Introducing ergonomics visualisation and simulation for exploring design problems and solutions in workstation design on ships

Mikael Blomé, Monica Lundh, Lars Hanson, Dan Högberg

Department of Design Sciences, Lund University, SWEDEN
Department of Shipping and Marine Technology, Chalmers University of Technology, SWEDEN
Virtual Ergonomics Centre, University of Skövde, SWEDEN

1. Introduction

This study is a result of common interests to develop and disseminate knowledge about ergonomics visualization and simulation to support the design of better working environments with applied technology at the research forefront. The general context of the research is that increased advanced technology and the pursuit of efficiency change our working environments, which in the short term often complicates the work when the old problems persist while new or other kinds of tasks are added. Research from recent years shows that relatively simple measures could significantly contribute to an improved working environment and reduces health and safety risks (Lundh, 2010). Shipping has also international mandatory regulations (IMO, 2001), which contain technical specifications on how the ships are to be built. The regulations related to the design of the machinery spaces are however just guidelines, i.e. the design does not have to conform to the regulations (Mallam & Lundh, 2013). In addition, these regulations are written in such a way that it is up to each individual to interpret. There is, however, an educational and usability problem when regulations, guides and manuals are in a format that is experienced difficult to access, with the risk that the information rarely is utilized. The starting point for making a change towards better procedures and designs is in improving existing environments, but there is less support in the design of new environments. The automotive industry sector struggles with similar issues, but there is a long tradition of using visualization and simulation tools to ensure successful designs of products and work environments (Mårdenberg et al., 2012).

Ergonomic guidelines have been visualized with improved availability and increased interest among the users (Blomé et al., 2006). Alternative design concepts and work environments are analysed based on calculations and simulations with digital human models in a virtual world. Thus, the ergonomic workload can proactively be simulated on the basis of existing or planned work situations and provide actual calculated values (ISO9241-11, 1998). This gives imperative input to the designers to ensure that the design will meet regulations, before the actual production of the design. This study aims to develop the simulation tool IMMA (Intelligently Moving Manikins) in order to evaluate and improve existing but also design new ships environments with regard to ergonomic aspects. It also aims to increase awareness of ergonomic work environment aspects in teaching and research with support of an interactive e-book.

2. Method

The methodology follows in line with the research group's previous projects principles of participatory ergonomics and user-centered design (ISO9241-210, 2010; Wilson, 1999) which in this study include the identification and modelling of critical working conditions on board ships, adaptation and evaluation with the support of the ergonomic simulation tool IMMA, usability evaluation with specialists in ship design and ergonomics as well as professionals and students in shipping.

3. Results

The study resulted in development of the simulation tool IMMA for applications on board ships (Figure 1) and an educational material in the format of an e-book (Figure 2) that have been introduced to students and experts in ergonomics.
4. Discussion

Industry and research particularly in the automotive industry is at the forefront regarding the use of ergonomic simulation tools, such as IMMA, for advanced and well-founded calculations in the evaluation and development of work situations. This study has demonstrated a unique opportunity to develop and situational adapting an ergonomic simulation tool to the complex conditions within shipping to thereby provide a practical tool for the prevention of musculoskeletal injuries. It is necessary that the simulation tool developed further with regard to the particular conditions in a marine environment to achieve a confident situational application. There is a great potential in applying an ergonomic simulation tool in many different industries. For example, the healthcare remains a vulnerable area in terms of musculoskeletal injuries and sickness absence due to musculoskeletal disorders. Despite comprehensive designed tools work still includes many heavy lifting and difficult and stressful postures. Home care services are likely to increase due to the demographic development of the population with an increase of aging and multiple illnesses.

The study also showed that it is valuable to use an interactive e-book to meet the needs of students and teachers to visualize design problems and solutions of workstations on ships, with a potential to include other working environments form a variety of branches. This study shows how the exploration and evaluation of design problems and solutions of workstations on ships can be supported by the introduction of Visualization and Applied simulation. The results offer great opportunities to improve the ergonomic work environment for working life in general by means of visualization and simulation and to increase awareness of ergonomic work environment aspects in teaching, engineering and research.

Acknowledgements

This research was performed within the IMMA Marine project, supported by AFA Insurance.
References


Lundh, M. 2010. A Life On the Ocean Wave - Exploring the interaction between the crew and their adaption to the development of the work situation on board Swedish merchant ships. Gothenburg.: Department of Shipping and Marine Technology, Chalmers University of Technology

