

ANNALS of Faculty Engineering Hunedoara – International Journal of Engineering

Tome XIV [2016] – Fascicule 4 [November]

ISSN: 1584-2665 [print; online]

ISSN: 1584-2673 [CD-Rom; online]

a free-access multidisciplinary publication
of the Faculty of Engineering Hunedoara



¹Dominika PALAŠČÁKOVÁ

DESIGN AND ERGONOMICS OF THE MACHINE WORLD

¹Department of Production Technology, Faculty of Mechanical Engineering TUKE, Košice, SLOVAKIA

ABSTRACT: In the initial period of development of visual constructing industry to some extent they draw on the experience of foreign design. Initially, it was unfortunately the only form of research, comparison of characteristics of foreign samples. This method of comparison has become one of the arguments in favor of introducing Fine, designed for industrial production. It was the first impetus to the creation of a specific concept of visual construction. Ergon helps choose from a number of art-design solutions to what is optimal from an ergonomic point of view. Models and replicas, such a variant is used only for verifying compositional solutions, but also allow experimentally verify the extent to which the new structure in accordance with the requirements of ergonomics.

Keywords: design, ergonomics, psychology of work

1. INTRODUCTION

Production of high quality products is a difficult task, resolving related not only to improve the technical - economic indicators, but also to enhance the aesthetic qualities of the entire production. To create such properties is important to the production of art construction, introducing complex processing with respect to the relationship between the various machines, environment and humans. Therefore, the optimal parameters, the arrangement of the functional groups and the external appearance of the product facilitate coordination of designer and artist, which would not be possible if the designer did not know at least the basic principles and methods of constructing fine.

2. TASKS AND DESIGN DIRECTION

Fine construct is an integral part of the design process. The Industrial Revolution, which affects all areas of human activity, bring to design engineers a new job. One of them is to create visually perfect aesthetic machine. Participation of the artist-designer with special training proved to be indispensable in the design of products. The market will get products with new quality characteristics and with unquestionable advantages. The need arose to artists-engineers knowledgeable functional peculiarities of engineering products, then design and production technology. The practice of making industrial products showed that the perfection of machine tools, vehicles and lifting equipment, instruments and other products is not limited to a mere performance. If the product is designed to cope with the account of the human factor, due to the demands of safety technology, psycho-physiological human performance and aesthetic effect - undoubtedly will increase economic effect, service culture and work it is superior. In addition, these products require careful treatment, which extends their service life and operating reliability, increases productivity and reduces scrap. If the external appearance of the machine and its driver-designed system are due to the human factor, it has a significant impact on the creation of an appropriate and disposable equipment, which reduces operator fatigue and brings him joy and moral satisfaction from work. It should also be noted that, aesthetically perfect product emphasizes beauty, tastes and shapes human thinking, t. j. It becomes an effective means of aesthetic education...". On any machine must be in accordance with modern requirements, strictly coordinated functional, operational, technological and aesthetic characteristics. Otherwise, we cannot be regarded as perfect products which do not meet the above requirements and operate uncomfortably. Artist-designer in the engineering features in a completely new role,

different from the one in which we did see each other in the past. But if we recognize that the designer is an artist-designer, we must not forget that this is a new type of expert, whose function cannot be limited to treatment of the finished product, but must participate in the development of the product from the beginning design to construction.

Design is a new category of social practice, which was established on the basis of advanced manufacturing design of the (industry and decoupled from engineering design, and created a separate and specific area of professional activity - art design. According to the definition adopted by the international seminar in Belgium (d. 1964), "Design is a creative activity whose aim is to determine the formal qualities of industrial products. Those characteristics include the external features of the product, but mainly structural and functional characteristics that transformed the product into a unified whole from a consumer perspective and in terms of the product." Art design thus becomes an integral part of the design process of industrial products, whose mission is to serve the people; it is necessary to ensure that products conform to maximize the operating conditions and create a harmonious compact size products with high aesthetic properties. If, for example, to propose a special machine tool, then after becoming aware of the technical mission and review job status it created many problems. Head designer must determine the movements of the machine tool for carrying out the necessary operations to establish, if possible, several structural and kinematic schemes to solve the source or sources of energy for the main and auxiliary feeds and solve problems related to clamp the workpiece setup and instrument cooling chip flow etc. on the basis of economic calculations and art-design analysis of possible options for the establishment of an acceptable solution of the kinematic and the general layout of the machine tool. At this stage, it is also addressed issues related to the deployment of auxiliary machinery, control panel and protective devices. Thinking the outer shape of the machine tool and its individual groups, which may affect the distribution of major and minor mechanisms, characteristics and mass production technology for basic parts of the machine tool. The relationship that occurs mainly between the shape, structure and general layout mechanisms in machine tool, forcing designers to vary the solutions to obtain optimal. After preparation of drawings and technical documents and discussing technical option adopted by the Council of the design office at the factory with the client and draw up a final report on the selected machine tool structure and the whole structure. Assuming that the machine tool will be produced in series, lives project (schematic diagram, drawing groups and reports, calculations and reasoning) often accompanied by spatial display machine tool or dummy, which will give a comprehensive picture of the overall layout, types of construction and deployment drivers.

