USABILITY TESTS ON COMPUTER ACCESS DEVICES FOR THE BLIND AND VISUALLY IMPAIRED

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Abstract

The scope of the German BITE project is outlined, and its first results are presented. BITE is an acronym for „Usability Tests on Information Technology for the Blind". The model project will specify user requirements and develop test methods concerning computer access technology. A major objective will be to assess the suitability of the devices for the various demands of the work-place. Test criteria will be effectiveness and efficiency in performing the required tasks as well as other ergonomic criteria. User involvement will play a major role in methodological procedures.

1. Problems and Objectives

The computer is a key to the occupational and social integration of blind and visually impaired people. The selection of the appropriate access technology has, moreover, grown into a branch of knowledge of its own. The great variety of products and the rapid technological change make the offers on the rehabilitation market unmanageable. Even the specialized advisory facilities of the grant-awarding bodies have trouble in maintaining an up-to-date and discerning overview of the market.

In order to provide support to those who give advice upon technical aids, the model project BITE, an acronym for „Usability Tests on Information Technology for the Blind", will in the years 1996-1998 carry out tests of computer aids for blind and visually impaired people. Financial support has been granted by the German Federal Ministry of Labour and Social Affairs and by the Central Social Services of Hamburg (Hauptfürsorgestelle).

The chief objectives of the model project are to make the offers on the market more transparent and to help improve economy and quality control in the provision of technical aids. As technical and ergonomic standards make little reference to special needs, another key objective of the project is to specify user requirements and to develop corresponding test methods.

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2. Contributors

The model project is being conducted by the Hamburg firms BIT GmbH and DIAS GmbH, who are experienced in the evaluation of technical aids and in the design of work-places for handicapped people.
The FIT Committee for Information Technology of the German associations for the blind and visually impaired are participating in the user panel.
The Central Social Services of Hamburg are making available their data-material for the selection of the test sites for empirical data collections.
The Institute of German Commerce - REHADAT - will incorporate the test results into their relational database upon technical aids.
The project's advisory board includes representatives from the grant-awarding bodies for occupational rehabilitation, the self-help associations, the rehabilitation centres, the technical advisors, the handicapped employees, and the institute for product-testing, Stiftung Warentest.

3. Product Groups under Evaluation

The model project is concentrated upon the most important product groups of information technology for the blind and visually impaired, namely the aids for computer access and reading aids that are ordinarily used in combination with a computer. Product groups under evaluation are, in the order of testing:

- braille bars
- adaptions of graphical user interfaces
- speech output
- text recognition
- screen magnifiers
- video readers

Groupings follow as much as possible the classification of ISO 9999, but have been in part modified to correspond to the developments on the market. Adaptions of graphical user interfaces are a new product group. Further delimitations are needed in order to produce a viable sample of devices for the tests. For instance, the investigation of braille bars concentrates upon products using piezoelectrical technology that have a display to reproduce 80 characters of the screen.

4. Methods of Testing

4.1 State of the Art

Existing technical standards and guidelines which provide the basis for the established testing facilities are namely the safety laws for appliances, the German and European product standards (DIN, CEN), the product tests by Stiftung Warentest, and the quality requirements from the technical aids registers of the statutory medical insurance companies. These standards are insufficient for testing computer aids, as they lack rules that take into account the adaption of equipment to the special needs of the handicapped.

As a starting-point for the evaluation of technical aids for computer access it is thus necessary to ascertain the user requirements. Test methods are to be developed and tests to be carried out upon this basis.

4.2 Ergonomic Approach

The suitability of technological devices as personal aids at the workplace should be judged according to ergonomics, the scientific study of work. First principle is to look at the conditions of usage in their entirety. Basic components of the work system are the person, the task and the tool, which have to be described in great detail. The quality of the technological equipment is to be judged under the terms of safety and usability, of which usability is divided into effectiveness, efficiency, and user satisfaction.

From the ergonomic point of view, the evaluation of computer access technology for the handicapped follows the same rules as for information technology in general, except that the conditions of the impairment must be taken into account as additional requirements.

