

ERGONOMIC DESIGN APPLIED IN A SUGAR MILL INTERFACE

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Abstract— In tasks requiring human supervision in an industrial control room there are applied generic disciplines like automatic control and engineering systems. From the point of view of the human computer interaction applied to these disciplines it is necessary to add usability engineering and cognitive ergonomics. This integrated framework is an example of human-centred design on automation systems. The main goal of this work is the application of a cognitive ergonomic guideline for supervisory control in order to improve the efficiency of a sugar mill interface design.

Keywords— display design, supervisory control, sugar mill, industrial automation.

I. INTRODUCTION

In recent years, control systems and the role of control room human operators have changed dramatically (Samad and Weyrauch, 2000). Human operator activity has evolved from manually performing the process to control system supervision (Sheridan, 1992). Today, the human operator requires an in-depth knowledge of the process that he/she is overseeing and the ability to make effective decisions within demanding constraints.

The increased complexity of industrial process control calls for a new methodological approach (for research and design purposes), which reproduces the essential components of current control systems, the environment, the task at hand and human operator activity.

The complexity of industrial process supervision makes it necessary to supplement the Automatic Control approach and the Industrial Automation approach with a cross-disciplinary cooperation in order to integrate knowledge and methods from other fields, especially Cognitive Ergonomics, and Human-Computer Interaction (Cañas, 2004; Granollers *et al.*, 2005; Holstom, 2000; Nimmo, 2004; Raskin, 2000). Our view is that complete control systems engineering must encompass all these approaches.

Ergonomics is concerned with the adaptation of technology to suit human operator need and ability in order to achieve effectiveness, efficiency and user/worker satisfaction and comfort (Karwowski, 2005).

Supervisory control is the set of activities and techniques developed over a set of controllers (programmable logic controllers and industrial regulators) which ensures the fulfilling of control goals (Saez *et al.*, 2005).

One of the main goals is to prevent possible plant malfunctions that can lead to economic loss and/or result in damage. For this reason, other fields of knowledge concerned with manufacturing systems performance – such as maintenance and industrial security – are complementary to the study of supervision systems.

It is necessary to develop techniques to aid the human operator in supervisory control tasks because they reduce the effort he must make. One of the good ways to enhance human operator knowledge is to train them using simulation techniques (PSI, 2008; Costa *et al.*, 2003). Two types of simulators in the industrial domain exist: the simulators for the design of the installations and the process training simulators (RSI, 2008). In the process industry, for example the sugar mill, a typical process training simulator is the Full Scale Simulator (CTA, 2006). This simulator is associated with a replica of the control room with a realistic appearance and functions.

With the use of a training simulator it is possible to develop a training program and a usability study of the human supervisory control task out of the control room, for example in a usability laboratory or in an automatic control laboratory (Shneiderman, 1998).

In this paper a methodology for the creation of an ergonomic guideline for supervisory control interface design is proposed. In section two we present briefly the previous research on human interface design guidelines. A checklist of indicators of the guideline called ‘ergonomic guideline for supervisory control interface design’ (GEDIS *Guia ergonómica para el diseño de interfaz de supervision* in Spanish version) is described in section three. In section four, transition from the GEDIS model to the sugar mill interface in the control room is evaluated. Finally, we finish with conclusions and future research lines.

II. PREVIOUS RESEARCH

A simulation can be used in the oil & gas, processing, manufacturing, agricultural, and transportation sectors.

One of the modes of the simulation is the use of virtual reality. In this case, with a virtual scenario, the operator is inside a control room that closely emulates a standard environment. This system may be used to inject faults, or to emulate operating sequences. The trainee responses may be fully monitored from a separate room, and certified competence assessment may be given (TSC, 2008).