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► To cite this version:

Mustapha Tendjaoui, Christophe Kolski, François Gambiez, Patrick Millot. Towards an intelligent interface between decision aid tool and operator in control rooms. 11th Congress of the International Ergonomics Association, Jul 1991, Paris, France. pp. 652-654. hal-03426821

HAL Id: hal-03426821

<https://uphf.hal.science/hal-03426821v1>

Submitted on 14 Feb 2024

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TOWARDS AN "INTELLIGENT" INTERFACE BETWEEN DECISION AID TOOL AND OPERATOR IN CONTROL ROOMS

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INTRODUCTION

Planting aid tools in control rooms may lead to the reorganization of the operator's and calculator's tasks, so as to come to a cooperation between them. In every implantation projects of an aid system in an industrial process control room, we have to tackle the communication problems, between the intelligent system and the operator, caused notably by the variety and the big flow of information, that expert systems can deliver. In consequence, we have to develop a Man-Machine Interface which is able to prepare and to present available information, in order to make them compatible with the operator informational needs, in his approach of the problem resolution. Our research works concern particularly cooperation problems, and aims at optimizing the information communication between the human operator and the aid tool, using the "intelligent interface" notion (Kolski et al., 1990).

Many "intelligent" interface definitions are described in the literature, see for instance Hancock & Chignell (1989) or Hefley (1990). In the specific domain of industrial process control, we call "intelligent interface" an independent interface which is able to adapt itself to the operator's informational needs, using expert knowledge relative to the operational context of the problem to be solved, to the characteristics of the different users of the system and on to the tasks they have to perform. In brief, our approach consists in using an expert system to ensure the communication between the aid tool and the human operator (Tendjaoui et al., 1990). Such an approach should help to optimize the communication and the collaboration between the Human and the Computer System. This paper concerns particularly the realization of such an interface called D.M.I. (Decisional Module of Imagery). The second part of this paper is devoted to the software realization and to the evaluation of this interface in a simulated context.

THE D.M.I.: THE CONCEPTS

The figure 1 presents the integration of the Decisional Module of Imagery in a global Man-Machine system in process control rooms. This model integrates an assistance tool : the supervisory calculator centralizes the whole process scored data. These data are accessible by both the decision support expert system and the D.M.I. using these data, the decision support expert system infers information such as predictive, diagnosis or recovery procedures. This set of information is transmitted to the D.M.I., which selects those that can be presented to the operator. This selection must be based on a task model to be performed by the operator, and on a model containing information about the operator, called "operator" model.

- The task model is currently restricted to problem solving tasks and results from a previous analysis of fixed tasks which have to be performed by the operator. This model is based on the qualitative general model of Rasmussen (1980). So, a task is built by four information processing steps : event detection, situation

assessment, decision making and action. This task model contains a set of process significant variables used by the operator while performing his different tasks.

- The operator model integrates a set of ergonomic data which is presently limited to :
 - three possible levels of expertise for the human operator (unskilled, experienced, expert);
 - the type of displays associated to each operator's cognitive behavior, according to Rasmussen's model.
 - the representation mode associated to each type of display (for instance, to a "reflex display" is associated a textual action piece of advice, which must help the operator during his decision making process).

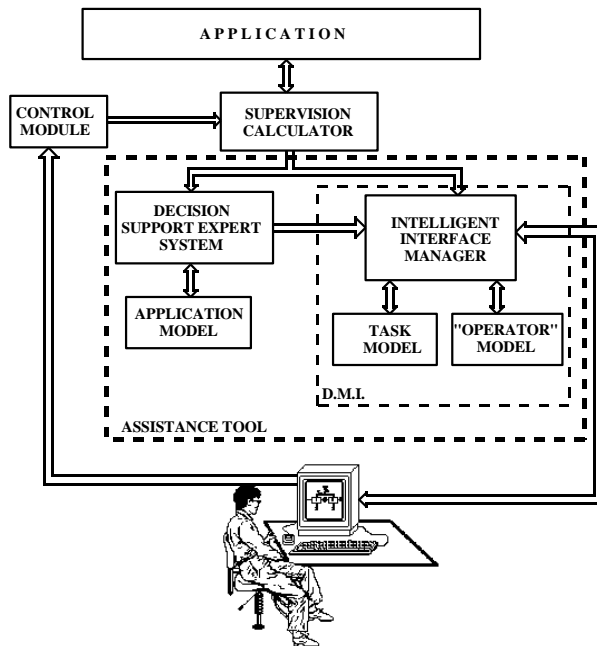


Fig. 1. Global Man-Machine system integrating the notion of "intelligent" interface (Kolski et al., 1990)

