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ERGONOMIC RATIONALIZATION

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Abstract: *Ergonomics and design of workplaces are today increasingly important issues in enterprises. The first part of this paper is devoted to stating the ergonomic problems of rationalization, and is dedicated to approaches to the ergonomic design of workplaces and describes their rationale, pros and cons. The second part of the paper is devoted to the application of new approaches to ergonomic rationalization. The new aproaches are the process approach and the approach to the aspects of ergonomic rationalization. The end of this article describes the additional steps that lead to the formation of a new methodology for the ergonomic design of workplaces. The aim of this paper is to describe steps and reasons that lead to the formation of a new methodology for ergonomic design of workplaces whilst taking into account human health, system performance and the functionality of the system.*
Key words: *production systems, ergonomics, proactive approach to rationalization processes, sustainable development*

1. INTRODUCTION

In order for a company in today's turbulent times to succeed, it must be competitive and capable of fulfilling all the conditions for sustainable development. When designing manufacturing systems, one of the parts appears, which is the workplace itself. This workplace, as well as the whole production system should be designed ergonomically. On this basis, the smooth functioning of the worker at such a proposed workplace should be ensured. If we address the issue of ergonomics only at one closed workplace, we may find that if we connect the workplaces with material flows, information flows, and provide service and maintenance, that the ergonomic problem begins to pushed aside. This former local approach was passive. Therefore it is necessary to start ergonomic design, seen as a process. Today's problems of ergonomics are that it is necessary to be able to quantify the effects so that the company management is willing to release funds necessary for ergonomic adjustments. Further it is necessary to focus on major issues through rationalization. This must go hand in hand with ergonomics. In this paper we would like to introduce a new perspective on the rationalization of ergonomics and what this approach can bring to the deployment of production systems, respectively workplace.

2. CURRENT PROBLEMS OF THE ERGONOMIC APPROACHES TO THE DESIGN OF WORKPLACES

Currently, it is possible find three basic approaches to the ergonomic design of workplaces in the Czech Republic. It is technical–design approach, rationalizational approach and only ergonomic approach.

All these approaches with their specifics can be used in the ergonomic design of the workplace. The technical-design approach focuses on defining the design task or a goal. Its fulfillment will improve the ergonomics. The next step in this approach is the determination of specific objectives, to respect the ergonomic and technical criteria. The last step is the selection of a particular solution. The leaders of this approach are Matoušek and Zastávka. (Zastávka & Matoušek, 1977) The rationalizational approach sets the objective which will be achieved by the rationalization. Then it focuses on individual areas which will be achieved by rationalizational effects and determines their depth, along with a timetable of steps. Further steps are determined according to the general project process:

- gathering of information,
- analysis,
- proposal of solution,
- realization,
- stabilisation.

The leaders of this approach are, for example, Chundela (Chundela, 2005) and Hlavenka (Hlavenka, 1995). A purely ergonomic approach at the start provideas a formulation and concept of the ergonomic task. Then follows the collection of relevant information and documents, in terms of ergonomics, and then their classification. Then it is possible, based on the analysis of these documents, to set the direction of the solution and to work on the ergonomic design solution. This solution is then implemented and stabilized. The leader of this approach is, for example, Král. (Král, 2002)

3. CURRENT STATE OF ERGONOMICS

The current state of ergonomics is dependent on the state of the market on to which the product enters, the type of customer it wants, i.e. the product complies with everything in terms of production.
If we look at today's product market, the following characteristics can be specified:

- dynamic,
- turbulent,
- customer-oriented,
- shortest delivery period,
- maximum modularity of the product,
- etc.

Producers are therefore forced to use the most advanced technology. The technology itself, in relation to customer requirements for a product, can contradict the ergonomics of the workplace, and the whole production system. As a result, the workforce is overloaded by physical and psychological factors, high repeatability, and monotony. This constant technical improvement of production processes is again beginning to reach the limits of human ability. The effects of simulation and applications of lean production approaches, are already well-known and the human factor is starting to come into the picture. The human element, as the quickest and easiest adaptable to changes, is seen to be the most important element, but based on the requirements imposed on the worker, s/he is

also "the most vulnerable" element of the whole production system. Because to gain, retain and train quality staff who possess know-how, is the most valuable thing a company has, it is therefore necessary to adapt the production systems to this fact, or to modify them. This corresponds to the trends, that can be divided into two groups:

- approaches to ergonomics, using sophisticated tools with computer backup,
- creation of simple tools based on the "new ergonomic methods" (development in Western Europe).

The first of these approaches uses modern tools of the digital factory which in its functionality includes modules for addressing ergonomic issues. In combination with ergonomic analysis and the possibility to simulate human motion and loading, these products represent a very powerful and useful tool in the hands of designers and engineers. They can use their functionality in both product design and the design of manufacturing systems.

