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Designing a dynamic system traffic control of a freight railway*

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Abstract. This paper empathizes the interface design for a new control system for freight that was developed during the process of modernization in a company. On one side, there are managers, intermediate decision levels, that dialogue with the ergonomists and, on the other side, the operators with their own opinions about the system. These last ones are rarely asked by the managers about their opinions. The proposed system is configured from the opinions of the operators. Other problems, such as technology transfer and insistence of the managers about using similar systems obliged that the final project should include some modifications.

1. Introduction

Sperandio (Laville 1977) defines workload as a quantitative or qualitative measure of activity level (mental, sensorial, physiological, etc.) of the operator that is necessary for the conclusion of a certain task. Laville (1977) says, complementing: the workload must be distinguished from the exigencies and constraints of the task, i.e., the work quantity and quality and the imposed limitations.

Moraes (1998) says that we can observe that the operators which develop tasks with hard workload are usually complaining about physical problems, such as pain in the back, in the neck and visual disturbances. These complaints are related with the high level of immobility imposed by the task and also the high mental concentration.

The railroad dispatcher is responsible for the safe movement of the trains through a certain territory (Popkin 1999). Besides the train control, the dispatcher is responsible by the coordination of the other users of that railway, like the maintenance team. The work of dispatching requires a high level of vigilance during long periods of time. He also must be prepared to meet a hard and continuous workload, such as track the traffic rush, and make fast decisions from simultaneous visual and audible inputs (Popkin 1999).

2. Methods and techniques for the ergonomic intervention

One of the ergonomic techniques is the systemic focusing. Some models are proposed for the system in operation, and so, it is possible to define how to obtain the system. Montmollin (1971), defines model as a group of elements that partially reproduce other groups of elements, richer, considering this last one as a standard which that the model is compared.

Firstly some nonsystematic observations were conducted and focussed interviews were carried out aiming the comprehension of the system hierarchy (supersystem and subsystems) considering inputs and outputs, exigencies constraints, improper results of the system.

After, some behavioural registers were carried out. Some groups of events were selected, and the frequency of its occurrence was observed. These were considered the following activities for behavioural analysis: uptake of information, actions, oral/gestures communications and uptake of information/ actions in general (stimulus-response).

3. The project

From the results of the behavioural registers about uptake of information it was verified the necessity of a synoptic panel. This synoptic panel is a fundamental

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piece for the work in any part of the railway, once the operator needs a global vision of the system to 'feel safe' regarding his actions and also allow a more precise, faster and more efficient decision. This opinion is the same of the managers, as shown in figure 1.

3.1. *Conceptual project*

While designing the dispatcher workstation it was determined five 17″ VDUs considering the biggest section to be controlled and the screen legibility. It was established the focus ratio (105 cm) and the height of alpha-numeric characters as recommended by Richadeau (1976) and Pheasant (1987). The characters sizes varies between 3,5 mm and 7,35 mm.

For controlling the operation chart and operations were indicated two 21″ VDUs, once more considering the screen legibility. In this case, the focus ratio was 70 cm and the height of alphanumeric characters used was that recommended by Pheasant (1987), from 2.5 mm to 5.25 mm.

For data input, the project contemplates ergonomical keybord and mouse.

The ergonomical studies – behavioural register of the activities – confirmed the necessity of synoptic panels usage. Anyway, this first proposal was not well-accepted. It was compared with other 'modern' workstations as that used in *Alameda Corridor* control centre (that operates two railways in USA), the *Burlington Northern Santa Fe Railway* and *Union Pacific Railroad Company*. The synoptic panel was considered unnecessary by the managers, even though the uptake of information registered the opposite.

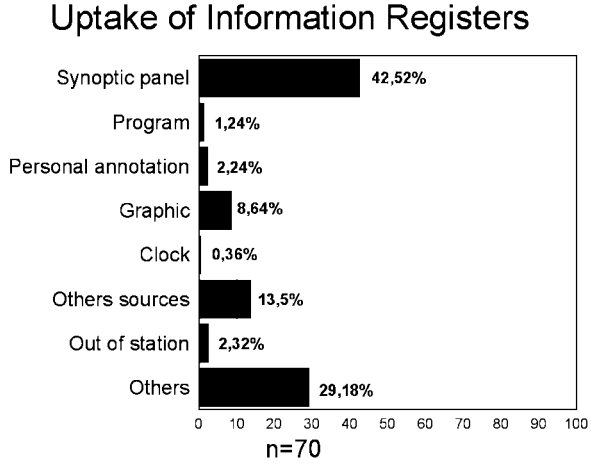

Figure 1. Chart of uptake information registers.

It is an important observation that even though the managers consider the synoptic panel, they reserved some space in one of the walls for its installation in the futures.

The initial project for the new workstation was changed. The five VDUs replacing the synoptic panel were refused. The managers preferred two screens for controlling the whole system: the first for the operation chart, the second, for the railway.

It was asked for the ergodesigners a new workstation concept that integrates the synoptic panel and the operations' screen, both positioned in the same level, like the consoles made by the American company *Evans Consoles Inc.*

3.2. *A new proposition*

It was defined for the workstation a sequence of VDUs framing a horizontal panel, that could assign a general vision of the part of the railway that the

Table 1. Some examples of the proposed symbols for the new interface.

Symbology	Existent	Proposed
Signals Automatic Opened Closed Manouvre		
Even though some restrictions the main colors were maintained representing the signal as a arrow indicating the direction observed by the operator.		
Group of ways	Does not exist	
Deviations	Does not exist	
Represents parts of the field communication with the control center.		
It was aimed a representation that allows the dispatcher the real position of the field deviation, reducing his cognitive workload.		

operator is monitoring. In these VDUs could be presented information about the railroad, trains positions, routes and other relevant information. The direct interventions in the trains movements (turn on/off the traffic lights, routes cancellations, interdictions) can be done by the operators in a VDU screen that represents the railway.

It was also proposed another VDU in which the dispatcher could draw a 'circulation graphic' in the same way as he does presently (but hand made) where he can verify the train position, schedule, possible crossings with another train, and plan new routes and schedules, based on the daily schedule of each train.

For the screen design of this proposed system was also observed all the actions and needs for the activity of dispatching using some kind of representations (like pictograms or icons) used in the present system and for the new functions, already familiar for the dispatchers. It was also determined the development of a interface in a familiar computer platform trying to minimize the impacts during the migrations for this new system. Based in this idea, the use of the keyboard for the actions was maintained, once it is primarily used in the inputs of the system in use.

4. Examples

After studying those already existent in the synoptic panel new ones were proposed for the new interface project.

In table 1, there are some of the new designed symbols, showing the existent symbols and the concept for each one.

5. Conclusions

Considering the solutions indicated for the representations and the recommendations based on the behavioural registers and the task analysis, and also the necessities for the proposed system, some guidelines and screens were presented, which will be the basis of this project.

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