respectively.

7.2.2 Diagnostic evaluation

If a work system is judged to be unsatisfactory, systematic analyses of the contribution of different components of the context of use should be conducted. Both direct contributions and the interactions between the components of the context of use should be considered in order to determine the principal causes of the problems. This process may also be used to identify which components are amenable to change, in order to bring about improvements in the overall work system. Diagnostic activity relating to the context of use is often necessary to determine whether problems are due to the product or other components of the work system.