The second of these approaches is based on the assumption that people in business still do not know about the effects of ergonomics, and thus do not know about the problems and risks if ergonomics are not respected. Another assumption is that not every business can afford a trained ergonomist, or possess digital business tools. With regards to this the European Union has made efforts that lead into projects. Their outputs are simple tools working on the principles of ergonomic methods. They are used for simple and rapid determination of the risk of problems related to ergonomics. These tools are then disseminated, along with examples of "good practice" in small and medium-sized enterprises.

4. APPLICATION OF NEW APPROACHES

Conventional approaches to ergonomic design of the workplace have been described in many articles. By applying new approaches such as the process approach it is possible to obtain measurable results of ergonomic rationalization.

4.1 Application of process approach

An efficiently functioning organization is possible only if it is able to conduct many activities. For the functioning of these various activities an organization uses resources. Individual activities transform inputs into outputs, which is the very essence of a functioning process. The concept of the overall system is that the outputs of one process are the inputs to the following process. By applying a process approach to the process of ergonomic rationalization it is possible to create a new procedure. Thus it is possible to obtain a tool to describe even the individual activities within the workplace and then to measure aspects of the process.

4.2 Determination of the aspects of the ergonomic rationalization

In order to apply the ergonomic rationalization and measure its effects, it is necessary to determine the individual aspects that should be fulfilled and monitored. Based on their status the whole process of ergonomic rationalization will be evaluated. . If we focus on the essence of ergonomics, then with its help ideal working conditions for humans should be provided. This fact can be converted into human health. The World Health Organization defined health in 1947: "as a state of complete physical, mental and social well being and not merely as absence of disease or weakness" (WHO, 1947). Human health itself can then be divided into more components, like the physical, mental, social, emotional and personality health.

These aspects have been compiled into the Ebers model of health. These aspects can then be monitored. In Ebers model (Koukalová, 2006), human health is based on a hierarchy of human needs, as A.H. Maslow determined. If we look at the other side of the process from the view of its owner, so we should be interested in their performance. It is therefore necessary to establish a target value to be achieved and for comparison with the measured values. The desired value represents the requirements for human health and performance of the system, which correspond to the ergonomic parameters. Universal indicators of process performance can be used as performance indicators (Nenadál, 2009):

- continuous time of process,
- efficient usage of process time,
- the total cost of the process,
- effective usage of cost,
- etc.

Of course certain specific indicators can also be used that are derived from the universal indicators of the performance of processes, or if necessary entirely new ones can be set.

5. CONCLUSION

Using the new approaches to ergonomic rationalization mentioned above, a new methodology will be created. Using this methodology it will be possible to design a workplace while balancing aspects of human health, system performance and functionality. Previously used methods for ergonomic workplace design are characterized by certain common features, but only describe the approach for ergonomic design of workplaces. Their authors don not deal with, the links between ergonomic design and its reflection on system performance. The design must comply with such conditions to ensure the health of the worker. Therefore links between the parameters of human and system performance will be established. Furthermore, these links will be quantified using performance measurement processes. The most important step will be assigning the importance of individual links. The result will be a methodology for the ergonomic design of workplaces that will respect all these facts. It will be used to design an ergonomic workplace which balances these aspects.

The purpose of this paper is to describe a new approach to ergonomic design of workplaceswhich balances aspects of human health, system performance and functionality of the system. A methodology based on the principles described in this paper will be created.

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7. REFERENCES

Chundela, L. (2005). *Ergonomie*, Vydavatelství ČVUT, ISBN 80-01-02301-X, Praha, Czech Republic

Hlavenka, B. (1995). *Racionalizace technických procesů*, PC-DIR s.r.o., ISBN 80-214-0705-0, Brno, Czech Republic

Král, M. (2002). *Pět kroků chronologického postupu ergonomického zkoumání a hodnocení v rámci pracovního systému,* VÚBP, Praha, Czech Republic

Matoušek, O. & Zastávka, Z. (1977). *Metody rozboru a hodnocení systému člověk – stroj*, SNTL, Praha, Czech Republic

*** (2006) http://vnl.xf.cz/vkz_zapisky.php - Koukalová, Výchova ke zdraví, *Accessed on: 2011-03-06*

*** (2009) http://katedry.fmmi.vsb.cz/639/qmag/mj24-cz.htm - Nenadál, Příspěvek k měření a monitorování výkonnosti procesů v systémech managementu jakosti, *Accessed on: 2011-01-15*

*** (1947) https://apps.who.int/aboutwho/en/definition.html - World Health Oragnization, *Accessed on: 2011-03-01*