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Some Background on Standards  
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# Usability is easy to use: Some Background on Standards and Processes

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## ABSTRACT

Based on the consideration, that in corporate practice the implementation of the „EU Directive on the minimum safety and health requirements for work with display screen equipment“ [3] is still paid too little attention, this paper describes main standards, which have to be considered during development, selection, purchase and modification of software. The focus is directed at the standards ISO 9241-2: Guidance on task requirements [5], ISO 9241-11: Guidance on usability [6], ISO 9241-110: Dialogue principles [7] and ISO 13407: Human-centred design processes for interactive systems [11]. These software ergonomic standards should not be understood as a displeasing performance duty. In the contrary, they serve the humanised creation of software and thereby the humanised creation of working conditions.

## Author Keywords

software ergonomic standards, ISO 9241-2, ISO 9241-11, ISO 9241-110, ISO 13407

## INTRODUCTION

Usability has high payoffs. It is cost justified, enhances development and customisation processes and leads to reduction of worker's stress. Usability enhances the productivity in computer use [1], reduces the investments in training [13] and support [12] and lowers psychosomatic [4] and musculoskeletal complaints [2].

Regarding this background it is astonishing that usability often has no top priority during software development and implementation [14]. A decisive factor for this is apparently the fact that the „EU Directive on the minimum safety and health requirements for work with display screen equipment“ [3] and its corresponding standards sometimes are neglected in corporate practice (for a „European state-of-the-art overview“ see [16]). Probably this is because the positive chances are hardly identified and their practice is seen as an annoying duty.

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Against this background it is the aim of this paper to provide a short overview over the most important software ergonomic standards explaining their significance for software and, therefore, job design.

## USABILITY STANDARDS

For the humanised creation of human-computer interaction a number of international standards were defined to make demands on the dialogue taking place between user and technology, while carrying out a task.

Of central importance for „usability“ are the international standards ISO 9241 „*Ergonomics of human-system interaction*“ (formerly known as: „Ergonomic requirements for office work with visual display terminals“) and ISO 13407 „*Human-centred design processes for interactive systems*“.

## ISO 9241

### ERGONOMICS OF HUMAN-SYSTEM INTERACTION

The following list includes an overview of the standards already been published within the ISO 9241 framework. Additional parts, e.g. „Guidance on World Wide Web user interfaces“ [8], „Guidance on software accessibility“ [9] and „User performance test methods“ [10] already exist as drafts (for an overview see [www.iso.org](http://www.iso.org)).

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: Guidance on the work environment

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 (formerly part 10)

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

Part 400: Principles and requirements for physical input devices

From the single items one can see that merely the parts 110 and 11-17 are about software ergonomic standards in the narrower sense. Here, especially part 110 „*Dialogue principles*“ [7] and part 11 „*Guidance on usability*“ [6] take up a main position where generally, superior demands are defined being independently applicable of the type of dialogue. Furthermore, ISO 9241-2 delivers „*Guidance on Task Requirements*“ [5].

### ISO 9241-2

#### Guidance on Task Requirements

ISO 9241-2 [5] provides guidelines to users of VDT-based information processing systems with reference to office tasks. This guidance is relevant to both, the organisation implementing the system and the people using the equipment. The objective of ISO 9241-2 [5] is to enhance the efficiency and well-being of the individual user by applying ergonomics knowledge in the light of practical experience, to the design of tasks.

Work means carrying out tasks. Decisive for the efficiency and the well-being of the individual user is the appropriate configuration of the task. What this means is defined in ISO 9241-2 [5] and concretised in seven criteria. They are shortly described in the following.

#### *User Orientation*

Designing tasks should „recognise the experience and capabilities of the user populations“ [5, p. 2].

In the demand for user orientation the awareness is expressed that „the user“ does not exist. User orientation depends on the user's individual knowledge, experience and way of working. Accordingly, tasks with software should be designed to be neither excessively demanding nor unchallenging. The advantage of user orientation is the balance between user conditions and task demands leading to less stress.

