SLOVENSKI STANDARD
SIST EN 16710-2:2016

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Ergonomija - 2. del: Metodologija za analizo dela za podporo razvoju in načrtovanju

Ergonomics methods - Part 2: A methodology for work analysis to support design

Verfahren der Ergonomie - Teil 2: Eine Methodologie für die Arbeitsanalyse zur Unterstützung von Entwicklung und Design

Ergonomie - Partie 2: Méthodologie d'analyse du travail à l'appui de la conception

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ICS:

13.110	Varnost strojev	Safety of machinery
13.180	Ergonomija	Ergonomics

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

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European foreword

This document (EN 16710-2:2016) has been prepared by Technical Committee CEN/TC 122 “Ergonomics”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 2016, and conflicting national standards shall be withdrawn at the latest by September 2016.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

EN 16710 consists of the following parts under the general title *Ergonomics methods*:

— *Part 1: Feedback method - A method to understand how end users perform their work with machines* (Technical Report)

— *Part 2: A methodology for work analysis to support design*

These present independent methods that can be used to support the implementation of ergonomics principles, for example as advocated in EN ISO 12100 and the EN 614 series.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

The ergonomic design approach involves considering human capabilities, skills, limitations and needs. It is developed on the basis of a decision process, which calls upon not only scientific and technical knowledge data provided by existing standards but also expression of the "know-how" capitalised by the intended user population. Know-how and other knowledge data provided by standards can only become meaningful when based on preliminary analysis of real-work.

Ergonomics design focuses on the actual activity of operators. The methodology described in this European Standard therefore increases the effectiveness and efficiency of the machinery or system being designed; improves human working conditions; and reduces adverse effects on health, safety and performance.

This methodology can lead to one or more suitable solutions embracing situations to be confronted by future users. Applying this will raise productivity, improve work quality, reduce technical support, maintenance and training needs, and will enhance user/operator satisfaction.

Application of this methodology will be most effective when management is closely involved (adoption, communication, etc.).

Extensive ergonomics knowledge exists in relation to organizing and establishing an efficient design process. Applying this knowledge, this present European Standard structures a user-based approach and proposes corresponding requirements for project managers. This approach complements existing design methods and requires reference to ergonomists.

This process concerns both established, as described by EN ISO 12100, and emergent risks and their association with the independent evolution of any system, user variability and conditions of equipment usage.

In this respect, the methodology for work analysis presented in this document is based on the resultant design being at least partly determined by anticipated future developments, especially those indicated by the client.

This is a shared procedure, in which the client provides specifications detailing the knowledge helpful to a design suited to the needs and expectations of users. Examples of the contribution of an ergonomics design approach to preparing specifications are included in informative Annex A.

Design based on an ergonomics process is necessary to meet any "performance obligation" (i.e. obligation of result).

This European Standard complements knowledge generated by work activity analysis to enhance the quality of references and other solutions validated within a participative framework. This is indeed the case when a compromise solution cannot be found in relation to a specific point because the underlying knowledge cannot be validated. This European Standard facilitates orientation towards a shared final decision.

1 Scope

This European Standard describes a procedure for analysing human activity in relation to specifying and refining the human component in the design or redesign of machinery and work systems.

NOTE 1 The ergonomics methodology described in this European Standard could also be applied to the design or redesign of products and non-work systems.

This European Standard is intended to assist project leaders in implementing human and physical resources, methods and schedules as well as in preparing the documents necessary to meeting related requirements.

The ergonomics methodology described can be applied to all different stages in design projects from the earliest concept to the final “prototype” or “mock-up”, whatever the industrial field or sector.

The objective of this European Standard is to achieve a solution that takes into account as many situations as possible which all users - including operators, maintenance staff and installers, may encounter. This will ultimately allow improved usability of the machinery and more robust technical solutions, combined with significantly greater system resilience, user autonomy and accessibility.

NOTE 2 Examples of the application of the methodology described in this European Standard are provided in Annex A.

