

## DEVELOPMENT OF CSA-Z412 (2000) GUIDELINE ON OFFICE ERGONOMICS AS AN INTERACTIVE CD-ROM PRODUCT - PROCESS AND RESULTS OF USER TESTING

### VILLAGE JUDY

Judy Village & Associates/UBC School of Occupational and Environmental Health  
2220 Badger Rd., N. Vancouver, B.C. V7G 1T1, Canada, village@interchange.ubc.ca

### MACKENZIE CHRISTINE L.

School of Kinesiology, Simon Fraser University, Burnaby, Canada. MacKenzb@sfu.ca

### GAUTHIER JOSEE

Canadian Standards Association

#### Abstract

A written standard some 300 pages in length was developed as an interactive CD-ROM product. This paper details methods and results for heuristic evaluation and user-testing of storyboards and of the beta version of the CD-ROM, prior to final production. Six members of health and safety committees at 7 organizations completed 5-page questionnaires following a series of tasks. Questions asked about screen layout, presentation of information, terminology, learning and system capabilities. This was followed by focus groups. After both sets of user testing, recommendations resulted in design changes. Users were positive about overall visual appearance, ease of learning and interactivity. Of major importance was speed of responsiveness, knowing their location, ability to go back to previous pages, minimizing the program on the desktop to multi-task, ability to increase a text box to full screen, searching by using keywords, scroll bars, arrows, and the ability to print sections.

**Key words:** user-testing, information technology, office ergonomics, usability, interactive CD-ROMS, electronic standards, electronic guidelines

## DÉVELOPPEMENT DE LA NORME CSA-Z412 CONCERNANT L'ERGONOMIE AU BUREAU SUR UN CD-ROM INTERACTIF – PROCESSUS ET RÉSULTATS DES TESTS AVEC LES UTILISATEURS

#### Résumé

Le développement d'un produit cédérom interactif à partir de la norme écrite contenant plus de 300 pages. Ce document décrit les méthodes et les résultats, pour des raisons heuristiques ainsi que, les tests faits auprès des utilisateurs avec les scénario-maquettes et la version Beta du cédérom. On a sélectionné six membres faisant tous partie de comités de santé et sécurité au travail, répartis dans sept organisations différentes, pour compléter une série de tâches et par la suite remplir un questionnaire de cinq pages. Les questions étaient reliées au topogramme de l'écran, à la présentation de l'information, à la terminologie, à l'apprentissage et aux capacités du système. Par la suite, des réunions de groupe ont eu lieu. La compilation des résultats provenant des questionnaires et des réunions de groupe a résulté en une liste de recommandations du design. L'apparence visuelle, la facilité d'apprentissage et l'interactivité ont été jugées positivement par les utilisateurs. Les éléments suivants ont dû être améliorés: la vitesse de réactivité, la facilité de localisation, la possibilité de retourner à une page ultérieure, la réduction du programme sur le bureau, la possibilité d'agrandir la boîte du texte à un plein écran, l'utilisation des mots clés, les barres de défilement et les flèches ainsi que, la possibilité d'imprimer certaines sections du document.

**Mots clés:** test avec les utilisateurs, technologie de l'information, ergonomie au bureau, convivialité, cédéroms interactifs, normes électroniques, guides électroniques

## BACKGROUND AND PROCESS OF CONVERSION TO CD-ROM

This paper describes the process of converting a written 300 page standard to an interactive CD-ROM, and the methods and results of heuristic evaluation and user-testing of the CD ROM. The Canadian Standards Association is a not-for-profit membership-based association working in Canada and around the world to develop standards that address real needs. In 1998, a 24-member committee of the CSA began the process of developing an update to the CSA-Z412 "Guideline on Office Ergonomics" (1989). An Ergonomist designed the layout and updated content for the new standard. In 2000, a concurrent process began to convert the written material to an interactive CD-ROM format by CSA staff, the Ergonomist, and the software developer (Oberon Interactive Inc., Toronto). The ergonomist was a subject matter expert and a liaison for CD-ROM development as well as ensuring the product would provide the added value to meet the users' needs. The primary users of CSA-Z412 are health and safety committee members responsible for office ergonomics within an organization.

Principles of usability, considering the users, task, tools and environment were considered in evaluating the CD-ROM product (Shackel, 1991), as were the eight golden rules of dialog design (Shneiderman, 1998): (1) Consistency in sequences of actions, terminology, menus and commands; (2) Shortcuts for frequent users; (3) Informative feedback for operator actions; (4) Closure in design dialogs; (5) Simple error handling; (6) Easy reversal of actions; (7) Supports internal locus of control and; (8) Minimal short-term memory load. It was also essential the user interface be clear, uncluttered, interesting, visually appealing, and easy to navigate, find and retrieve information.