#### *Variety*

Tasks should „provide for the application of an appropriate variety of skills, capabilities and activities“ [5, p. 2].

Software is versatile if the user is able to utilize a wide spectrum of her or his competencies and capabilities. Tasks become more versatile if the user is able to switch between routine and challenging tasks; between tasks including work in front of a screen and handwriting; between tasks like reading, sizing, sorting etc. as well as between activities that require them to be sitting or standing. The advantage of variety is the avoidance of uniform stresses.

#### *Task Identity*

The job design should „ensure that the tasks performed are identifiable as whole units of work rather than fragments“ [5, p. 2].

Holistic tasks enable employees to identify the contribution of their job to the whole product; feedback about the progress is the outcome of it. A holistic task contains planning, preparative, implementing and controlling elements. Holistic and complete tasks allow autonomous planning and goal setting - goals which in turn can be arranged in a superior context. This also includes coordination with others, monitoring the results and personal responsibility for decisions made. The advantages of task identity let the user identify the significance and local value of their job and let them receive feedback about her or his own work progress.

#### *Directness*

The job design should „ensure that the tasks performed make a significant contribution to the total function of the system which can be understood by the user“ [5, p. 2].

Here the significance and understandability are combined to form the term directness. Directness is existent, if users perceive their work with software as necessary, important and useful; when they are able to foresee the impact of their work on the job of others; when they receive exact and transparent instructions and feel a high degree of responsibility for their work. An unambiguous task contains exact information about its requirements, like quality and quantity of the results as well as the deadlines which have to be met. The advantages of directness are the realistic planning and accomplishment of work assignments which also increase the motivation of users.

#### *Control*

Designing tasks should „provide an appropriate degree of autonomy to the user in deciding priority, pace and procedure“ [5, p. 2].

Users have an appropriate degree of autonomy, if they are able to choose the way of working, their work equipment, the time line and if they have the possibility to influence a situation according to their own ideas (e.g. varying the pace of work, according to their current form, to delay tasks, that require a higher level of concentration, to a time free of interference, etc.). Even the knowledge that options are available is relaxing. In contrast to that, restricting rules or a too strong guidance by the software appear as stressors. The limitation of choice may lead to interferences in well being, continuous mental and physical disturbances, as well as to a decrease of intellectual performance. Advantage of having control is that the user is able to better cope with stressing situations. Workplaces where employees have a lot of control, can set meaningful goals, are able to make decisions and develop plans, turn out to be beneficial to health.

### *Feedback*

The job design should „provide sufficient feedback on task performance in terms meaningful to the user“ [5, p. 2].

In line with the design of feedback there are two possibilities: feedback by software or feedback by colleagues and disciplinarians. Feedback by software must be unambiguous. The user should have the possibility to request feedback by her- or himself. Constructive feedback by colleagues and disciplinarians mean social support. This dimension decides how employees are able to rely on their work environment. Social support is an important „buffer“ for stress and decisive for the quality of the social interaction with colleagues and disciplinarians. The advantage of feedback is that it is easier to cope with difficulties, when working with software, and easier to bear stresses and strains.

### *Possibility for Development*

The design of tasks should „provide opportunities for the development of existing skills and the acquisition of new skills with respect to the task concerned“ [5, p. 2].

Every job has an effect on the personality of the employee – sometimes bad, sometimes good. Therefore it is important to design tasks that are developing the competencies of the user. For instance, working with software should be challenging and should offer enough complexity; as a consequence user productivity will increase. Improving learning and personality in the job is a necessary requirement for the motivation of the user. Tasks are regarded as negative if an employee constantly has to work above or below her or his capabilities, allowing no development or even leading to loss of qualifications. Possibilities for development offer the user the advantage to keep his mental flexibility and develop job-related qualifications.

### **ISO 9241-11**

#### **Guidance on Usability**

ISO 9241-11 [6] defines usability and explains how to identify the information, which is necessary to take into account, when specifying or evaluating the usability of a visual display terminal, in terms of measures of user performance and satisfaction. ISO 9241-11 [6] defines usability as the „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“ [6, p. 4].