2 Terms and definitions

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

2.1
ergonomics
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 optimise human well-being and overall system performance

[SOURCE: EN ISO 26800:2011, 2.2]

2.2
worker
operator
person performing one or more tasks within the work system

[SOURCE: EN ISO 6385:2004, 2.8]

2.3
work activity
manner in which a prescribed task is, in reality, performed

2.4
work system
system comprising one or more workers and work equipment acting together to perform the system function, in the workspace, in the work environment, under the conditions imposed by the work tasks

[SOURCE: EN ISO 6385:2004, 2.16]

2.5
accessibility
extent to which products, systems, services, environments and facilities can be used by people from a population with the widest range of characteristics and capabilities to achieve a specified goal in a specified context of use

[SOURCE: EN ISO 26800:2011, 2.1]

2.6
work equipment
tools, including hardware and software, machines, vehicles, devices, furniture, installations and other components used in the work system

[SOURCE: EN ISO 6385:2004, 2.7]

2.7
assumption
proposal relating to the explanation or interpretation of phenomena, observable facts and solution principles, assumed temporarily before being subjected to checking

Note 1 to entry: In observing workers the observer should verify any hypotheses concerning knowledge acquired regarding the work and its translation into solution principles with the workers concerned.

2.8
prescribed task
formal description of how a task is expected to be performed

EXAMPLE prescribed and prohibited tools, conditions of use, procedures, order of operations etc.

3 General requirements in specifying the human components

3.1 User experience and resultant activity

Ergonomics design involves considering all work situations that may be encountered by intended users. Users of machinery and of other systems performing the same or similar functions, possess a variety of levels of skills (including procedures for anticipating and avoiding risks) and knowledge of various constraints concerning individual and collective performance (described by the term “know-how”). Systematically collecting this know-how is fundamental to decision making in developing the design of a new machine and or work system. The know-how of an individual has a strong influence on their activity. It is essential to understand the motivations induced by the work system and the experiences of the user, which determines their observed activity.

To maximize accessibility, the design shall take account of the full range of users depending on the objectives of design including, where applicable, older people and those with disabilities. This requires the designer to consider characteristics which are associated with increasing age. It might also include identifying specific subgroups that should be included, for example people with impaired hearing, those with cognitive impairment, and people who are already using assistive technologies or who might require individualized solutions or alternative means of access. For this purpose, the approach described by this European Standard firstly requires identification of reference situations, in which work analysis will be performed. Reference situations are situations close enough to the design situation to enable the extraction of the knowledge data required, to enrich the specifications for the system (machinery, work system, product, etc.) to be designed.

A key part of that knowledge data will be the assumptions made by individuals in operating existing systems (machines and or work systems) in these reference situations.

This type of knowledge, concerning real work situations, is valuable in specifying system functionality consistent with work system requirements.

Figure 2 (see 5.1) illustrates the work activity's central position in understanding work system operation. It is necessary to proceed iteratively in establishing relationships between different components of the overall work situation. The work activity analysis methodology is described in 5.3. The knowledge generated by these analyses and their translation into specifications requires validation by the intended personnel. 7.2 describes the validation of the outcomes.

3.2 Limitations of the scientific and technical knowledge provided by existing ergonomics standards

A standard aims to smooth out differences to produce a standard applicable to all situations and conditions. However, it is unable to integrate specific characteristics of the work context. Both existing variability criteria and an ergonomic design approach require consideration of these differences.

Variability can be:

— industrial: raw material quality, adherence to delivery times, etc.;

— inter-individual: age, gender, morphology, experience, know-how, etc.;

— intra-individual: chronobiology, ability to act, etc.;

— contextual: organization, daily period, yearly period, night work, etc.

It is these sources of variability that essentially qualify the real operation of work systems and hence production systems. They should therefore be taken into account.

Within an ergonomics design framework, the standard implemented as an assessment tool appears to be a component contributing to the resulting validation process. The two processes, involving assessment by standards and work knowledge validation by intended operators, combine to reinforce decision-making rigour, a guarantee of design system sustainability.

4 Fundamentals

4.1 Participatory approach

Personnel participation in implementing and developing a project is a valuable part of the design process. It simultaneously enriches the knowledge generated in relation to user activity and validates the principles behind solutions or other references to be considered in the design. Clearly defined at the start, these objectives are immune from any risk of the approach being instrumentalized, e.g. by seeking acceptance by relevant personnel in relation to technical options selected without their involvement.

