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Ergonomics methods —

Part 1: Feedback method — A method to understand how end users perform their work with machines

Ergonomie —

Partie 1: Méthode de retour d'expérience — Méthode permettant de comprendre la manière dont les utilisateurs finaux effectuent leur travail au moyen de machines

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Foreword

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This document was prepared by the European Committee for Standardization (CEN) (as CEN/TR 16710-1:2015) and was adopted without modification other than those given below.. It was assigned to Technical Committee ISO/TC 159, *Ergonomics*, Subcommittee SC 1, *General ergonomics principles*, and adopted under the “fast-track procedure”.

— Source documents for 3.8, 3.18, 3.19 have been updated to ISO 6385:2016.

— Definition 3.16 has been supplemented by Note to Entry 1 to 3.

A list of all parts in the ISO 16710 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The importance of involving users in the design of machinery is recognized in most standards that deal with ergonomic design principles. In fact, i.e. EN 614-1 strongly recommends user involvement because it helps to identify measures and improvements for future design.

CEN Guide 414, ISO 6385, ISO 9241-210 and ISO 12100 also provide for feedback from the end-users of machinery, and affirm the need to continue monitoring the effect of the system in order to safeguard against long-term deterioration in the performance or health of the users.

Collecting users' experiences by reconstructing their activities, how they perform their work in different real-life operating conditions, will yield knowledge of the problems that emerge from common, everyday use and help to identify possible corrections and improvements to harmonized technical standards and machinery design and manufacture.

In the context of machinery safety, it is widely accepted that end-users possess extensive knowledge of the equipment they work with every day.[15] Collecting this information as feedback from end-users, mainly workers, provides a basis not just for improving machinery standards by incorporating ergonomics principles,[17] but also for putting standards to work and monitoring their quality over the years. Those who can benefit from such knowledge include:

— CEN and ISO and national standardization committees and working groups who can become aware of the problems relating to the real use of specific machine in different work contexts, and will thus be able to draw up new or to revise existing standards accordingly;

— designers (who are involved in the design or redesign) and manufacturers enabling them to produce better, more comfortable and safer machines and to provide precise, clear and exhaustive instructions for use;

— employers/buyers to help them choose the best available machinery on the market;

— the end users, employers, artisans and workers for training purposes and for defining appropriate work procedures;

— market surveillance, authorities to enhance their knowledge and improve the efficiency of their interventions;

— the machinery working group (MWG) chaired by the European Commission, whenever they need to collect further details on machinery design problems tabled during the MWG meetings.

Studies have shown that the "Feedback Method" described in this document has a high level of repeatability, as demonstrated by the results obtained in many different production contexts in seven different European member states from applying this method to five CE-marked machines manufactured in conformity with their specific C-standard (see Annex A).

The full participation and support of employees, employers, users and buyers of machinery, technicians and market surveillance personnel in putting the "Feedback Method" into practice is key to its successful application.

Within these studies, a detailed ergonomic analysis of the work with each machine, involving a number of work groups, yielded a large body of valuable information on the specific characteristics of machine use in different work contexts and socio-cultural, climatic and microclimatic environments.

Using the standardized method described in this document, that makes little demand on time and resources, multiple work groups can easily be set up to collect skilled users' experiences with a specific machine and to use this valuable information to:

a) identify failings in the appropriate technical standard or the design rather than in its use;

b) validate the results already obtained;

c) monitor improvements in the work activity and the efficacy of the ergonomic and safety solutions applied.

The outcomes of the method described in this document can also be used for evaluating and/or designing new machinery similar to the one under study.

EXAMPLE When dealing with the roll-over risk of any self-propelled machinery with a driver on board during use on uneven or lose ground.

The method can be used by workers' representatives or, more generally, representatives of consumers and users, to collect evidence for making improvements to various types of machinery, possibly after the occurrence of unwanted events during the use of a machine, so as to identify the causes and possible solutions.

Where appropriate, recommendations can then be forwarded to the appropriate ISO/IEC Technical Committees. For example, one important safety recommendation for any revision of ISO 21281 is to standardize the position of the main foot pedals to avoid the risk of confusion and accidents. Figure 1 shows the differences in pedal layout identified during the application of the "Feedback Method" to fork-lift trucks.

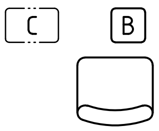	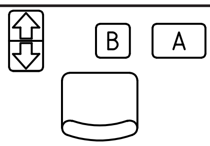	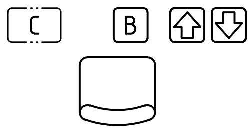	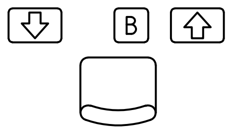
Manual selector of direction. Right-foot-operated (car-like) accelerator.	Left-foot-operated selector of direction. Right-foot-operated accelerator.	Right-foot-operated selector of direction and right-foot-operated accelerator.	Foot-operated selector of direction and accelerator (both left and right feet).
A = Accelerator **B** = Brake and/or approach at reduced speed **C** = Clutch coupling (if present) or approach at reduced speed			

Figure 1 — Illustration of the various foot pedal layouts identified in different fork-lift trucks

Ergonomics methods —

Part 1: Feedback method — A method to understand how end users perform their work with machines

1 Scope

This document describes the "Feedback Method", a method designed specifically to collect the contribution of machinery end-users by reconstructing and understanding how work is actually performed (i.e. the real work). This method can help to improve technical standards, as well as the design, manufacturing, and use of machinery.

