A DYNAMIC TRANSPORT CONTROL SYSTEM OF FREIGHT TRAINS: ENVIRONMENT, LAYOUT, WORKSTATIONS, INTERFACE DESIGN

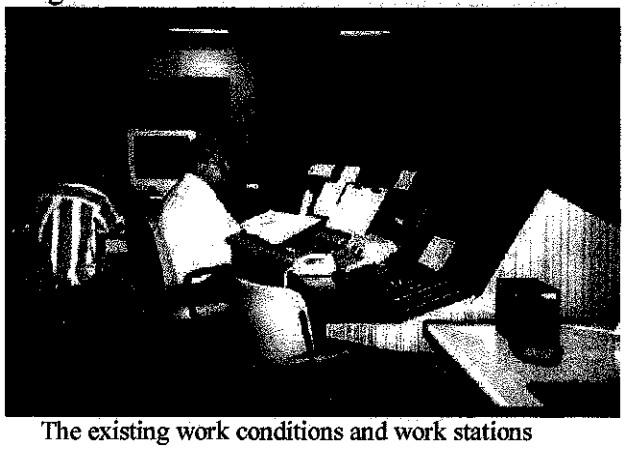
Anamaria de MORAES, D. Sc.; Alexandre Dresch; Rosane Schonblum; Maria Manuela Quaresma; Cláudia R. Mont'Alvão, M.Sc.; Claudia R. Mourthé, M.Sc.;

LEUISHT Laboratory of Ergonomics and Usability of Interfaces in Human-Technology Systems
Master Program in Design
PUC-Rio Pontifical Catholic University Master Program in Design
Rua Marquês de São Vicente, 225 GÁVEA Rio de Janeiro RJ BRASIL
Tel.: 55 21 527 5077 Fax: 55 21 527 1907 E.mail:moraergo@rdc.puc-rio.br

This study presents once again the necessity of synoptic panel as a fundamental tool to the dispatchers work. Based upon the data collected in a railway freight control room, where a change is occurring in the control and management systems, where it was decided get out of the synoptic panels.

THE PROBLEM

The Federal train Transportation Net was privatized. One par of the trunks nowadays belong to a company, responsible for the freight trains that transports steel from Minas Gerais to Rio de Janeiro and São Paulo. They have a traditional control system that uses telephones, box and some computers. Part of the systems has a safety electrical system to control the via circuit and others work with teleprocessing information. At the moment they are changing the hole control room – the space, the workstation, the panels, the communication system. In this opportunity they will substitute the consoles desks by digital computerizes systems, what implies the design of interfaces, considering usability and friendly dialogue.



The existing work conditions and work stations

METHODS AND TECHNIQUES

Firstly we began with assystematic observations and focused interviews to organize the system hierarchy (suprasystem and subsystems) and serially (feeder systems and ulterior system), considering input and output, requirements, undesirable output, systems constraints. In continuation behavioral diachronic sequential registers (with 3 seconds intervals, during 15 minutes) of uptake of information, commands manipulation, communications, dislocations of controllers or colleagues to get some information- controllers tracking operator and register of data to the federal information system.

It was considered the following items for each kind of behavioral register:

Uptake of Information Register: synoptic panel; schedule; watch; personal notes; graphic and other sources (Omnisat system VDT, control VDT, tracker VDT).

Communications Register: radio – with station; driver; maintenance staff; telephone – with station; using the message system of the Omnisat system - with the driver; verbal communication – with the supervisor; schedule supervisor; maintenance manager; others dispatchers; commercial manager; operational telephone and others (cellular telephone).

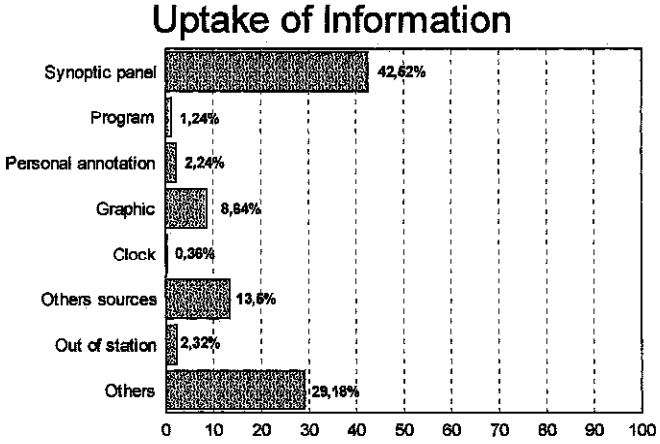
Downloaded from pro.sagepub.com at PONTIFICIA UNIV CATOLICA on July 13, 2015

Manual Handling Registers:
mouse; synoptic panel keyboard; radio's keyboard; Omnisat system's keyboard; radio; telephone; graphic; operational telephone and tracker keyboard.