The next step is designing a correction of the approved design and preparation of manufacturing drawings. If the project involves several types of dimensions special machine tools (for example, flat grinders, or honing machines), then it is desirable to verify the solutions adopted to models, replicas of all types of dimensions. This practice has almost completely eliminated by modifying the project for the production of machine tool. The methodology of production scale models and modelling take many project offices, making the produced many aesthetically valuable products. Artist-designer must have the ability to synthesize, t. j. ability that allows him to unite and balance the diverse factors. Its field of action is vast: from the development plan and the composition of the product to exploring the aesthetic tastes of consumers. Must have different skills: able to draw a shape according to the vision of the future of machine or product to be dreamers and practices and must be able to scientifically predict. The full cooperation in the design of the machine must have an artist-designer knowledge in engineering sciences, because its duty is to determine the relationship of various factors relating to the external shape of the designed object, the control system and performance characteristics. In addition to engineering drawing and addition in the display must have an idea about the operating conditions of the proposed machine to increase or at least maintain performance characteristics, must know the properties of metals and materials to fully exploit the unusual traits, production technology peculiarities of assembly, packaging, but the possibility of using various forms of energy in the machines, and others. At any stage of the design is the work of artist -designer inseparable from the work of engineer-constructor. Before you can find an optimal solution must remain in dispute, seek solutions and even contradictory to restate previously approved options. Just by virtue of the creative results can be obtained by rational product with a nice outer appearance.

3. ERGONOMICS KNOWLEDGE BASE

Ergonomics draws on knowledge from multiple disciplines, the most important are: psychology of

work, work physiology, sociology of work, occupational hygiene and safety. These scientific disciplines together to form the knowledge base ergonomics. The interdisciplinary nature of the economy is shown in figure 1.

- » **Psychology of work**-the subject of the investigation is the work activity, the personality of the worker and also a working environment in which the work activity takes place. Psychology of Work is a body of knowledge that is relevant and necessary to adapt working practices, working conditions for the selection, training and deployment of staff evaluation and influencing human relations in the workplace.
- » **Physiology of work** - Medical science is applied to the activities of the various organs of the human body and the human body as a whole in the work carried out by a certain time in a certain working environment. Knowledge of the physiology of labour used to solve two basic groups of tasks:
 - ≡ Maintaining the health of workers, i.e. capping systemic exposure at work, that is such a burden that man can endure without harm,
 - ≡ To achieve the highest labour productivity, i.e. establish classes of onerous employment, business model breaks the design of the workday and rest.
- » **Sociology of work** - It deals with the social aspects of work. Examines the impact of employment on the social role and status of a person who carries it out under certain conditions. Deals with:
 - ≡ Sociological - psychological aspects of employment,
 - ≡ Sociological aspect of age employed workers,
 - ≡ Alternating activities at work,
 - ≡ Looking for employees to work and participation in governance,
 - ≡ Social aspects of remuneration for work performed.
- » **Hygiene of work**- It deals with human hygiene conditions and the working environment, examines the impact of factors working environment for job performance and health. The aim of hygiene is prevention of occupational diseases.
- » **Safety of work** - a series of measures to protect the life and health of employees and to ensure the property from damage during labour. Work safety objective is prevention of accidents at work.

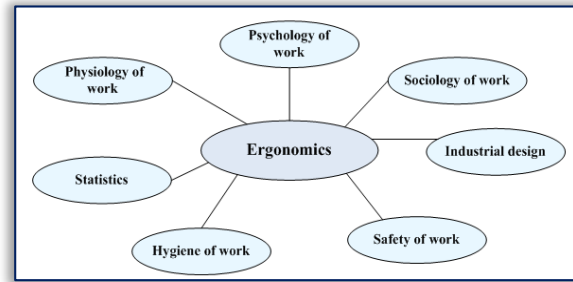


Figure 1: Interdisciplinary nature of ergonomics

Addressing the issue of ergonomics using the knowledge of these disciplines helps optimize working conditions humanisation of work, labour productivity growth and improve the overall quality of work.

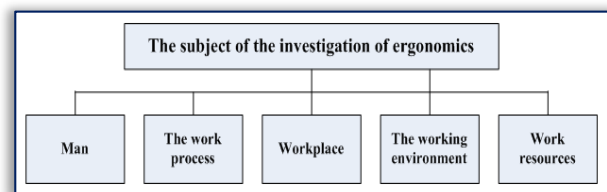


Figure 2: Subject examination ergonomics

3. SUBJECT EXAMINATION ERGONOMICS

The essence of the investigation ergonomics is human labour. The idea is to adapt the work and working conditions, human, improvement of working conditions without risk to health, more pleasant working environment and increase the efficiency of business operations. Under review Ergonomics is the position of man in work, figure 2. Basic factors that need to be in the work process or complex improve the system, figure 3:

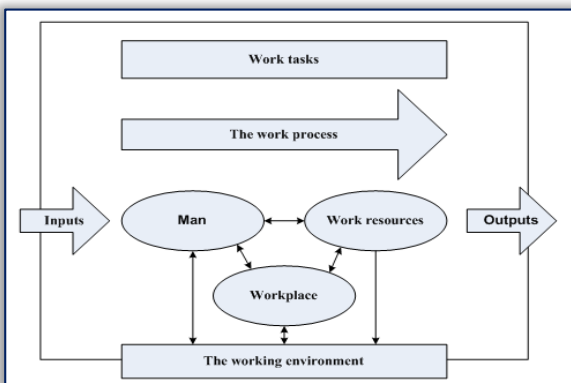


Figure 3: Working system and system boundaries

- ≡ The work process - taking into account the possibilities of human beings, ensure optimal and economic use of its capacities.
- ≡ Workplace -achieving maximum productivity with minimal effort.

- ≡ The working environment - the elimination of disturbing factors that adversely affect human health, its performance and safety at work.
- ≡ Work resources - machines, tools, and equipment shall be designed and located in accordance with the circumstances and the psycho-physiological capabilities of human.

The process must be provided with optimal and highest possible economic use, taking into account human performance. A job should enable maximum productivity with minimum effort. Elimination of interference factors and amplify the positive factors affecting the health, performance and security of Man must ensure a work environment. The final element in the labour force are work equipment must be designed and positioned that the operator was the easiest and simplest. Ergonomic system man - working environment system allows you to analyze, model, rationalize and last but not least it projects according to ergonomic principles.

4. ERGONOMIC PRINCIPLES WORKPLACES DESIGN AND SYSTEMS

Designing production systems creates a structured set of resources whose function is the transformation of inputs (raw materials, semi-finished products, energy, etc.) To the desired outputs (products and services). The transformation processes have an important role and people. Production systems are made up of production and auxiliary agents (machinery, tools, jigs, energy, etc.) And the production forces, which are interconnected by material and information flows, and perform manufacturing operations on objects of production (materials, raw materials, components). Current production systems integrate a large number of make-up elements (machines, robots, storage, transport systems, control equipment, people), among which there are many complex bonds. When designing production systems, it is necessary to respect the requirements for functional and operational capability, reliability, and short time of project implementation, flexibility, simplicity and safety of operation, low investment and operating costs. Particular attention must be paid to the human factor, i.e. human activities. Designing a specific creative process of creating a manufacturing system (production line, workshop, factory, etc.), and the project documentation is in space and time expressed the functions and structure of the system, material and financial conditions of its implementation and effective operation.

The role of design is to develop a complex consisting of materials, technical equipment, software and people from the real technical, economic, functional and social terms. The designed system has to work reliably under real conditions, be optimum (technically and economically) and long-term and reliable operational. The design will be applied general patterns of production and technical procedures for special solutions object so that their conscious and deliberate modification achieves the creation of the most efficient forms of production of the products and service of their delivery systems. The model structure of the production system is shown in figure 4.

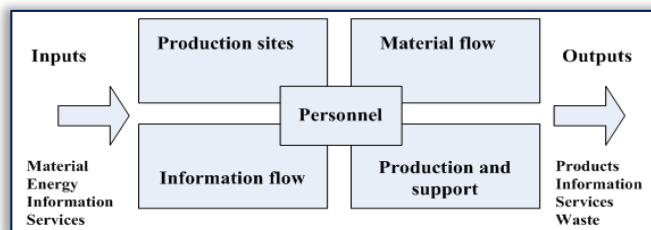


Figure 4: Production system and its inputs and outputs

5. CONCLUSION

Man is generally possible problematic element of the working process, so it is necessary to adapt the workplace capabilities, skills and knowledge. Human performance can be improved just by applying ergonomic design knowledge to the work environment, so while reducing its workload. This brings economic benefit and reduce the cost of removal of damage caused by high load worker incorrect arrangement of the working environment and the like.

Acknowledgement

The work was supported by Ministry of Education of the Slovak Republic KEGA 039 TUKE-4/2016: The creating of virtual laboratories based on web technologies to support the educational process in the field of Manufacturing Technology.

Reference

- [1.] L. B. Bogdanovič, V. A. Burjan, F. I. Rautman, Design v strojárstve, Kyjev 1976, 63 – 102 – 81
- [2.] J. Kováč, E. Szombathyová, Ergonómia, TUKE Sjf 2010
- [3.] Chundela, L.: Ergonomie, Praha: VydavatelstvíCVUT 2007
- [4.] Savlík, J.: Ergonómia, Bratislava: ES SCST 1990
- [5.] Petr Baron [et al.] Expert system approach to safety management, 2013. In: Risk Analysis 8. - Southampton: WIT Press, 2013 Vol. 44, no. 8 (2012), p. 77-88.
- [6.] Jozef Dobranský, Juraj Ružbarský, Štefánia Salokyová, Stabilitavý robných procesov, 1. vyd. - Košice : TU - 2015. - 161 s. [CD-ROM].