

EVALUATION OF WORK ENVIRONMENT FACTORS IN MECHANICAL ENGINEERING PLANTS

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Abstract: *The challenges of competing business interest in production process as determined factor for quality products, environment protection, production machinery condition, required parameters for machining and elaborateness for given accuracy. One of solution is the implementation of modern simulating devices and applications of analogy in production practice.*

Key words: *production process, evaluation, analogy, simulation*

1. INTRODUCTION

It is necessary to pay attention to production process, which are determined as factors for product quality, environment protection, production machinery state, required parameters for machining and elaborateness. That is given for achievement of required accuracy. One of solution is the implementation of modern simulation devices and application of models in production operation.

2. MECHANICAL ENGINEERING PRODUCTION PROCESS

Production process is the collection of human activity, machinery and physical processes and its results are particular kinds of products (Jovanovic et al., 2010). At every production process there are three factors:

1. systematic activity – human work,
2. work objects which are transformed to products – basic mechanical engineering products are machines, function groups, nodal points and components,
3. means of work, which are production machines, devices, tools, accessories, helpers, transport and handling equipments, control technology (Jovanovic et al., 2010).

Production process has also got its life cycle. There are characterized its production, system, technological and environmental phases. According to production aspects the process can be in beginning phase of its cycle. However according to environmental impact view can be out-of-date or according to qualitative parameters in leading countries “outsider”. Working out of equivalent model of production process is has got several phases as followings:

1. **Prediction analysis:** In this step is important to establish the reliable obtained information. It can reach to use accurate methods of data collecting or application of measurement methods if there is an existing operation plant where it is possible to obtained parameters.
2. **Development of method:** According to number of inputs and outputs, we can choose strategy or methods for model development. We obtained various types of models with the combination of individual parameters. If we choose the main point as economical point and inputs will be reduced only gains, expenses, costs per hour, costs per piece, etc. Very simply model comes into existence but in real

operation there is not applied. Many customers are asking for quality, ecology, and modern technology not only for low price.

3. **Model implementation:** There is a verification of prediction and correctness of used methods. If the preparation is worked out in detail then the implementation is simply and the model can be applied in short time. Implementation make possible to modify a model and it creates other opportunity to regulate and to adjust model.
4. **Control model:** This is the last stage, therefore, control. It is the adjusting according to external and internal operational demands. All feedback relations in system can be used and following modifications, which do not influence the model creation but only they simulate all changes in production.

Model, which is created in this way, exists from its beginning to its finish and this model makes possible to eliminate or minimize mistakes. Mistakes in model are cheaper than real production and changes, which are done in model, are reversible as well. Production enterprises can use **Model** for improving or representation for customers, contact persons from state institutions, for certification of quality or environmental management, for training and courses of employees or for comparison of product quality to competing product. In model there are all accessible methods and technologies, which product operator requires. One of methods is LCA (Majernik et al., 2001).

3. ENVIRONMENTAL ASPECTS

Environmental aspects, its loading and protection give production enterprises the possibility of evaluation of their production methodology, used technology, raw material and energy management in term of environmental influence reduction.

However, the quality of these solutions is depended on project quality for new building-up or reconstruction of production, there is needed to add ecological aspects to ordinary methods of projecting. The ecological ones in determined term ensure sustainable development of environment. Policy, economy and ecology have got significant function. Works, function and possibilities in environmental creation and protection is possible to outline in points which represent strategy of mechanical engineering development in environmental view at present:

- production of environmental suitable products,
- using of environmental acceptable technologies for their production,
- energy and raw material economy – low-waste, non-waste and recycling technologies,
- machinery and devices production for environmental protection and creation (water treatment plants, filters, separators, traps, eco-technology).

4. MONITORING OF ASPECTS IN WORKING ENVIRONMENT

The evaluation is based on monitoring. The evaluation of aspect in working environment is based on their monitoring. Enterprise environment is often changing and that is why it is important the responsible approach of HSE (HSE - Health, Safety, Environment) (Majernik et al., 2001). All in connection with external changes included groups require a development from industrial companies and continuous improvement of data, behaviour and their efficiency in this area. The following main goals that should be subserved with the mechanical engineering enterprises:

- a minimize of work accidents, occupational diseases, fires and likewise,
- losses and breaks of production by reason of HSE,
- full legalness in the legislation of HSE,
- continuing minimize of waste, emissions and releasing of waste,
- cost effective restoration of old environmental burdens.

Monitoring of working environmental aspects has got still a greater relevance from the point of view for production quality and safety.

At our department there are several tasks and projects, which are related to the monitoring of working environmental aspects in mechanical engineering enterprises (Rusko et al., 2009). Measured data operation and their visualisation were done (Fig.1) for specific factors in specialized programs for:

1. light and lightning
2. noise
3. non-ionized rays
4. microclimate
5. dust

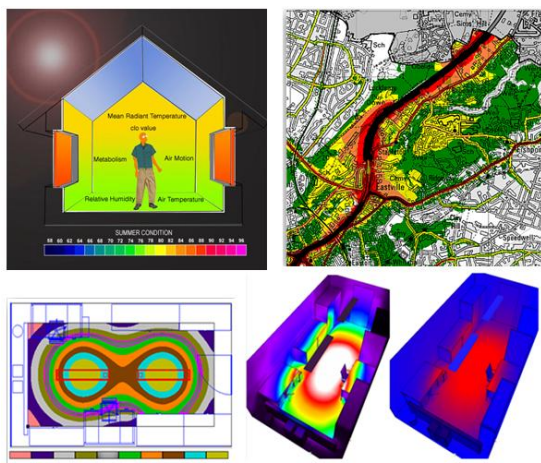


Fig. 1. Visualisation of measurement data

In the specific mechanical engineering enterprises there were the multicriterial methods for the applicability assessment as well as the comparison of the agreement according to ISO 14001 and ISO 18001. These outputs are exact bases for project assessment according to HSE. The aim of solution is the verification of origin mathematical-statistical method on the base of chosen factors and parameters in working environment in the common mechanical engineering operation plants. The method of multicriterial assessment for the working environment factors in the mechanical engineering enterprises makes able the assessment of production process as a system on the base of applicability for these factors, which significantly influence the quality, safety and hygiene of working environment (Kevicka, 2009).

5. MULTICRITERIAL EVALUATION

This evaluation is based on quantification of parameters for environment quality by means of unbalanced evaluating effects of production process (Macala et al., 2003). During the evaluation it is suitable to go out the following steps:

- specification of working environment aspects,
- choosing the factors which influence safety, quality and hygiene of working environment ,
- significance tests of chosen factors and parameters,
- computer mathematic-statistical operation of chosen factors and parameters.

Deriving from following relations it is possible to determine Q_j , value of environmental load:

$$Q_j = \sum_j \frac{a_{ij} - u_j}{s_j} \cdot k_j \quad (1)$$

Q_j - value of environmental load,

a_{ij} - value j-element of vector,

u_j - average value of j-element,

s_j - standard deviation of modified j-descriptor,

k_j - reduction constants.

6. CONCLUSION

Methods for monitoring and checking of technological, social and environmental aspects for production can have other applications. There are in small and medium enterprises for development of technology or optimization of operation according to customer's, producer's or environmental engineer's demands. This period is period IT technologies and it could show that environmental pollution is slowing because operation plants of individual productions began to behave more understanding. It is true only in developed countries with strong environmental feeling. Model of life cycle for production process is one of tools that helps producers produce with optimal technology, develop products with optimal balanced performance and costs, characters which are up to standards for environment, health, safety and maintenance of sustainable development.

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