Interdisciplinary Methods for Stress and Strain Analysis

Yvonne FERREIRA, Verena BOPP und Rolf HELBIG

Institute of Ergonomics, Darmstadt University of Technology
Petersenstraße 30, D-64287 Darmstadt

Abstract: Goal of this study was to analyze the existing stress and strain situation in a network control enterprise. A unique feature was the extensive use of interdisciplinary methods in this study.

Keywords: Stress – Strain – Interdisciplinary methods – Job satisfaction – Control room

1. Introduction

A stress and strain analysis was carried out in a network control enterprise, whose unique feature is the extensive use of interdisciplinary methods. The main tasks of the highly skilled personnel are monitoring and managing energy and volume flow (gas, water, electricity and teleheating). They are accountable for the supply of more than 160,000 households. These tasks are performed in a control room, which is monotonous, hazardous informational work.

The goal of this study was to collect, analyze and evaluate the existing stress and strain.

2. Procedural method

2.1 Overview of the internal processes

A lot of time was invested to get a detailled look at the internal processes. In a first step, **inspections** were made. During these inspections, the employees were observed in order to record the operational procedures and the basic conditions for them.

Video recordings were produced to analyse several operations. Of course, only persons, who agreed to these recordings, were included. This point was a very awkward one, because the employees were quite mistrustful at the beginning of this study. We had to arrange extra **informative meetings** to explain exactly our procedure, the goals and the expected results. We learned that another study was carried out some years ago with a negative outcome for the employees (a pay cut and reduction in human resources). Only through the (honest) disclosure of all the intentions for this study and by taking the concerns and fears of the employees seriously could we acquire their confidence.

Every ergonomic analysis and study in the occupational psychology requires the inclusion of the employees. Firstly, the employees have special knowledge about the internal processes, which is quite important for the whole understanding. Secondly, the employees have to accept future changes. Thus, to assure this acceptance, the best way is to include the employees right from the beginning. Furthermore, job satisfaction and motivation grow through the showing of respect and care for the employees.

More information was collected through one-on-one **interviews** and group sessions with all involved persons (employees, chiefs, work council and so on).

The last step to get a complete overview of the internal processes was the **analysis of internal company documents**, for example, the operating manual and job descriptions.

Based on this information, partial workloads were identified.

2.2 Identification of partial workloads

The identified partial workloads were presented in a workshop. We asked the concerned persons if these workloads were complete and which workloads had the most weight. Through this we could split the total workload into single partial workloads. These were derived from the situation and the work-task.

2.3 Stress Analysis

The goal of the stress analysis was to collect all aspects of the work situation, as comprehensively as possible, which cause stress (and strain). To achieve this, we developed a standardized tool. It allowed a detailed survey on the workload and was used in eleven shifts. With the help of these data, we could determine which partial workloads appear simultaneously.

Besides this tool, the Nasa Task-Load-Index (NASA-TLX) was utilized. The NASA-TLX determines mental, physical, and temporal demands, performance, the necessary effort, and the perceived frustration. It was filled in every half hour during the eleven shifts.

2.4 Strain Analysis

To collect data about the effects of stress, a strain analysis had to be carried out. We chose two methods to collect strain data. To gather information about the subjective (perceived) strain, a questionnaire was developed. The objective strain analysis was determined by blood pressure measurements during the eleven shifts, as well as in a non-working shift.

Questionnaire

The questionnaire was based on the information from the overview of the internal processes and from previous project experience. The questioning was in written form, anonymous and voluntary. The questionnaire included the following fields: demographics, working time / overtime / holiday / payment, requirement / qualification, information, working atmosphere / work task, ergonomics and job satisfaction.

Job Satisfaction

The Job Satisfaction was assessed with “FEAT – Fragebogen zur Erhebung von Arbeitszufriedenheitstypen“ (Questionnaire to assess types of job satisfaction) (Ferreira 2009)

FEAT is based on the Zurich Model (Bruggemann, 1976; Büssing & Bissels, 1989). This model describes the development of job satisfaction and possibilities of

employees to influence it. FEAT not only allows the survey of types of job satisfaction, which have already been postulated, but also permits theoretically evaluating any possible type of job satisfaction that can be deduced from the Zurich Model. Knowledge about job satisfaction types in the enterprise allows for the possibility to improve the work environment and to document the effects of improvements. Job satisfaction types give more detailed information about employees and their commitment to the company than single evaluations of typical facets of job satisfaction.

Blood pressure measurement

Methodology, insertion and results of the blood pressure measurements were reported in Bopp et al. (2010).

3. Results

The results show that stressful situations, which are typical for monitoring tasks, vary considerably. Workload peaks exist, however, they do not lead to acute overloads. It was possible to identify numerous possibilities to reduce the workload by optimizing the work design, which will have a positive impact, especially in critical situations.

We were able to show, that the mental demands have a significant influence on the weighted workload.

