# BSCW for Disabled Teleworkers

## Usability Evaluation and Interface Adaptation of an internet-based Cooperation Environment

UI4ALL draft-contribution

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**Abstract**: TEDIS (Teleworking for Disabled People) is a research & development project of the research group on Human Computer Interaction at the German National Research Center for Information Technology (GMD). TEDIS is an assistive technology contribution to the promotional program „Telecooperation - Value Added Services" of the German Federal Department for Education, Science, Research and Technology (BMBF) and accordingly funded. The general goal of the project is to implement a generic human computer interface for accessing internet, which can be adapted to a variety of different needs of handicapped as well as elderly people. As part of a field-trial, the internet-based telecooperation environment BSCW (Basic Support for Cooperative Work) was installed to manage the teleworking process for two severely physically disabled teleworkers. At present, BSCW is adjusted to their special needs based upon data gained by structured usability-interviews. As a result, complete accessibility of BSCW by keyboard will soon be available, since operating a mouse causes many problems for motorically-disabled, blind or visually impaired end-users.

### 1. Introduction

At present, there are about 100 mio. elderly and 50 mio. handicapped people living in Europe. Recent official surveys reveal 6,4 million severely handicapped people only in Germany. This tendency increases. Modern telecommunication technologies offer many possibilties for special needs adjustment. Thus severely handicapped as well as elderly people can be enabled to live a self-determined life and take part in social and economic affairs. For example, telecommunication technology can compensate for an often prevailing lack of physical mobility, which is detrimental to the vocational integration of handicapped people.

Unfortunately technological progress does not necessarily imply enhancement of applicability of information technology. In general, special needs of handicapped end-users are not equally taken into consideration by system designers. Handicapped people are usually not included in design processes. Therefore, products are often inaccessible due to small but with regard to certain disabilities crucial shortcomings. In order to ensure the suitability of the teleworkstation developed within the TEDIS project, principles of participative systems design are applied. This refers to technical aspects as well as issues of usability. For instance, the internet-based telecooperation environment BSCW is adjusted based upon data gained by structured usability-interviews [1].

## 2. The TEDIS field-trial

The adaptation of the teleworkstation is realized in cooperation with the FTB (Forschungsinstitut Technologie-Behindertenhilfe in Volmarstein) an internationally renowned rehabilitation center in Germany. Two physically handicapped end-users living in Dortmund, which is located 65 km away from Volmarstein, work for the FTB administration with support of BSCW (Basic Support for Cooperative Work), a telecooperation environment which has been developed by GMD's research group on Computer Supported Cooperative Work (CSCW). BSCW is available free of charge by common Internet browsers in the World-Wide-Web [BSCW].

## 3. BSCW

The BSCW (Basic Support for Cooperative Work) project at GMD FIT is developing tools to support cooperative work over the Web. The basis for this work is the BSCW ‘shared workspace’ system - an extension to a standard Web server which supports document upload, event notification, group management, communication and much more. BSCW provides facilities for collaboration over the Internet. It runs across the most commonly used platforms on PC, Macintosh and Sun. This serves as an integration platform onto which a variety of CSCW applications can be added. The emphasis is on integrating existing tools, rather than constructing new ones.

The BSCW system is based on the ‘shared workspace’ metaphor: an object store for group work, with some simple awareness functionality that allows users to keep an overview of what is happening in the workspace. A workspace user can browse through a shared workspace (if he or she has permission to do so) with an unmodified WWW client on any platform. The BSCW workspace allows to (over)write objects by means of a small ‘helper’ application that is provided with the system.

## 4. Usability

Before starting the actual telework by using BSCW, a usability test was conducted in order to evaluate the user front-end of that telecooperation environment. The goal was to investigate whether the two teleworkers had learned to handle the system successfully as well as to assess the usability of BSCW for end-users with special needs, since BSCW was not originally designed with regard to the special needs of disabled end-users.