By collecting the experiences of skilled users, this method can be used to reconstruct their actual work activities under different operating conditions and with any kind of machine. This helps to identify all the critical aspects having an impact on health and safety, or associated with ergonomic principles. Moreover, it makes it possible to identify some basic elements for defining the standards for machines and for their revision and improvement. It can also improve production efficiency and identify any need for additional study and research.

The method is designed to minimize the influence of the subjectivity of the facilitators and researchers in reconstructing and describing the reality of work, and to maximize the "objective" contribution of the skilled users of the machine.

The method combines a high level of reproducibility, sensitivity, and user-friendliness with low demands in term of resources, which makes it attractive to micro, small and medium-sized enterprises.

This document is addressed to standards writers, designers and manufacturers, employers-buyers, end users, craftsmen and workers, market surveillance and authorities.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12100 and the following apply.

ISO and IEC maintain terminology 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
end-user feedback
information given back by end-users

3.2
expert
skilled end-user
person who has habitually used the machine under investigation for an extended period; normally he has received specific training in the use of the machine through professional courses or directly at the workplace by a tutor, often by the employer or expert co-worker; he is often in charge of training of co-workers in the use of the machine under investigation; he may be considered expert in the installation, use and maintenance of the machine

Note 1 to entry: In micro and small-sized enterprises the expert/skilled end-user is often the employer.

3.3
facilitator
person, who leads the "Feedback Method" Work Groups and collects the contributions of the skilled users of the machinery

Note 1 to entry: The facilitator is competent in leading groups, and in occupational health and safety and the ergonomics of machinery, or is supported by experts in such disciplines.

3.4
Feedback Method
specific method designed and applied to collect the contribution of machinery end-users by reconstructing and understanding the real work, in order to improve technical standards, together with the design, the manufacture and use of machinery

Note 1 to entry: See also [11].

3.5
Feedback Method sheet
document used by the facilitator to guide the discussions of the FMWG and to record the collected information

Note 1 to entry: See 5.6.2.

3.6
Feedback Method Work Group
FMWG
group composed of five to nine experts/skilled end users, coming from different enterprises, which, under the direction of a facilitator, provides the reconstruction and understanding of the real work with a specific machine by means of the "Feedback Method" sheet

3.7
final technical report
synthesis of the results of all the processes of the "Feedback Method" to a specific machine, written by the researcher from the reports of the FMWG meetings with the help, if needed, of other ergonomists/technicians/consultants

Note 1 to entry: The main contents are represented by the critical aspects identified, risks and disorders as well as by the possible solutions and or any need for further research.

3.8
job
organization and sequence in time and space of an individual's work tasks or the combination of all human performance by one worker within a work system

[SOURCE: ISO 6385:2016, 2.16]

3.9
machine dossier
collection of technical documentation and data on the machine, so as to be aware of the main safety issues (i. e. normal and abnormal use, residual risks) and ergonomic requirements as well as health effects and wellbeing of the end users

Note 1 to entry: Information on the productivity, efficiency and efficacy of the machine is also included.

3.10
real work
work as actually performed by workers

Note 1 to entry: Real as opposed to formal work reflects the difference between the formal/designed description of the activities and what is really performed at the workplace.

3.11
report of the FMWG meeting
"Feedback Method" sheets compiled by the facilitator/researcher during the FMWG meetings and validated by each participant

3.12
researcher
person competent in occupational health and safety and ergonomics of the machine, cooperating with others in the planning, execution and reporting of the "Feedback Method", including helping the facilitator to lead the FMWGs

Note 1 to entry: The researcher also contributes to the application of the outcomes to the standardization, design, manufacture and use of the machinery studied.

Note 2 to entry: Market surveillance bodies may also benefit from the outcomes.

3.13
safeguard clause
clause in Article 11 of Directive 2006/42/EC providing for a procedure whereby any measure taken by a Member State (on the grounds of non-compliance with the Essential Health and Safety Requirements, and where it is deemed that equipment is liable to endanger persons, animals or property) for the purpose of withdrawing from the market, prohibiting the placing on the market or restricting the free movement, of equipment accompanied by one of the means of attestation provided for in the Directive and therefore bearing the CE marking, must be immediately notified to the Commission by the Member State, which has taken it

Note 1 to entry: See also [10].

