A framework to describe and categorise a complex human-machine system

Anna-Lisa Osvalder, Lars-Ola Bligård, Jonas Andersson, & Anna Thunberg
Chalmers University of Technology
Gothenburg, Sweden

Abstract

The evaluation and design of useful operator interfaces is important in human-machine systems. In order to facilitate and focus the design work, there is a need for a clear description and understanding of the system, to ensure that design solutions are beneficial for safe and efficient control of the process. The aim of this paper is to present a systems model, and a framework, for evaluation of similarities and dissimilarities between different human-machine settings. The framework, based on system theory, consists of a systems model of: operator, process system, control system, tasks, environment and organisation. Totally, 34 factors were used to describe the properties of the system in a systematic way. Each factor was graded as low, medium or high, in relative comparison to the other human-machine systems included in the evaluation. The framework was applied on 15 different human-machine settings, to evaluate similarities and similarities between how operators work and handle the system. Specifically, the model was used to compare the thermal power and the pulp & paper industries with other settings, to find out if ideas and beneficial design solutions can be found in other settings, possible to implement as parts of new visual screen designs. The settings most useful for this purpose were nuclear power plants, refineries and maritime engine rooms.

Introduction

In most human-machine systems the complexity of the technology is increasing, while the number of human operators handling the systems is decreasing. To be able to control the technical systems in a safe and efficient way, the need for better visualisation of information is necessary for the operator in the control room. Increased automation and remote operation of several plants lead to that the amount of operator supervisory work increases. Thereby the screen design solutions need to provide support for single operator performance, but also adequate help to handle process variations and manage disturbances and incidents. Poor overall system performance can also result in financial losses, environmental consequences and hazards to people. To achieve optimal human-machine interaction, a systems approach with the user's abilities and limitations in focus is necessary.

In D. de Waard, A. Axelsson, M. Berglund, B. Peters, and C. Weikert (Eds.) (2010). *Human Factors: A system view of human, technology and organisation* (pp. 409 - 420). Maastricht, the Netherlands: Shaker Publishing.