#### *Effectiveness*

In ISO 9241-11 [6] effectiveness is defined as „accuracy and completeness with which users achieve specified goals“ [6, p. 4].

If the user is not able to reach his goals effectiveness is missing. He may need to look for alternatives (e.g. using a calculator) to obtain a result. A lack of effectiveness

generates extensive additional expenses for users and thus, costs.

#### *Efficiency*

In ISO 9241-11 [6] efficiency is defined as „resources expended in relation to the accuracy and completeness with which users achieve goals“ [6, p. 4].

In everyday working life efficiency lacks are common and their effects are added up and multiplied by the number of repetitions. Employment of usability engineering eliminates such losses in efficiency and increases productivity.

#### *Satisfaction*

In ISO 9241-11 [6] satisfaction is defined as „freedom from discomfort, and positive attitudes towards the use of the product“ [6, p. 4].

Here the subjective valuation of the product and the acceptance during the accomplishment of different tasks play a role.

### **ISO 9241-110**

#### **Dialogue Principles**

Part 110 of the international standard ISO 9241 [7] deals with the ergonomic design of interactive systems and describes seven principles that are valid independently from the type of software. These principles of dialogue design should be applied during analysis, design and evaluation of interactive systems. In the following ISO 9241-110 [7] will be introduced and commented.

#### *Suitability for the Task*

„An interactive system is suitable for the task when it supports the user in the completion of the task, i.e. when the functionality and the dialogue are based on the task characteristics (rather than the technology chosen to perform the task)“ [7, p. 8].

Software should be supporting while the user carries out his tasks. The software should be uncomplicated, including all functions to accomplish the tasks efficiently, offering possibilities to automate recurring procedures, not calling for dispensable input – in short: software should be adjusted to the requirements of the task.

#### *Self-descriptiveness*

„A dialogue is self-descriptive to the extent that at any time it is obvious to the users which dialogue they are in, where they are within the dialogue, which actions can be taken and how they can be performed“ [7, p. 10].

Software is self-descriptive if it offers sufficient understandable explanations – either by itself or requested by the user – and if the icons and terms are self-explanatory.

**Conformity with User Expectations**

„A dialogue conforms with user expectations if it corresponds to predictable contextual needs of the user and to commonly accepted conventions“ [7, p. 11].

Software follows the principle of conformity with user expectations if it meets the requirements and habits of the user with a consistent and understandable design – easing orientation, informing whether an input was successful or not, sufficiently informing about what it is doing, reacting with predictable processing times and runs according to consistent principles.

**Suitability for Learning**

„A dialogue is suitable for learning when it supports and guides the user in learning to use the system“ [7, p. 12].

Suitability for learning means it does not take too much time to be able to deal with the software. The software encourages the user to try new functions, does not demand from her or him to memorise many details and is designed to be learnable without further help or instructions.

**Controllability**

„A dialogue is controllable when the user is able to initiate and control the direction and pace of the interaction until the point at which the goal has been met“ [7, p. 13].

Controllability means the users are able to modify the software according to the way they are using it. To assure this, the system should offer the possibility to interrupt work at any time and to proceed later without any losses. The software should neither enforce needless rigid compliance nor needless interruptions, offering easy swaps between menus or different screens. Furthermore, the user should be able to influence which information is viewed on the screen.

**Error Tolerance**

„A dialogue is error-tolerant if, despite evident errors in input, the intended result may be achieved with either no or minimal corrective action by the user“ [7, p. 14].

Error tolerant software is designed to be resistant against small mistakes, to inform about errors promptly, offering understandable error messages, with concrete details for the correction, done with low effort.

**Suitability for Individualisation**

„A dialogue is capable of individualisation when users can modify interaction and presentation of information to suit their individual capabilities and needs“ [7, p. 15].

Software fulfils the principle of suitability for individualisation, if the user is able to adjust it to different tasks and her or his individual way of working, as well as the scope of presentation, if it can be easily updated for new tasks and is qualified for experts as well as beginners.