3.14
task
specific activity performed by one or more persons on, or in the vicinity of, the machine during its life cycle

3.15
technical action
elementary manual action required to complete the operations within the cycle

EXAMPLE Holding, turning pushing or cutting.

[SOURCE: ISO 11228-3:2007, 3.1.4]

3.16
user
person who interacts with a system, product or service

Note 1 to entry: Adapted from ISO 9241-110:2008, 3.8, and ISO 9241-11:1998, 3.7.

Note 2 to entry: The person who uses a service provided by a work system, such as a customer in a shop or passenger on a train, can be considered a user.

Note 3 to entry: A user who is using a system is not a component of that system. However, both the user and the system used can be considered as components of a higher-level system.

[SOURCE: ISO 26800:2011, 1, 2.10]

3.17
work phase
set of tasks required to achieve an intended part of the whole outcome of a work process

3.18
work process
sequence in time and space of the interaction of workers, work equipment, materials, energy and information within a work system

[SOURCE: ISO 6385:2016, 2.7]

3.19
work task
activity or set of activities required by the worker to achieve an intended outcome

[SOURCE: ISO 6385:2016, 2.17]

4 General principles

ISO 12100 requires risk assessments to be based on the experience of users of similar machines and, whenever practicable, an exchange of information with the potential users. It also provides a schematic representation of the risk-reduction process that includes a three-step iterative method. Each step concludes by asking whether the planned risk reduction is obtained.

This question is currently answered at the design stage, whereas a more exhaustive and practical answer could be provided by the collection of the experiences of actual users, not only of similar machines, as required in ISO 12100:2010, 5.2, but also of the same machines already in use.

This requires a structured and standardized method that can also be used by designers; and used systematically to add to their knowledge and provide a clear and unequivocal answer.

A number of standards provide for workers to be involved, both in risk assessment and in the design phase, through the use of prototypes, mock-ups, models and/or laboratory simulations. In simulations, operator feedback can be obtained in various ways including: group discussions, interviews, questionnaires, checklists, and observational studies, see EN 614-2.

Although in principle their value is uncontested, the question remains as to whether simulations can ever capture the complex reality of working with machinery in real life. Simulations with models and prototypes:

— are often confined to pre-defined environments which cannot reflect the real work environment with its multiple variables;

— are time-limited, whereas problems from prolonged actual use of machinery may only arise over longer timeframes;

— are limited to restricted circles of users that are not necessarily reliable and sufficiently heterogeneous samples of the population of real users;

— using machinery in a laboratory inevitably conditions the ways it is used and the worker's responsiveness, thereby rendering his impressions of the machinery unreliable;

— are unable to predict all the possible circumstances that may occur during real use in various production, social and economic contexts.

In contrast, the "Feedback Method" uses a different approach that aims at avoiding these shortcomings. In this approach, the reconstruction and knowledge of working practices is obtained by researchers and facilitators through a detailed ergonomics analysis of end-user feedback, following a specific procedure with the participation of skilled end-users working in different companies.

Emphasis is placed on evaluating the working conditions through observation at the workplace and the need to plan studies to that end with the involvement of workers in the real environment of use. In reality, only the skilled and experienced end-user, the operator at the workplace, is able to provide relevant feedback on real work with a machine.

CEN Guide 414, for the drafting of safety standards, raises the question: "*Is there sufficient feedback on the use of the existing safety standard?*". The "Feedback Method" is appropriately designed to collect users' input in reply to this question.

The description of work activities identifies omissions or issues that are of high intrinsic value for depicting what actually happens in daily real work in different workplaces, as described by those most immediately concerned, skilled machine users. It is important to note that activity descriptions are not those of one individual skilled worker or even the aggregate of many individual skilled workers but the collective product of a group of skilled/expert workers interacting with one another, coordinated by a facilitator.

The work activity may be performed differently in other companies or in other production contexts. The best results are therefore obtained when the same machine and work activity are analysed by more than one work group, possibly in different geographical areas and socio-economic contexts. The description created will need to incorporate this diversity. This enables every user to compare the acquired knowledge against their specific reality and to update and expand the content in a way adapted to their working environment.

5 Feedback method

5.1 The "Feedback method" steps

The "Feedback Method" involves the following seven main steps:

— selection of the machine to be investigated;

— collection of documentation, and preparation of a machine dossier;

— identification of companies where the machine is regularly used;

— inspection of workplaces;

— work groups and work analysis with skilled users of the machine;

— written report of the FMWG results and their validation;

— project overview and final technical report.

5.2 Selection of the machine to be investigated

The "Feedback Method" may be applied whenever stakeholders identify a machine and a corresponding harmonized standard, which merits closer examination and analysis. The principal criteria for selecting the machine to study are:

— number and severity of accidents;

— lack of safety and ergonomic requirements;

— number and geographical dissemination of the machine;

— revision or definition of the machine's standard.

The interest and cooperation of the social partners, workers and employers, manufacturers, buyers and end-users are key requirements for the selection of the machine and the success of the study.