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# **VISUALIZATION OF ERGONOMIC GUIDELINES – DEVELOPMENT AND EVALUATION OF PROTOTYPES**

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This study attempts to discover how ergonomic guidelines should be visualized in order to make it easier and more interesting to find and interpret the guidelines throughout the construction process. A prototype, visualizing ergonomic guidelines on the intranet, has been developed and evaluated at a company that produces cars for the global market. The results show that the visualization of ergonomic guidelines should preferably be based on a picture of the physical car with hyperlinked segments easy to relate to a group of guidelines or a specific guideline. The specific ergonomic guidelines should preferably have the dimensions illustrated in pictures, with body parts showing dimensional relations and how the details are to be used. Animations makes it easier to understand the usage of details and dimensional relations; it also makes the presentation more fun.

## **INTRODUCTION**

Technical developments and a competitive market encourage companies to continuously improve their construction processes. Those processes should benefit the personnel's knowledge, with a customer focus and result in continual improvements. Furthermore, the companies have to consider their overall brand profile strategically throughout the construction processes in order to maintain and strengthen their market position.

Guidelines and instructions are used in quality systems to ensure high quality and an effective construction and production process. The guidelines and instructions often consist of a table of contents and text documents. However, these do not respond to some company's requirements for supporting dialogue between their personnel. Ergonomic knowledge available in guidelines and documents is often hard to acquire, incomplete or not suited to the process (Woodcock and Flyte, 1998).

A field study has been carried out at Saab Automobile, a member of the GM (General Motors) Corporation. The company is located in Sweden and has approximately 8500 employees including six human factors engineers. Their existing system of ergonomic guidelines consists of a handbook on the intranet, where a table of contents and pages with text and some pictures presents information. The constructing engineers receive the ergonomic guidelines as printouts distributed by the human factors department, and

they also have access to the guidelines via the intranet. The company would like to improve their ergonomic guidelines to support the human factors engineers as well as the constructing engineers when working with ergonomic issues.

The aim of the study is to explore how ergonomic guidelines should be visualized on the intranet in order to make it easier and more interesting to find and interpret the guidelines throughout the construction process.

## **PROCEDURE**

The studies presented in this paper were conducted in accordance with Kolb's experiential learning theory (Kolb, 1984) and the usability engineering life cycle (Faulkner, 2000), i.e. the prototype development was supported by frequent feedback meetings and discussions with the users.

The research of possible approaches to visualize guidelines started with discussions with the human factors engineers. Viewpoints were collected from them and three constructing engineers of how the existing ergonomic guidelines were presented and how they support the human factors engineers' work and their communication with other departments. A prototype of an alternative presentation of guidelines restricted to one part of the interior of the car, the front door, was created and evaluated (Blomé, et al., 2002).

The results revealed an interest by the human factors

engineers to proceed and develop a visualization of all existing ergonomic guidelines, at present embracing 151 pages (Figure 1).

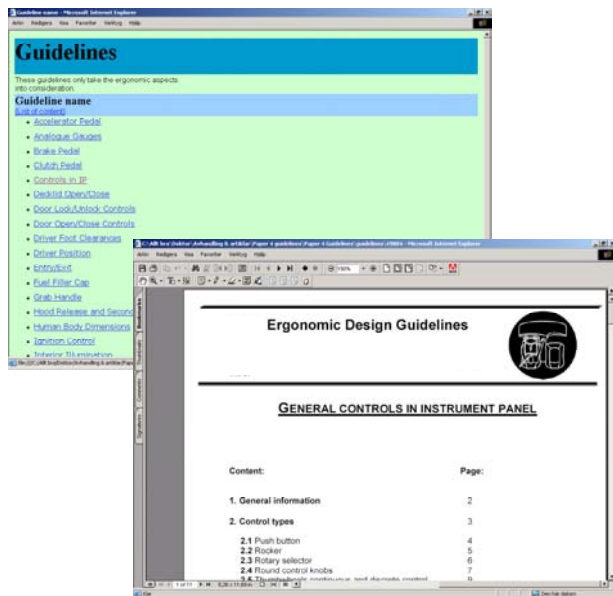


Figure 1. The present system with two screen dumps showing the path to ergonomic guidelines for push buttons.

An enhanced and extended computer-supported prototype visualizing all existing ergonomic guidelines was constructed taking into consideration theoretical principals on presenting information (Shneiderman, 1998), (Löwgren, 1993), (Blomé, 2000) and viewpoints of research colleagues at Lund University and the human factors engineers at the company.