RESULTS

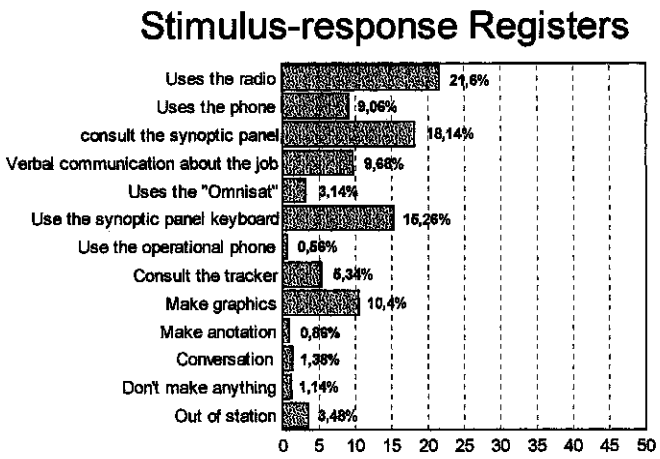
"The railroad dispatcher is responsible for the safe and expedient movement of trains across a given territory (Devoe,1974). In addition to controlling train movements, the dispatcher is responsible for coordinating the activities of other track user, such as track maintainers. The job of dispatching require a high degree of vigilance over long periods of time. In addition, the dispatcher must be prepared to cope with sustained high workload and surges in workload, as may accompany rush hour traffic, and make rapid decisions from simultaneous visual and auditory input." (Popkin,1999).

Examining the graphic of information uptake, it presents the more significant results about the dispatcher cognitive workload where we can observe that he controls the trains movement looking at the synoptic panel (42,52%), while "others" has a totals of 29,18%.



In the Stimulus-response graphic it might be observed that the main dispatchers operations are: use of the radio (21,6%); consult of the synoptic panel (18,14%); and use of the synoptic panel keyboard (15,26%) - are well-distributed.

It can be confirmed that the most important function is the radio use, which is the unique source of information that complements the synoptic panel.



Analyzing both graphics we can notice that the synoptic panel is a fundamental tool for the dispatcher task. Only in a section of the railway, the synoptic panel attention is combined with another system - the Omnisat - that is a synoptic panel in digital format.

"Quantitative records of frequency of uptake of information and also of stimulus-response intakes emphasizes the importance of the signal box (TCO) and of its mapping from left to right, and vice versa, as a form of evaluation of the general performance of the system, of verification of the consequences of decisions and interventions, and of anticipation of the necessary actions to regulate the performance of the system. (de Moraes, 1991).

It is clear that the dispatcher needs a holistic vision of the system, to feel himself safe about his acts and decide faster and more precisely, about the train movements or track maintainers.

PROPOSED HUMAN - TASK - MACHINE CONFIGURATION

It was proposed that instead taking out the synoptic panel, this one was changed to a digital media, using VDT monitors, side by side, representing the whole railway line control by that workstation.

Downloaded from pro.sagepub.com at PONTIFICIA UNIV CATOLICA on July 13, 2015

The main necessities of the dispatcher where taken into account: obtain information about the trains circulation in a fast and safety way; clear communication between the driver and other workstations and be able to program the circulation, deviations, maneuvers and other regular management operations.

After we used a design procedure that begins with the concept of the system-how many monitors would be necessary – one for demanding information about conductors, train freight, dead lines and possible delay.

It was also considered the ergonomic criteria about characters legibility in VDT, visual field angles and reach envelop.

The obtained results with this study raised the following criteria for the workstations design: how many VDTs must be allocated for each dispatcher necessity (5 monitors to compose the synoptic panel, 1 representing the circulation graphic, and the last one for the railway management, as a section of the synoptic panel; communication system characteristics, using microphones instead of PTT's, layout considering reach envelop; and some general recommendations about illumination, temperature and noise.