4.3 General Procedures

General aims and procedures for constructing systematic test methods are to be taken from the guidelines in ISO 9241 and from the practical experience of managerial cost-benefit analysis. According to this, the progressive steps for working out the testing procedure for a product group are

- the description of typical users and typical working requirements in the form of a usage scenario
- the definition of user requirements for the desired properties of the product in the form of a hierarchical and weighted system of goals

- the working out of testing procedures for the evaluation of the product according to the requirements

A special methodological approach is required to do justice to the target group of the blind and sight-impaired, who as a marginal group with a higher degree of individual dispersion presents a problem for the employment of the methods and results of the scientific study of work. The model project will above all try out a variety of approaches to user participation, following the recommendations of the HEART study of the EC research programme TIDE for the development, evaluation and standardization of rehabilitation technology.

4.4 User Involvement

The self-help associations and occupational rehabilitation facilities for the blind and sight-impaired possess a rich fund of experiential knowledge of the requirements criteria for technical aids. This experiential knowledge is being evaluated for the development of test procedures by means of a user panel.

The user panel is a committee of practical experts who actively participate in the decision-making process through discussion and the formation of opinions.

As users are understood in this context not only the disabled users of technical aids, but also those interest groups who give support to these users. The composition of the user panel takes into account the following user groups:

- technical advisors of the grant-awarding bodies
- colleagues from the vocational rehabilitation facilities
- representatives of the self-help associations
- users of technical aids with diverse experience, from varied occupational groups and with varied degrees of impairment

The user panel consists of approximately 20 persons who have agreed to make themselves available for the duration of the model project. The complete panel is to meet at the beginning and at the end of the project. In addition, there will be working sessions for each product group.

An important task of the user panel is involvement in the working out of the requirements profile. Furthermore, the opinions and comments of the user panel upon the results of the project will be obtained.

Further forms of user involvement will be a structured survey of selected work-places, the participation of blind users as test persons, and interviews with software instructors.

4.5 Requirements criteria

A requirements profile is to be established as a foundation for the test procedure. It is to contain the requirements of the users of the technical aids and is to be arranged in the form of a hierarchical system of statements of goals and technical derivations from these. The lowest level of the requirements profile is to contain the indices that are to be tested through the drawing up of the test procedure. The single criteria are to be weighted relative to the different situations of usage.

4.5.1 Windows adaptions

As a first result of the project, the user requirements for Windows adaptions are being worked out in June 1996. In accordance with the situation on the market, the investigation of the product group will at first concentrate on Windows adaptions for braille bars, and later on take into account other output devices. With respect to the approaches to a multimedia representation of the screen contents that are under development, the interface between braille bar, screen magnifier and speech output will have to be considered as part of the user requirements.

4.5.1.1 Context of use

The product is a fundamental technical aid for computer access and is not limited to particular purposes. It has to be used by all blind persons who have to use software operating under MS-Windows at their workplace. The suitability of the product for different users and situations of usage can be differenciated according to the following criteria:

- breadth of usage
- depth of usage
- operational support
- learning requirements conditioned by the handicap

These criteria should be investigated independantly of each other in order to bring the product into relationship with the various working tasks an with the organizational and personal requirements of the user.

The three first-mentioned criteria are concerned with the working situation. For instance, users with a small breadth and depth of usage and an extensive level of support are, for example, typists or telephonists in large companies or administrations. Users with great breadth and depth of usage and

a low level of support are, for example, electronic data-processing experts. For executives, lawyers, teachers and scientists these factors can be variously put together according to their individual circumstances.

Learning requirements conditioned by blindness include for instance learnt techniques of compensation such as familiarization with acoustical aids. Cognitive processes such as spatial imagination or orientation in logical systematics should be supported. General personal learning requirements such as previous knowledge should be considered.

4.5.1.2 Requirements criteria

The aim of the product is to compensate for restrictions in the usage of Windows software conditioned by blindness, to the extent that a level of performance can be reached comparable with that of non-handicapped colleagues. This overall aim is to be structured according to the criteria mentioned above. We are discerning three branches of deductive aims:

- general quality standards for hard- and software
- ergonomic requirements
- functionality according to tasks

General quality standards for hard- and software are such as compatibility, operational security, complete documentation, and service. Keeping up to these standards will have the effect that the technical aids are above all a marketable product, as opposed to individual adaptations.