**ISO 13407**

**Human-Centred Design Processes for Interactive Systems**

ISO 13407 [11] „provides guidance on human-centred design activities throughout the life cycle of computer-based interactive systems. It is aimed at those managing design processes and provides guidance on sources of information and standards relevant to the human-centred approach.“ [11, p. 5].

To achieve the global aim to provide usability a user centred process is essential. ISO 13407 [11] is concerned about these topics. The provision of a user centred approach is characterised by following aspects [11, p. 7].

- “the active involvement of users and a clear understanding of user and task requirements;
- an appropriate allocation of function between users and technology;
- the iteration of design solutions;
- multi-disciplinary design“.

The activities of this user centred approach can be divided into four parts:

- understanding and specification of the context of use;
- specification of the user and organizational requirements;
- production of design solutions;
- evaluation of designs against requirements

It is important to identify the need for human centred design at the beginning of the software development process and to repeat the process until the system is able to meet the requirements of the users and the organisation; i.e. to organise an iterative design process (see fig. 1).

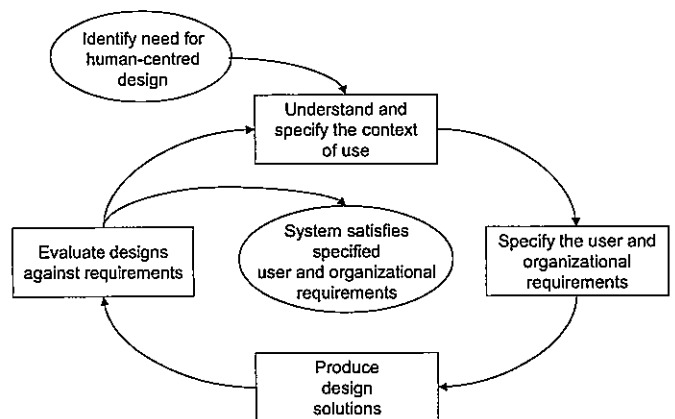


Figure 1: The interdependence of human-centred design activities (after ISO 13407, p. 10)

**CONCLUSION**

This paper is based on the observation that corporate practice might lack confidence in the knowledge and in the processing of international standards. This is well astonishing because the standards discussed in this paper

concretise – as the EU Directive 90/270/EEC [3] already says – barely the minimum (!) safety and health requirements for work with display screen equipment.

On the other side, positive developments can be observed recently pointing at countries, which already have existing legislation that meets or even exceeds the proposals. Also several software-companies and their customers strive for not only meeting the standards, but to define criteria for quality management of usability even beyond them.

A good example for this is the Swedish initiative UsersAward [17]. The UsersAward activities follow the „Scandinavian tradition“ of involving users in IT development for use at workplaces and aim at promoting innovative IT-systems, which support the development of work routines and systems, which transfer the control to the end-users. UsersAward takes it, that the quality and success of a software product at the work place are determined both by the context of use within the organisation and the characteristics of the software itself. Against this background, UsersAward defines success factors and developed a questionnaire for measuring their fulfilment. The questionnaire quantifies users' satisfaction with a software product on six dimensions: *total benefit, deployment process, technical design, support for work tasks, support for communication and cooperation, and quality assurance*. Although not explicitly referring these six dimensions to the ISO 9241 UsersAward is very successful in Sweden. In Germany also first promising attempts with the transfer of this method have been undertaken [15].

This experience may suggest the conclusion, that unitary and harmonised standards are not necessarily needed for high level software ergonomic quality management. Perhaps official standards are even prejudicial to the effort to achieve good usability. Are there not enough people who see standards – precisely because they are standards – acting as a deterrent? And – should standards have the effect that ...

- software developers are shortened in their creativity programming one way or another;
- project managers, starting an iterative design process, put up with the direction of development by users;
- directors, already having a lot on their plate, representing the budget for the new software, now should also be concerned about the consequences, the new technology has, on health and well-being of employees?

We say yes: for the sake of quality, productivity and health. Software ergonomic standards are based on scientific knowledge grown over several decades. They reflect the state-of-the-art, create a unitary language, transparency and commitment and ... they make usability easy to use.

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