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# Using the Theory of Technical Systems to Describe the Interaction between Human and Technical Systems within the Ergonomic System

Tomas Gorner\*, Michal Simon

*University of West Bohemia, Faculty of Mechanical Engineering, Department of Industrial Engineering and Management,  
Univerziitni 8, Pilsen, Czech Republic*

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## Abstract

The application of ergonomics in enterprises is gaining in importance. Nowadays ergonomics in enterprises is addressed in a more technical manner. Therefore it is necessary to try to adapt generally applicable ergonomic practices to a technical perception. The result of this is a search for approaches that can be used as a link between technical and ergonomic perspectives of problems in the workplace. The Theory of Technical Systems has been found to be suitable for this. The first part of this article deals with the application of the Theory of Technical Systems to ergonomics. The second part is devoted to the use of the Product Life Cycle according to the Theory of Technical Systems. This theory allows the technically comprehensible analysis of the interaction between the basic elements of the Ergonomic Human-Machine-Environment system. The third part describes the interaction between Human and Technical Systems.

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## 1. Introduction

Ergonomics is a multidisciplinary science with a very wide range. Its main task is to comprehensively and systematically solve the human-machine-environment system. Ergonomics examines and optimizes the relationship between the human and the working conditions using a multidisciplinary approach. This is done by applying the

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\* Corresponding author. Tel.: +420 377 638 492; fax: +420 377 638 402.

*E-mail address:* [tgorner@kp.v.zcu.cz](mailto:tgorner@kp.v.zcu.cz)

latest knowledge of biological, technical and social sciences. The main objective is to optimize the position of human in the working environment. This objective must be achieved while complying with conditions of the human health, human welfare, human safety and optimal performance.

These facts adhere to the definition by the International Ergonomic Association. Ergonomics is a scientific discipline based on understanding the interaction of humans and other system components. By applying the appropriate methods, theory and data we can improve human health, comfort and performance and contribute to the design solution and evaluation of work, tasks, products, environments and systems to make them compatible with the needs, capabilities and performance limitations of the human. Ergonomics is systemically oriented discipline that covers virtually all aspects of human activity. As a holistic approach it includes physical factors, cognitive, social, organizational, environmental and other relevant factors.

The main focus of this article is the application of the ergonomics in the assessment and design of workplaces in engineering companies. From the above facts it is clear that their application is based on the application of a 'proactive' approach. A proactive approach is more appropriate for the following reasons:

- The worker, responsible for the application of ergonomic approaches need not seek ties with an already functioning system. There are no limited by already-established relationships.
- The application of a proactive approach requires fewer financial resources.
- It usually brings greater effects.
- The worker is not exposed to the risk of non-compliance with ergonomic approaches.

The application of ergonomic approaches within companies does not only depend on the theory and knowledge of ergonomic principles. It is also related to the overall system of education of experts in ergonomics. In the Czech Republic there is no coherent educational programme for ergonomists. It is also related to the fact that there is no recognised working position of ergonomist. This gives rise to the major problem and its solution which is presented in this article. It is necessary to find an appropriate procedure for the application of an ergonomic approach suitable for technical staff, and which respects the modern concept of a product. The Innovation for Welfare project (subproject TIAM) also conducts research into the main approaches to applying ergonomics. The problem was the different conditions in the application of ergonomic approaches in five European countries (Spain, Italy, Czech Republic, Austria and Estonia).

Leading Czech ergonomists are engaged in conventional approaches to the application of ergonomics in the Czech Republic. Chundela [1] is representative of the traditional view of project rationalization. At the beginning, the methodology provides the specific objective to be achieved and in what areas. Then the focus is on the determination of the area and depth of rationalization and the schedule. It continues according to the general procedure of the project, i.e. the collection of information, analysis, solution design, implementation and stabilization. Král [2] has a more ergonomic approach. At the beginning of the methodology he presents the formulation and the concept of ergonomic task. Then he continues by collecting information in terms of ergonomics. These data are then sorted. Based on the analysis of this data he sets out various solutions. Then a comprehensive proposal for an ergonomic solution is worked on. Matoušek and Zastávka [3] are representatives of the design approach. They focus on the definition of the design task. The goals are determined on the basis of partial goals while respecting ergonomic sub criteria and technical criteria. Last they select a specific solution according to the procedure. The Refa Methodology [4] presents a general project approach. On the basis of the determined objectives, it sets up alternative systems, from which selects the optimum one is selected. Then follows the process of project implementation, monitoring and adjustments. Hlavenka [5] uses rationalization approach. Problems are exposed by using diagnostics. Then information is collected from documentation. This information is analysed in detail. Then he designs a rationalization proposal to implement it. Bures [6] states specific tasks that must be performed. The general procedure of the ergonomic design includes formulation of objectives, workplace diagnostics, data collection and design of solutions. The author also introduces a new part of the procedure. This is the creation of a digital model of the workplace. Then he designs a selection of optimal variants, documentation, implementation, checking and correcting. ErgoDesign from CEIT SK [7] begins with the collection of data, followed by the creation of the project and design solutions based on the data.

None of those approaches take into account new trends, regarding the concept of the technical product which relate to the PLM (Product Lifecycle Management). Another fact is that technicians in the Czech Republic are specifically responsible for the application of ergonomic approaches. It is therefore necessary to specify the worker responsible for the administration of the ergonomic approach in companies in the Czech Republic.

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