Participation is particularly beneficial when the personnel involved form a population similar to the one destined to operate the planned system. It is therefore a key factor in that it facilitates appropriation of future situations.

The ergonomics design process described in this European Standard envisages a participatory approach between all parties involved. As illustrated in Figure 1 for example, particularly for lager projects, this could involve the formation of a steering committee, responsible for formulating the design. Under the leadership of a project manager, this steering committee would be the decision-making body (final validation). Membership of such a committee should include representation from users, supervisors and managers, and project designers, as well as personnel with ergonomics and occupational health and/or safety knowledge and expertise. The participative structure of the ergonomics design process outlined, establishes a system for transfer of information between a steering committee and working groups established by that committee.

The working groups should include one or more “operator” working groups (WGO_1, WGO_2 ...), made up from volunteers drawn from appropriately experienced operators within the workforce (professionally qualified where appropriate). Inclusion of supervisory personnel in an “operator” working group is likely to focus the thinking of that group on technical options rather than understanding human and social issues. It is therefore recommended to include them in a specific “supervisor” working group (WGS).

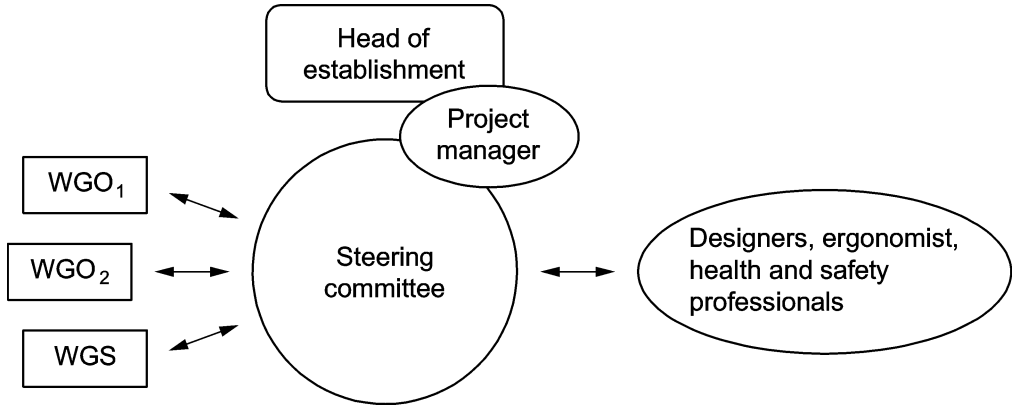

Figure 1 — Organisational structure of steering committee and working groups

Under the leadership of an ergonomist, the personnel in a working group discuss the knowledge derived from the analysis of work, performed under current or similar reference conditions. They should observe and analyse the work performed by a number of operators in real conditions. It is important to gather information about actual task performance. Based on this analysis, and drawing on their own knowledge and expertise, they propose, and provide the initial endorsement of possible solutions. At this level, standards or other technical and scientific knowledge are helpful for assessing results and consolidating potential solutions.

Based on knowledge acquired by themselves, working groups provide a forum for “proposals”, while the steering committee seeks the best compromises and validates specifications to be forwarded to the designer(s), albeit under the responsibility of the company manager.

4.2 Work analysis

Work analysis is based on methods and a corpus of scientific knowledge involving human functioning, as well as other knowledge relating to work organization, preventive health and safety regulations and standardization. All these areas contribute to the consideration of physical and mental health in designing work situations and equipment.

In analysing work activities, it is important to differentiate between the operations prescribed (e.g. instructions, procedures, checklists) for carrying out work tasks and those actually performed. Limiting work analysis to analysing tasks as prescribed is insufficient. It is essential to analyse how tasks are actually performed by considering the influences of work situation, context and operator variability in relation to their performance. This is then referred to as the analysis of an actual work activity. The activity is what is implemented by the operator in order to achieve the task goal.

Analysis of the work as it is really performed requires application of a combination of observation, description and interpretation methods, and assigns the operator to a central position in the analysis process.

The prescribed task is a reference or benchmark for optimal conditions and the analyst should avoid placing undue emphasis on this in carrying out the analysis and being judgemental due to expectations of how the task should be performed.