### 4.1 Methodology

As part of our investigation, we asked the teleworkers to perform a predefined task. Task accomplishment was then followed up by a structured interview to discover certain problems the disabled pilot-users encountered while using the system.

The task was divided into three subsequent parts. During their course the main functional body of BSCW was tested. The content of the task related to results of our initial field exploration comprising a description of the social environment, the pilot-users educational background, their computer literacy, their attitudes towards telework and the like. Pilot-users were asked to validate corresponding findings by modifying research documentation and commenting on these modifications within a common BSCW telecooperation environment especially devoted to these purposes. Therefore accomplishment of the predefined task aiming at testing systems usability can as well be seen to be crucial in a participative research and development approach which aims at involving end-users in an intensive dialogue on research validation during the process of designing technical and organisational systems adaptation.

The guideline for the interview, which was conducted after the teleworkers had successfully completed the given tasks, was developed in accordance to the software-ergonomic criteria listed within EVADIS II [2]. EVADIS II is a software-supported approach developed by GMD´s Department for Human Computer Interaction specifically to serve as a tool for evaluating dialogue systems. Most basically this evaluation procedure relates to the IFIP-Model of Human-Computer Interfaces, which already for years is being promoted by the International Federation for Information Processing, an international parent organization of national computer science companies.

According to the IFIP-model, the end-user interacts with a computer system through at least four interface layers, the terminal (input/output)-, the dialogue-, the functional- and the organizational interface. The terminal interface regulates the way work data, parameters and commands are input and vice versa the way how system feedback is presented to the user. The dialogue interface regulates the nature and form of dialogue processes (i.e. command-, menue-, icon driven etc.), system aids, error handling and intervention options in the course of the dialogue. The functional interface regulates the handling of system tools (i.e. applications). The organizational interface reveals the relations between different end users within the same organizational or socio-technical context, which is for instance defined by the system borders of a Telecooperation system.

However, the structured interview was more closely focussed on the input/output - ,the dialogue- and the functional layer of the overall user interface.

Another important orientation aid of the EVADIS II evaluation procedure is a standard developed by the German National Standard Organization (DIN 66.234, part 8), which was much discussed in specialized circles. This DIN categories, which in a two factorial design can orthogonally be combined with the four interface layers of the IFIP-model, are in the form of explicit recommendations for the software-ergonomic design of the overall user-interface [3].

### 4.2 Findings

The following issues, which are only more or less intrusive examples for the layered evaluation approach outlined above, were among others identified as demanding for adapation:

• terminal (input/output) interface

The cursor position serves within BSCW as a prompt for input. Yet, the cursor is not always positioned at the correct place for input, which - by the way - is more a general problem of the internet browser than of BSCW itself. Moreover, it is not possible to keep windows open after having completed the input for instance by offering a „More?“ option, thus the windows need to be opened again and again. Considering that people with functional impairments in the upper limbs depend upon optimizing the required mouse-movements as well as keeping the number of characters to be typed as little as possible in order to work efficiently, software adaptations are necessary at this point.

These findings interfere with the DIN-recommendation of „Problem appropriatenes“, which demands that the user’s actual task should be supported and not made more difficult by specific system properties.

• dialogue interface

Some of the icons presented by BSCW as part of the graphical user interface did not imply the action, which is set off by them. Furthermore, some abbreviations, for example „des“ for „description“ were not comprehensible by the teleworkers. These issues are pointing at an underlying more fundamental problem, that is the lacking consideration of the native language of the end-user. Most of the websites available in the internet respectively World-Wide-Web are presented in english. This causes a crucial obstacle in accessibility of the WWW for interested end-users with little knowledge of english, which is particularly true for elderly and disabled end-users. Most basically this is a policy issue of information politics which needs to be solved

on a fundamental level for instance by offering versions adjustable to at least the most prevailing languages or by provision of translational help.