Ergonomic requirements can be derived from the rules of software ergonomics in ISO 9241 part 10 „Dialog principles“ that have to be illustrated by the special requirements of blind persons. An important aim is operational control such as complete representation of the screen contents, mouse tracking and routing, minimum waiting times, and error tolerance. The aim of individualization, which normally is discussed under the terms of novice and expert users, will also have to comprehend the different needs for cognitive support such as speech output, acoustical orientation, spatial presentation and logical structuring. Ease of learning means that the functions of the product should be structured clearly, that help for rarely used functions is offered, and that orientation for a sighted assistant is given.

Functionality according to tasks refers to the terms of breadth and depth of software usage and of operational support. For users who need a large range of different software, it should be possible to adapt the product to specific software with minimal effort. As to the depth of software usage, three levels can be discerned: The basic functions of standard software, namely of word processors, should be operational in an efficient and satisfactory way. Advanced functions for secretariats and

executives, such as advanced formatting of text, calculation tables and the installation of a sinple relational database, should be operationally efficient. For users with little support by operational service, or who are a member of the service stuff themselves, special functions such as the configuration of MS-Windows, facilities for formatting patterns and macro development should be operational.

These goals are to be worked out by indices that can be measured by test procedures.

4.6 Test Procedures

The fundamental test procedures are

- descriptive investigation
- technical testing
- practical testing

The descriptive investigation can be applied to many criteria of electrical and mechanical safety, so long as there is no suspicion that the statutory safety regulations are grossly violated. In many cases the ascertainment of whether the corresponding test marks (VDE, GS, CE) are present will be sufficient. For the hardware ergonomics of braille bars, the overall height is amongst others an index that can be established through measurement.

The centre of the testing procedures will lie in the technical and practical proofs, where in the first place criteria of functionality and ergonomics will be investigated. A central proof procedure will be the carrying out of standard tasks. This instrument can be used as a technical test in the laboratory through which, for instance, the number of steps needed to reach the goal can be established. The standard tasks can also be used in the practical tests by means of handicapped users, if necessary in combination with the use of participating observers or a questionnaire. Indices are, for example, the quantity of successful solutions, the number of positive and negative comments during the solution or the subjective judgement ranged upon a rating scale.

As there is very little certified knowledge of the ergonomics of the blind and sight-impaired, a great importance is to be attached to practical testing by means of handicapped persons. At the same time the execution of these tests is difficult to deal with from the methodological point of view. For instance, the successful solution of tasks with the help of a braille bar is only possible after a longer period of familiarization. Only practiced computer users come into question as test personel, and their judgement is strongly impregnated by the individual features of the particular products they are familiar with. It follows from all these difficulties that it is not possible to create conditions for comparative testing of more than one product by handicapped users that adequately represent real

working situations. A solution to this problem may be to give up the idea of regular testing by handicapped users, and to combine laboratory testing with field studies of real work places.

5. Availability of results

Prospective outcomes of the model project are user requirements, test methods and test results. Test results will provide comparative product information according to the needs of different user groups. The reports will be made available to the expert public such as rehabilitation specialists and technical aids consultants. The test results will become part of REHADAT Rehabilitation Database.

6. Prospects

A lasting facility for the testing of technical aids has particularly been made into a theme by the self-help associations. The results of the model project should contribute to making clear the means and to creating a climate of opinion for its realization. As a solution to the problem of a supporting institution, a foundation of the grant-awarding bodies for occupational rehabilitation, the medical insurance companies and the manufacturers of technical aids could be considered as a possibility.

One task of a lasting facility for testing technical aids would be the regular updating of comparative product information. Another could be the application of the developed methodological knowledge to further groups of products, further groups of handicapped people and further areas of usage. For the further development of the testing work and for the international exchange of methods and results, a participation in the future projects of the EC research programme TIDE will be sought.

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