The analysis is not limited to observable behaviour. It is necessary for the analyst to understand contextual and other factors, which influence why the operator does not perform the task as prescribed.

The approach is heuristic, guided by uncovering new working hypotheses, which may lead to solutions that are innovative and best adapted to the variability of contexts and situations.

Analysing key factors within the overall work situation, together with reference to appropriate standards, aids the interpretation of the results provided by the work activity analysis and assists in understanding any operating difficulties identified during discussions with the relevant operators (see Figure 2, showing overlapping of means/resources and activity).

In order to optimize the relationship between a human and his environment (ergonomics) it is therefore essential to go beyond analysing the prescribed task to understand observed activity. Involving intended users as co-designers provides the basis for sustainable implemented solutions whose underlying principles will have been detailed in the design specifications.

5 Elements of methodology

5.1 Analysis of overall work situation components

Figure 2 shows the overall work situation in terms of the "Resources" and "Means" required to implement the work activity. It illustrates the interrelationships and interactions between all parts of the overall work situation. A work situation is qualified as "overall" insofar as it requires consideration of the links between its various internal and external components, which may affect the work activity.

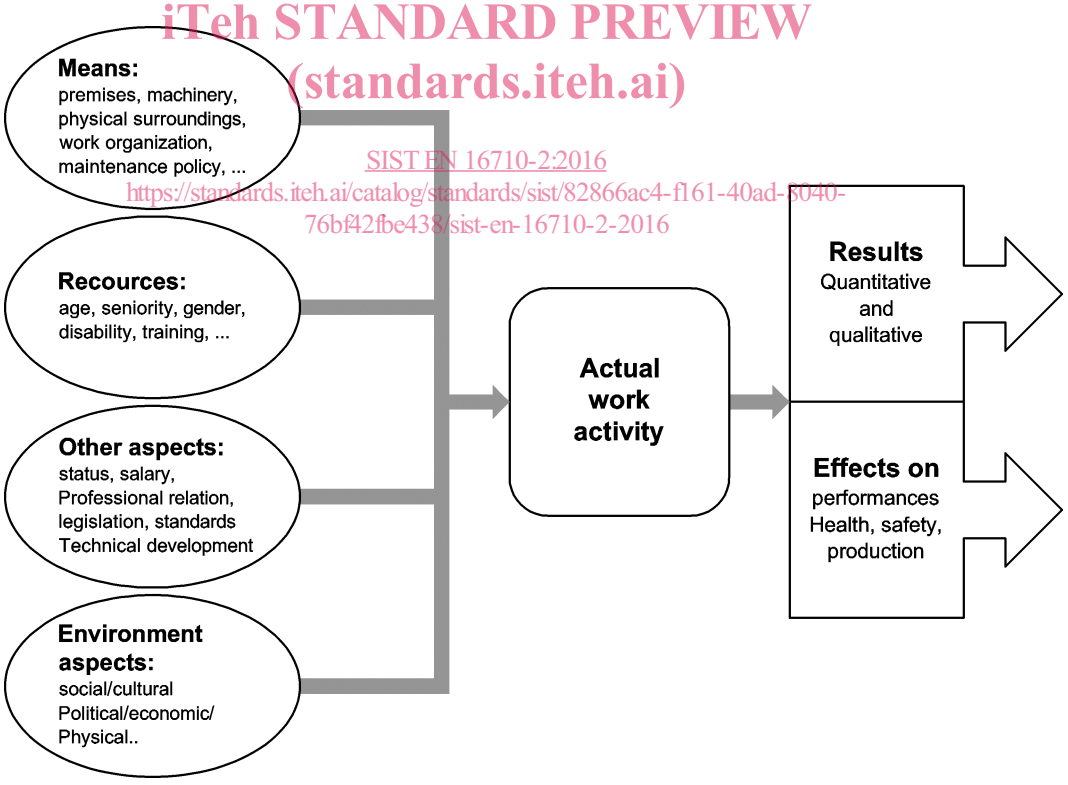

Figure 2 — Overall work situation

Analysis initially concerns a set of determining factors grouped under the headings "Resources" and "Means".