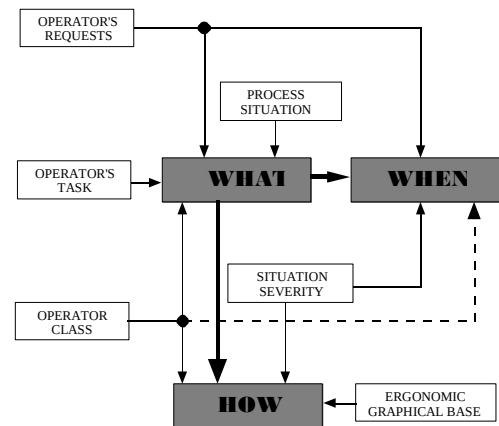


Fig. 2. The "What / When / How" notion (Tendjaoui et al., 1991)

The aims of the D.M.I are : (i) to select the data that can be displayed on the screen taking into account both the operational context of the process and the informational needs of the operator, in order to enable the operator to supervise the process and to define some possible corrective actions when a failure appears; (ii) to define an ergonomic presentation of this information in order to make the human operator's understanding easier; (iii) to add to this supervisory imagery the corrective advice given by the decision support expert system in order to justify its reasoning and thus to prevent possible conflicts between the system and the human operator (Taborin & Millot, 1989).

In order to meet these goals, the D.M.I. has to be autonomous and able to adapt itself to the operators' needs. So, the D.M.I. must integrate expert knowledge on : (i) the different operational context of the system to be supervised; (ii) the characteristics of the different users of the system and (iii) the cognitive and sensorimotor tasks that these operators have to perform. These knowledges allow us to answer the three following ergonomical questions, figure 2 : (i) What to present to the operator (we consider here, that the "what" includes the "why", by using justification scales of the information displayed); (ii) When shall we display it; (iii) How to display it. For more information about the "What/When/How" notion, please see (Tendjaoui et al., 1991).

THE D.M.I.: REALIZATION AND EVALUATION.

The D.M.I. is implemented in an experimental platform that integrates a supervisory system of a simulated process. It is written in "C" language. The platform is based on a VS/3100 station. Graphical

displays are created with a graphical tool called DATAVIEWS. The software architecture of the platform is described in (Tendjaoui et al., 1991).

In order to evaluate what the D.M.I. brings facing a classical interface, an experimental platform is being realized. The experience consists in supervising a simulated process (see figure 3) with the same scenario, using a classical interface and/or the D.M.I. In these experiences, a set of objective and subjective data is collected. This data is analysed, compared and can lead us either to change some specifications of the D.M.I. or to do some new experiences with new scenarios. The process used for the experience simulates a nuclear power plant. It is composed of many variable classes : control variables, command variables, variables regulated automatically, related with the system safety, in order to product energy.

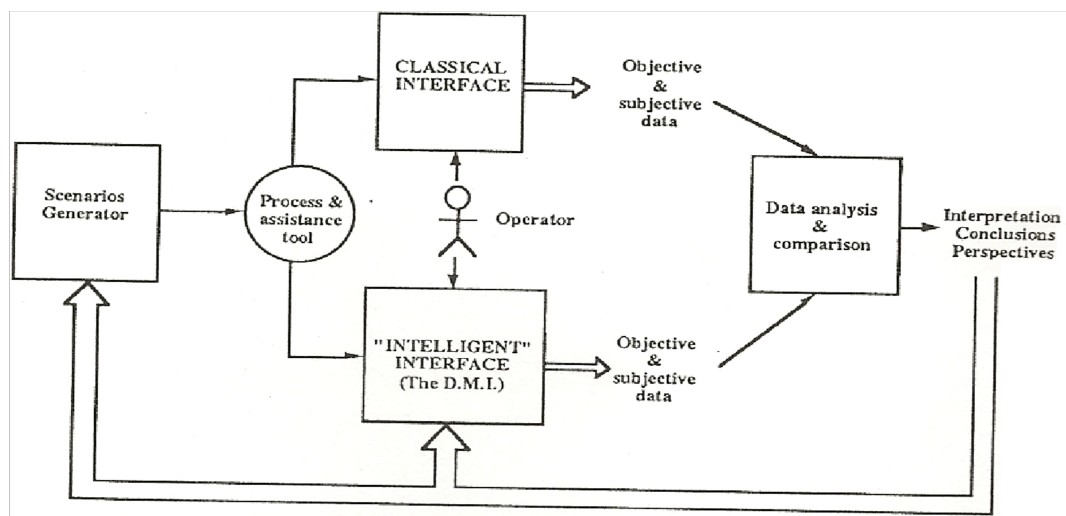


Fig 3. classical and "intelligent" interfaces comparison

CONCLUSION

After having defined concepts of an "intelligent" interface approach, our actual works concern the effective software realization of this interface. Thus, the most difficult step is to design the different knowledge bases relative to the way to solve the "What / When / How" problem.

Concurrently, we are spreading out an experimental platform allowing an ergonomical D.M.I. evaluation and operator performances comparison when this one uses two kinds of interfaces : a classical and an "intelligent" (based on the D.M.I.) one. The experimental results will be published in a future paper.

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