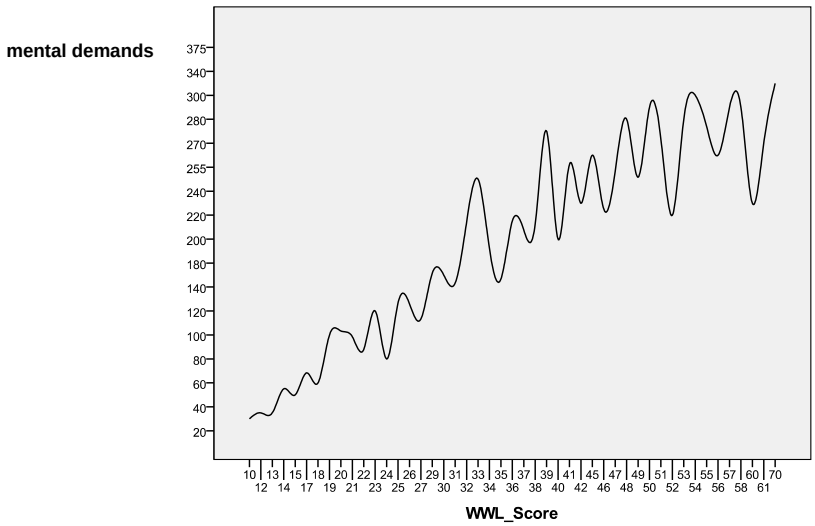

***Figure 1**: High significant (p < 0,001) coherence between mental demands (NASA TLX) and weighted workload (WWL-Score) (r=.879)*

Other significant coherences reveal possibilities to reduce the mental demands and thus, the weighted workload, e. g. the number of telephone calls during a shift or the number of simultaneous requests for switching and connections.

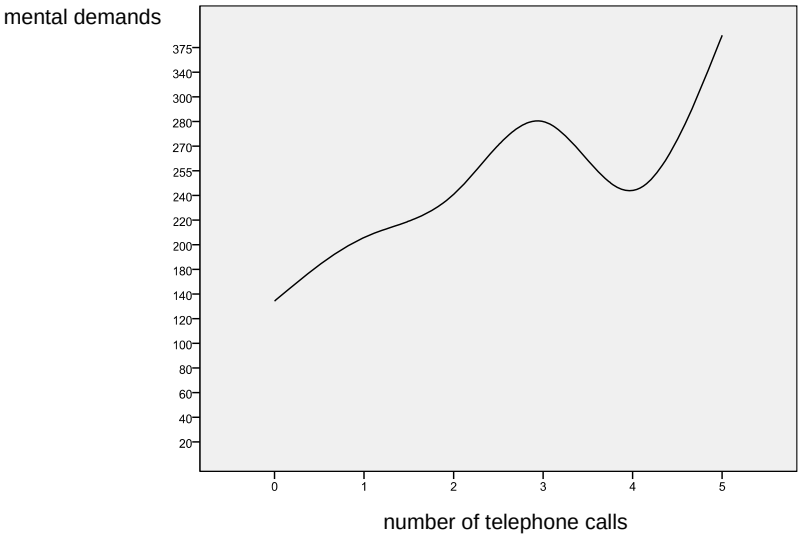

***Figure 2**: High significant (p < 0,001) coherence between mental demands (NASA TLX) and number of telephone calls(r=.496)*

This information enables the development of concrete suggestions for improvements in the organizational development.

In terms of an expansive health management program, the significant coherences between the blood pressure measurements and other aspects are highly useful. E. g. high blood pressure is related to the perceived frustration. It could be an interesting way to lower the blood pressure by reducing the perceived frustration.

In ergonomic studies and in studies with an occupational psychology background, deficit analyses are accepted and common. This study was also a deficit analysis, which means, we directly looked for bad or worse conditions of employment. Such a procedure could be quite frustrating and demotivating not only for the employees but also for the management. To reduce this effect, it is necessary and reasonable to also show positive results. Furthermore, positive results can be used as elements in good practices. In this study, we pointed out a lot of positive results. We presented these to the employees and, together with all parties involved, developed – based on these results – new ways for changes. Some positive results are mentioned here: The co-operation between the colleagues is (very) good; the employees have fun, are pleased with their work, and they are (still) motivated for their work.

Analyzed deficits are e. g. the required working time, information flow, time pressure and work interruptions.

4. References

Bopp, Verena; Ferreira, Yvonne; Helbig, Rolf; Bruder, Ralph: Belastungs- und Beanspruchungsanalyse im Bereich Netzführung einer Energieversorgungsgesellschaft. In diesem Tagungsband.

Ferreira, Yvonne: FEAT – Fragebogen zur Erhebung von Arbeitszufriedenheitstypen: Zukunftsperspektive für das Züricher Modell. Zeitschrift für Arbeits- und Organisationspsychologie. 53. Jahrgang (N. F. 27), Heft 4/2009, Göttingen: Hogrefe, S. 177-193