Set ups of alternative suggestions were visualized and evaluated by three researchers working with interface design at Lund University and three human factors engineers at the company. The suggestions presented different approaches to visualizing the path from an overview down to a specific guideline, i.e. photos or pictures with hyperlinked segments, marked zones of the hyperlinked segments with or without attached headings, headings in a list or integrated in the pictures (Figure 2).

A specific guideline had three different alternatives to visualizing the information of a push button: photo, picture with arrow to show direction, and a hand to show direction. Each alternative could also be shown as a film clip or an animation.

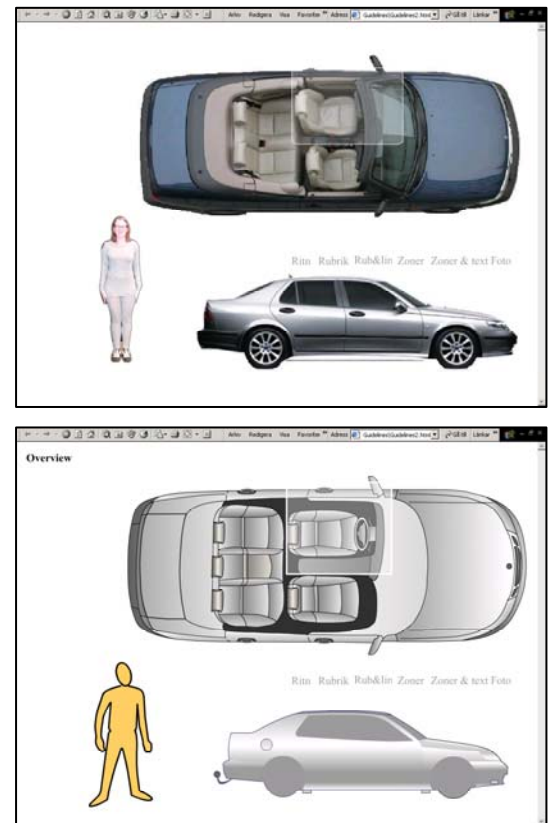


Figure 2. Screen dumps of two different approaches to visualizing the overview of the guidelines; photos or pictures with hyperlinked segments.

Based on the evaluation, a principal visualization from the overview down to one specific guideline were made and evaluated by the three human factors engineers. Hereafter a computer-supported prototype visualizing all existing ergonomic guidelines was developed.

The prototype were evaluated by five people from each of the following groups:

- human factors engineers at Saab (responsible for the contents of the guidelines),
- users of ergonomic guidelines at Saab (engineers and project managers),
- interface design experts (researchers working with human machine interaction at Lund University),
- industrial design students, and
- engineering students at Lund University.

The 25 participants were introduced to the present and the prototype system of the ergonomic guidelines by a demonstration where information within three different guidelines was searched for and found. The participating persons were assigned to perform the same set up of ten

tasks on both the present visualization and the prototype. An example of one of the tasks was to find the recommended width/diameter of the steering wheel. The task descriptions included key words that could be found in each system. Furthermore, each task was verbally explained to the participant. The order was alternated, i.e. the first person began with the prototype, and next person began with the present system and so on. The participants were asked to think aloud while performing the tasks and to evaluate each system by filling in a questionnaire and discussing the answers with the first author.

Notes about the observations as well as verbal comments were carefully written down. Performance time for each task was measured and if the subjects gave the wrong answers or got stuck and needed help to proceed.

## RESULTS

Figure 3 shows the computer-supported prototype developed in the field study. It consists of web pages with hyperlinked pictures and animations of physical details. The path to specific guidelines is shown by hyperlinked headings at the top of each page. The heading of a group of guidelines or of specific guidelines is integrated with the picture.

Specific guidelines are visualized by pictures of physical details and human body parts showing the scale and/or function of the details. No photos or film clips are used. Instead, pictures and animations are used in some cases to demonstrate function and/or measurements since these were considered to be more obvious, looked better and had no clear connection to specific car models.

Text and measurements are integrated in the pictures. Hyperlinked icons located at the left side of the page organize different aspects regarding a specific guideline, and decrease the need of scrolling. Text segments are located at the right side or beneath the pictures, thus focusing on the pictures.

The results of the evaluation can be summarized as follows:

- all participants preferred the prototype except one at the ergonomic department who wanted both systems,
- 70% performed the tasks faster with the prototype,
- the participants gave same amount incorrect answers using the prototype compared to the present system,
- the prototype was considered to be fun and interesting

to use whereas the present system appeared boring and heavy,

- the participants spent most time clicking around and looking at the pictures in the prototype,
- the participants spent most time reading text and scrolling in the present system,
- animations and pictures of human body parts made the presentation more informative and fun.