There were a number of steps (below) involved in the process of converting to a CD-ROM:

1. Discussions about various features to be designed into the CD-ROM. As always, there were limits to budget (based on market price) and to development time (to release the product close in time to the written version). Issues included: components for interaction; figures with interactive features and/or animation; navigational aids such as "search" functions and hyperlinks; and optimal use of graphics, icons and color. Some of these were resolved through heuristic evaluation by a number of independent experts.
2. Resolution of technical issues, such as installation to hard drives and search functions.
3. Iterative design of the main interfaces. Within this stage, *user testing of main storyboards* were conducted, recommendations implemented and approval given to interface design.
4. Programming of the CD-ROM, fine-tuning and internal testing by the software company.
5. Release and further user testing of a Beta 1 version.
6. Final changes implemented, based on results of user testing.
7. Release of final product.

## USER TESTING OF STORYBOARDS

### Objectives and Methods

Objectives of user testing of storyboards were to determine: ease of use of finding information; what information was most frequently used; perceived ease of navigation; clarity and understandability of the information; whether visual presentation was pleasing; and ease of use, and completeness of the index, for finding and retrieving information

Ten organizations with extensive offices from both the public and private sectors, ranging in size of workforce from 30 to 10,000 were contacted to participate. Seven organizations including a major insurance corporation, university, large union office, and provincial ministry agreed to participate. From each organization, there were a minimum of six participants from

their occupational health and safety committees. A set of instructions, questionnaires, return envelopes and demo CD ROMs were sent and participants were asked to independently complete the guided tasks using the CD storyboards and questionnaire. A five-page questionnaire was designed with six parts addressing: design of main cover, text pages, figures, table of contents, keyword index and overall impressions. The order of testing different components was counterbalanced to minimize fatigue and order effects. Questions were based on bipolar semantically anchored items, such as simple versus complicated, confusing versus clear, etc., and presented using 9-point Likert scales. Questions were modified based on a generic questionnaire for user interface satisfaction (Shneiderman, 1998). One week later, after analysing results, focus groups were held to clarify questionnaires "Average" scores, and frequency of responses were analyzed.

### **Results of Storyboard Testing and Discussion**

Thirty-six of a possible 45 questionnaires were returned (78%). Responses to the ratings, open-ended questions and focus groups identified areas where users pointed consistently to a need for change in either functionality, appearance, layout or terminology. Nineteen recommendations were made including, for example, to: clarify "quit" and "print" functions visually and through a change in location; change terminology of functions such as "find" to "search by keyword"; add maximize/minimize functions to text boxes; add greater spacing within text to make it easier to read; add functions, such as "to main menu", and "save as"; design navigational functions, such as arrows at the bottom of text boxes to move to next and previous sections or pages and; add specific interaction terms, such as "open figure".

## **USER TESTING OF BETA VERSION**

### **Objectives and Methods**

Objectives of user testing the beta version were to evaluate: ease of use, appearance and sequencing of screens; terminology for consistency and ease of understanding, ease of learning; specific functionality and features (such as printing, saving, keyword searches) and; system capabilities and limitations

In January, 2001, a beta version was produced for further user testing. Due to time and budget, an evaluation was performed with only two of the seven organizations participating in full testing, questionnaires and focus groups and the remaining five organizations providing feedback comments only. A package with CD-ROM, instructions and questionnaire was sent to each of 25 participants who were asked to navigate and try various features, buttons and functions, including: saving, printing, opening and closing figures and tables, using the search by keyword and definitions, and inserting information on forms and appraisals. They then completed a five-page questionnaire. Users included those previously involved in storyboard testing, as well as some "new" users. Using a 9-point Likert scale questions were asked about the screens (legibility of fonts, layouts, sequencing, etc), terminology (finding keywords, etc.), learning and system capabilities (speed, reliability, system failures). A separate section asked about specific functionality and features such as minimize/maximize buttons, "save-as" buttons, arrows, "search by keyword", printing, and entering information on the screen.

### **Results and Discussion of User Testing of Beta Version**

In total 24 participants evaluated the CD-ROMs from six organizations, with 14 participants attending focus groups and 16 participants completing questionnaires. Approximately half the group participated in user testing of the storyboards and half were new. Table 1 displays

average scores on a nine-point scale (with 9 being the most positive response) for the main features evaluated. It also displays the number of respondents who rated the feature  $\leq 4$ .