The main function of the controller is monitoring the system. So the first proposal was presented following the criteria mentioned above, where sequential VDTs compose a synoptic panel, positioned in a superior level, considering the criteria of legibility in a ratio of 105 cm, considering size and color of the characters. The other VDTs were positioned respecting the vision ratio of 70 cm, once they are VDTs for direct operation.

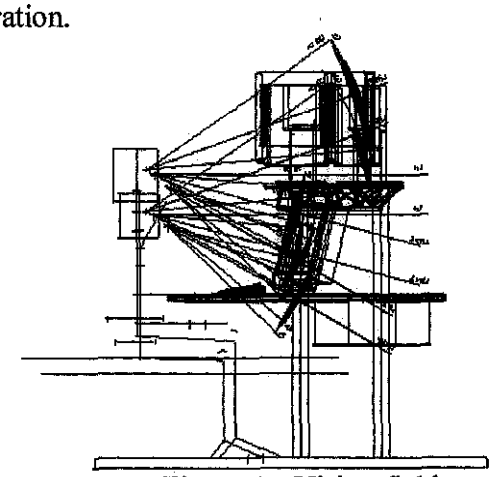


Figure 1 - Vision field

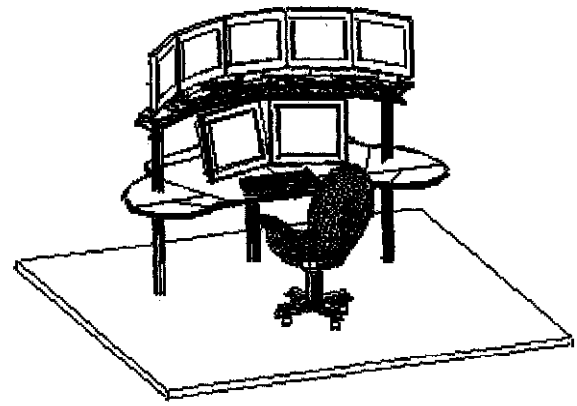


Figure 2 - First proposal

The ergonomic studies – behavioral task activities registers – confirmed the necessity of using synoptic panels. Nevertheless, the first proposal was not well-accepted. It was compared with other "modern" workplaces.

The initial proposal about the new workplace was changed. The synoptic panel were refused. The managers preferred two screens to control the system: one for graphic of train circulation; other for controlling the tracks. But it should be mentioned that they reserved a wall for a future projection of the synoptic panel.

It was asked a new concept for the workplace integrating the synoptic panel with the VDT for operation, and positioning all of them in the same level.

New ergonomic evaluations were done. In the second proposal, the dispatcher operates directly three VDTs that represents the synoptic panel.

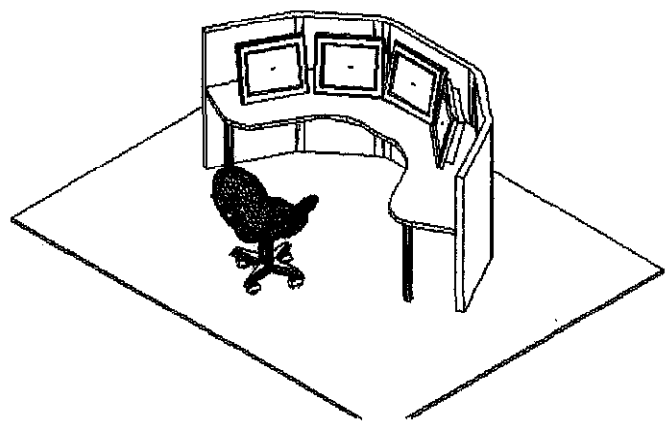


Figure 3 - Second proposal

Downloaded from pro.sagepub.com at PONTIFICIA UNIV CATOLICA on July 13, 2015

CONCLUSIONS

At the moment the layout of the control room is being developed. The workstation are arranged in a way that all operators can visualize the "wall" reserved for future synoptic panel. As ergonomists we can say that this will happen soon.

BIBLIOGRAPHIC REFERENCES

POPKIN, Stephen M., (1999), An Examination and Comparison of Workload and Subjective Measures Collected From Railroad Dispatchers. Proceedings of the HFES 43rd Annual Meeting. Houston, Texas, 1999.

De Moraes, Anamaria, (1991), Evaluation of The Metro/RJ Control Room; Ergonomics Recommendations for a New One. Proceedings of the IEA'91, Paris, 1991. Vol I, p. 807-809.

Downloaded from pro.sagepub.com at PONTIFICIA UNIV CATOLICA on July 13, 2015