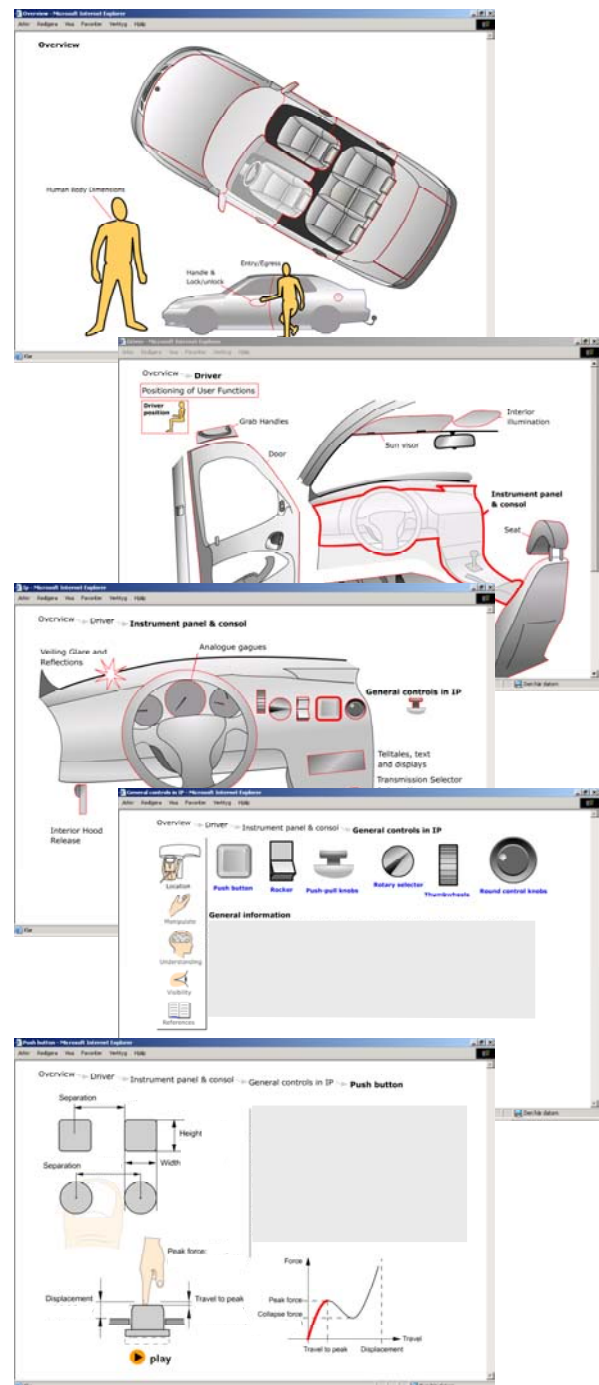


Figure 2. The prototype with four screen dumps showing the path to ergonomic guidelines for a push button.

## DISCUSSION

The ergonomic guidelines can be regarded as a checklist to ensure that ergonomic aspects are considered throughout the design process. It is then of great importance that they are easy to find, interpret and use.

The study shows that the overview of the guidelines was preferably based on the physical car, and not just a table of contents. The approach in the prototype was appropriate for all potential users, experts as well as beginners. It was not always faster to find the requested information in the prototype but since the participants spent more time clicking around and looking at different pages, it might felt less frustrating than scrolling and reading through several pages of written text.

It is possible that using the prototype makes it easier to find the correct information, however, there were still some incorrect answers and misunderstandings when using the prototype, which indicates a need for further development. A more standardized organization of the information would probably help the users.

Animations illustrating functions of details could be informative and fun for beginners, but might be irritating for experienced users (Blomé, 2000). The participants in this case study could choose to play the animation or not, and none considered the animations to be irritating.

By visualizing ergonomic guidelines according to the principals stated in this case study, it is likely that users with different backgrounds will find the information more interesting, easy to locate and interpret than a traditional documentation with a table of contents and documents.

## CONCLUSIONS

The following conclusions can be drawn from the study.

- The overview of all ergonomic guidelines and the path to specific guidelines should be based on pictures with a physical connection to the information.
- The specific ergonomic guidelines should preferably have the dimensions illustrated in pictures with body parts showing dimensional relations and how the details are to be used.
- Animations makes it easier to understand the usage of

details and dimensional relations; it also makes the presentation more fun.

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