**Table 1. Average responses to questionnaire and number of responses  $\leq 4$  (n=16)**

Questions	Avg. Response	Number $\leq 4$	Questions	Avg. Response	Number $\leq 4$
Legibility of characters	7.1	2	Learning to operate	6.8	2
Screen layouts helpful	6.8	2	Ease getting started	6.6	3
Amount of information	6.6	2	Explorations	6.4	3
Logical arrangement of	7.3	1	straight-forward tasks	6.2	3
Screen sequencing	5.8	3	CD-Rom speed	5.9	4
Ease of going back	5.7	5	Reliability of system	6.9	1
Size of text box	6.9	3	Dependability	7.1	1
Opening a figure	7.2	2	System failures	7.3	0
Consistency of terms	7.5	0	Systems warnings	4.6	2
Being kept informed	6	2	Correcting mistakes	6.6	1
Predictability	5.9	4	Ability to undo	6.1	3
Ease finding keywords	5.6	6			

In general, responses about the design of screens were quite positive. Participants found screens visually appealing and clear. There were concerns however about poor contrast (white text on green buttons) and small text size. A number of users found the amount of information resulted in a “busy” appearance, especially when a user wanted to read through text on a background of icons and buttons. Users wanted the ability to expand the text box to full screen size for reading and to reduce the visual “noise”. Where icons were used, for example for opening or closing figures or text boxes, users were confused or didn’t notice the icon-buttons unless they had a direct manipulation appearance. Many users mentioned the importance of being consistent with “Windows” or common browsers for familiarity.

Sequencing of screens and ability to go back to previous screens averaged a lower rating by users. Users commented they need to be kept informed about location. They suggested being able to see the section they are in and needed a “back” function. Users were frustrated when they either made a mistake or purposely moved to another area of the document and were subsequently unable to go back without starting the sequence over again. Compounding this, a number of participants reported being confused by the single and double arrow icons (similar to fast forward and rewind on video systems) at the bottom of text boxes. When they tried them and were moved to another section, they had no way back.

Another requirement based on users is to multi-task and be able to readily go between CSA, and other applications, e.g., email. Despite considerable efforts to design a usable index, the ease of finding keywords was rated one of the lowest features. Initially designed by an expert, the ergonomist then expanded the index ten-fold by adding common terms and extensive cross-referencing. It was further expanded after user testing. It must be assumed that more extensive user testing of the index is required with functional hyperlinks.

Learning to use the program was not difficult. Most responses were positive with regard to getting started and operating the program. As seen in Table 1, scores are somewhat lower however for ease of use, in a straight forward manner. This relates to comments above about

back functions. It also relates to design of the print function. Forms and appraisals can be saved in "Word", or a PDF file can be opened for printing the entire document. However, from within the program there were no capabilities for and printing a section or screen.

The two main issues regarding system capabilities was the slow speed of the program and the need for indicators. Many users found the program frustrating when the speed didn't match other types of programs they currently use. Some users reported that they assumed the program had frozen because it wasn't responding and there were no indicators; users suggested an hourglass, clock or the phrase, "please wait".

Users liked the interactive tables, figures, worksheets and animation offered by this CD-ROM product. In one figure for identifying risk from a lifting task, a user is prompted for choices about the task and is later provided with recommended guidelines for safe lifting. This interactivity allows the user to alter choices and see the effects quickly on the guidelines. Animation was used, for example in a figure showing a fully-seated workstation and how it can be adjusted for a fully-standing workstation. Realistic animation is recommended for future demonstration.

## CONCLUSIONS

As a result of user testing, the program was modified addressing most of the major recommendations. Operating speed was increased, as was the ability to scroll. A "back" function was added, considered essential for users. The ability to scale the program to the desktop was made clear, allowing multi-tasking and quick reference. Printing the PDF file was made easier with a hyperlink and a PDF print icon on the menu bar. The minimize/maximize buttons were redesigned to increase ease of recognition and comprehension. legibility of the table of contents design was improved and a quick reference table for each section inserted. Additional indicators were also added.

It is concluded that design, particularly of indexes and keywords requires extensive user testing both early in the process and with the final functionality (hyperlinks). It is otherwise impossible to anticipate how and why information might be used and the subsequent keyword attempts made by users to find information. As one example, some users described a scenario where a co-worker would report a sore neck to the health and safety committee. A user might then type into the keyword box "neck pain". While neck pain is discussed in various sections of the standard (general musculoskeletal disorder symptoms, height and viewing distance of monitor, etc.), none of these were hyperlinked to "neck pain".

The final CSA-Z412-00 CD-ROM was released in February 2001 and is considered a successful, usable, interactive product providing information, work sheets and guidance on design of office systems.

## REFERENCES

- Canadian Standards Association CSA-Z412 Guideline on Office Ergonomics (December 2000), CSA International, Toronto, Ontario, Canada (314 pages).
- Shackel, B. (1991). Usability ñ Context, framework, definition, design and evaluation. In Shackel, B. and Richardson, S. (Eds) *Human factors for informatics usability*. Cambridge: Cambridge University Press, 21 - 37.
- Shneiderman, B. (1998). *Designing the user interface: Strategies for effective human-computer interaction*. Third Edition. New York: Addison-Wesley. ISBN 0-201-69497-2