Again these findings interfere with another DIN-recommendation denominated „Transparency“ or „Self descriptiveness“. These criteria refer to the fact that the user should be able to „see through“ the system. Thus, the dialogue must be either directly comprehensible or, if this is not the case, the system should be able on demand to explain to the user the dialogue's purpose and method. Where the dialogue is not directly comprehensible, the user should, on request, be given a list of the avilable facilities (e.g. switch to native language or translational help), so that he has a good idea of the system context for his own task.

• functional interface

Furthermore, it was suggested by the disabled teleworkers to enhance the BSCW-system by offering the possibilty to read in input by cache memory for instance in case of long e-mail addresses, so that on-line times can be kept as short as possible in order to work economically.

The DIN recommendation of „Flexibility“ matches with this end-user suggestion. It requires that software tools be adapted as far as possible to suit the users individual wishes, experience, etc. Account should be taken of the gfact that user control of a system grows gradually with use. The user should be able to influence the dialogue process, ist speed - including interruptions - and the order of various dialogue operations.

## 5. Multi-modal interface adaptations for physically handicapped end-users

Looking at new developments in multimedia-technology, there are quite a few new qualities of human-computer interaction emerging adaptable to a variety of special needs of handicapped end-users [4]. Assistive technologies offer now a variety of acoustic, visual and tactile human-computer interface adaptations. Among others these include „stereophonic earcons“ (e.g. the sound of a garbage can symbolizing the deletion procedure in the Macintosh-Operating-System) and „Virtual Lipreaders“ (e.g. an animated human face presented on a graphic display moves its lips according to speech input enabling deaf people to understand speech) [5,6]. These two examples illustrate possibilities to adapt human-computer interfaces to receptive handicaps. The research project TEDIS, though, aims at adaptations for expressive handicaps. They do not appear as spectacular as the above described adaptations but they are just as useful for people with motor impairments.

### 5.1 Complete internet access by keyboard

In general, navigation through BSCW can be eased dramantically for end-users with physical handicaps by replacing cursor positioning by mouse requiring good fine-motor coordination through navigation access by keyboard. Since this adaptation comprises functionality of the browser rather than the underlying BSCW application, TEDIS currently realizes complete access to an internet browser by keyboard. This accessibility will be also valid for special keyboards designed to meet special needs of motorically impaired end-users.

The adaptions under concern will be implemented by using „MS Internet Control Pack", a toolbox consisting so far of 8 so called „Active X TM Controls". They can be integrated within Visual Basic. Beyond this, modification of the HotJava browser sourcecode being available as public domain software is also considered.

According to the results of further in-depth usability interviews, the following features will be realized for people with physical handicaps:

- tabbing through forms and checkboxes of an HTML document
- provision of a keyboard command to mark text
- selection of a link by typing the first letter of the link´s label
- determination of a special keyboard command to tab through links with a changeable step range
- scanning procedures that allow for sequential marking of buttons and links as well as selection and setting off the actually marked by keyboard
- recognition and completion of recurrently occuring input after typing only a few letters

### 5.2 The generic approach

In the long run, development efforts within the scope of TEDIS seek to develop a generic human computer interface for a reliable internet browser. The concept of generic human computer interfaces most basically means to implement a software layer between the user´s front-end and the application, which can easily and universally be adapted to a variety of different needs of handicapped people and other end users with special needs [7].

To comply in the short run besides the more challenging software-architectural foundations at least partially with the demand of implementing a generic interface for internet access, the following not browser- but HTML-related adaptations of WWW-documents and WWW-applications (like BSCW) for receptive handicaps of visual impairment and blindness shall additionally be taken into consideration:

- Insertion of labels into listings of HTML-documents (Amount of HTML-links, number of sublinks)

- Listing of all Links incorporated into a HTML-document (by URL)
- Conversion of tables into sequential representations
- Listing of all „Header x“ titles in HTML code
- Keywords like ‘Link’, ‘Radiobutton’ etc. at corresponding locations within HTML-documents

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