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POSITION OF ENGINEER OF TECHNOLOGY IN MULTIDISCIPLINARY RESEARCH IN ERGONOMICS

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ABSTRACT

Ergonomics as a typical non-basic field of science gathers a large number of experts of various profiles, a multidisciplinary team in the centre of which is the man, the conditions of his work, and the environment which surrounds him during and after work.

This paper is concerned with problems of team work in the co-ordination of the system man-machine-working environment with special reference to the role of the engineer of technology. The theoretical arguments are supplemented by data during a two-year study by the Centre for Ergonomics. The position of the engineer of technology in an ergonomics team is treated from two aspects: planning of man distribution in the respective production technology and possibilities of planning technology in accordance with the characteristics and specific qualities of men. Both aspects aim at increasing the efficiency of the worker, without harming his health which, after all, is the main aim of production ergonomics.

Ergonomy engages a large number of experts, i.e. a multidisciplinary team which investigate work from several different aspects. The main aim of research of the system man-machine-working environment, which is the subject of ergonomy, is to increase the effectiveness of man's work and reduce his physical and mental efforts and the strain on his senses by adapting the machine and the working environment to him, without causing harm to his health or affecting his working capabilities. In other words, the aim is to make an appropriate choice of workers according to the demands of work.

According to Singleton[2], members of the team must be experts familiar with man's capacities, and experts possessing through knowledge of machines, work processes and working conditions, because only on the basis of data will it be possible for the engineer to decide which functions in the work process will be assigned to the machine and which will be entrusted to the man. In most Yugoslav institutions the problems of the co-ordination of the system man-machine-working environment have not been approached by team work.

A model of an ergonomic team has been worked out by Filipowski[1]. This model shows that, depending on the nature of individual ergonomic problems, experts in other fields of science also have to be included in the team.

Experience has shown that the engineer of technology is still not given an equitable position in the team work in ergonomy, his role usually amounting to partial, occasional help to other experts (physicians, psychologists), or to a simple identification of various noxious effects which accompany the working process. In such an ergonomic team, the subject of research of an engineer of technology is the material working environment, as opposed to the "social environment which falls within the domain of social psycho-physiology"[1] for "most people realize the importance of maintaining certain standards to ensure the health and safety of the operators, but are unaware of the extent to which efficiency depends on adjusting the environment to the requirements of a particular job"[2].

The material working environment which directly influences the behavior and work of people is treated from three aspects: physical factors (light and colour, noise and vibrations, heat, ventilation, air flow, radiation), chemical factors (air pollution, water pollution, materials used in the production process) and biological factors.

According to our concept the engineer of technology should participate in the following: in identifying the working environment, in discovering causes of noxiousness, in suggesting measures for their elimination and in putting into effect the proposed solutions.

Due to the diversity of technological processes we engage experts specialized in particular fields of technology. In our ergonomic team the work of the engineer of technology has proceeded so far in two main directions. The first is planning the distribution of people within the existing production technology. This becomes clear from the following example: A company manufacturing building materials was faced with a selection problem of already employed workers. Both the workers from the existing selection and unemployed workers were available. In trying to deal with the problem, first all jobs were defined both in the physical and organizational sense. For analysing the jobs it was necessary to determine all factors which formed the material working environment. The duty of the engineer of technology was to establish all sources of noxiousness and determine their level by means of standardized methods in accordance to the existing regulations and standards. The analysis showed that some of the demands of the jobs resulted from an increased presence of noxious factors of the material working environment (although a newly built section of the factory was involved). In the cement packing department the concentration of cement dust was found to have increased (2000 particles/cm^3, 300 mg/cm^3). The physician pointed out the effects of such concentration on the worker's organism. The technological process of cement packing was automatic and the increased dust concentration was due to the work of the machine which packed the cement into sacks. The engineer of technology considered all possibilities for adjustments at certain critical points of the process. He also consulted a mechanical and a civil engineer about possible changes in the construction of the packing machine. After a careful consideration of the problem the engineer of technology concluded that by correcting the critical points in the technological process no major decrease of dust concentration in the working environment could be

achieved. In co-operation with an economist it was concluded that none of the proposed measures were economically justified, especially when taking into account that they would not greatly diminish the effects of the noxious factor. The only solution was in a redistribution of the workers according to the state of their health and their capability to work with protective equipment (personal and collective). This now was the task of other members of the ergonomic team (physician, psychologist, sociologist and the engineer of occupational safety).

The second task of the engineer of technology is to determine possibilities of planning technology in accordance with the characteristics and of workers already employed on particular jobs. This can be explained by the following example: The galvanizing plant of a metal-works was planned to be reconstructed in order to increase production capacity. The reconstruction plan did not anticipate a shifting of workers from one job to another or the employment of new ones. The ergonomic team organized its work in the following manner: The engineer of technology first investigated the factors of the material working environment in the old plant. The investigation showed the concentration of trichlorine-ethylene vapours in the atmosphere during the degreasing of metal parts to be much above the tolerable level (400 mg/m^3). The coating process was carried out in a closed space in which a considerable concentration of toluol steam (600 ppm) and acetates (350 mg/m^3) was detected. Consultations with the team's occupational health physician pointed to the necessity of decreasing the noxious effects to the required limit. In seeking to solve the problem the engineer of technology considered possibilities of changing the coating technology, and chose the technologically and economically best solution. He proposed moving the entire coating process into a special cabin equipped with a water curtain and an appropriate ventilation system. As for the degreasing process he proposed replacing the trichlorine-ethylene by perchlorine-ethylene which is much less harmful to human health while not affecting the functioning of the process. In this manner favourable working conditions were created for the existing workers, simply by technology planning and by certain changes in the process.

Another example of the role of technological engineer is as follows: In a company manufacturing high-voltage equipment, a number of workers in the section for the production of insulating materials suffered from allergic skin malformations and chronic sickness of the respiratory organs. The technological process of the production of insulating materials includes the moulding of a previously prepared mass. After hand weighing a certain quantity of each component of the mass (epoxy resin, hardener, extender) and hand mixing of the mass in an open vessel, the mass is heated and filled into moulds. During these operations the workers come into direct contact with the resin and the hardener the chemical structure of which is a compound based on amides, imides and amines which have an allergic irritating effect. Quartz powder is used as extender and, when handling it, the worker is exposed to the harmful effect of quartz dust. In order to reduce the noxious effects of the process and thus help to decrease the number of sickness, the engineer of technology proposed changing the

tehnological process by introducing closed vessels with a dosing device for the three components of the moulding mass, mechanical mixing of the mass, and moulding the mass by means of a hydraulic system. In this way not only was direct contact of the workers with the noxious materials avoided but the duration of the production process was shortened, the quality of the product improved, and waste reduced to a minimum, so that the productivity of the section increased.

The described examples point to the necessity of an ergonomic team to include an engineer of technology, who would study the technology of the respective production process and the environment in which it takes place. The engineer of technology also takes part in the identification of the working environment, in discovering the causes of harmful effects, in suggesting measures for their elimination, and in working out appropriate solutions. He must co-operate closely with all other members of the team, in particular with the occupational health physician and the industrial psychologist – in the identification and evaluation of the material environment factors in the respective work process; with the mechanical engineer, the civil engineer and the expert for protection at work – in suggesting measures for the elimination or mitigation of noxious effects and in working out appropriate solutions; with the economist and the sociologist – when considering introducing new measures.

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