Structuring information on the state of labor safety at mechanical engineering enterprises

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Abstract. The article discusses the issues of structuring the information received on the state of labor safety issues at mechanical engineering enterprises. Factors, multipliers and indicators on occupational safety issues at these enterprises are selected. The parameters of the BT control system and the relationship between them are determined. Sanitary and hygienic factors.

1. Introduction

The analysis shows that information on safety parameters is of a multilevel nature, which must be taken into account when solving various problems of assessing working conditions and taking measures to reduce occupational risks.

All parameters of labor safety in this work are proposed to be divided into three large groups - factors, multipliers and indicators of labor safety. The semantic relationships between factors, multipliers and indicators of occupational safety are shown in Figure 1.

Studies have shown that socio-economic, organizational and technical factors are the result of the impact on working conditions in the production sphere and the socio-economic relations prevailing in society. As for natural factors, they have a direct impact on the formation of working conditions and necessitate the use of complexes of social and other measures to reduce the adverse impact of these factors.

The specificity of the considered group of factors lies in the fact that, in addition to the direct influence on the formation of working conditions (ecology, temperature, pressure, etc.), they also impose additional requirements on the means of labor (machines, machine tools, tools, structures, etc.), technological and operational processes, the organization of labor and its individual components are the general environment in which the factors belonging to the first two groups operate. The selected groups of main factors affect the process of formation of working conditions simultaneously and in an inseparable unity; they are closely related, interdependent, are in constant interaction.

In accordance with the basic requirements, this classification, firstly, covers all the main factors affecting the formation of working conditions; secondly, it reflects a general, fundamental target setting: factors are classified that comprehensively affect the employee from external and internal threats and as a person (on his health, performance, various forms of social security), and, thirdly, helps to create a methodological basis to develop complexes of targeted measures: to solve the
problem of creating favorable (permissible) working conditions at the design stage of production facilities and facilities, operating systems, etc., to improve working conditions by substantiating the choice of optimal options for the necessary measures at different levels - at the working place, in a division; on the timely determination of the sequence and priority of the implementation of these measures and for solving other problems.

Figure 1. Factors, indicators and multipliers of occupational safety.

Research shows that working conditions, which are formed under the influence of three groups of main factors, are determined by a large number of indicators. Due to the complexity of such indicators, it is proposed to call them multipliers of hazard and harmfulness of labor.

These dangers and hazards are directly determined both by the general action of all three groups of main factors, and by their specific action, depending on the characteristics, technological and operational processes, labor organization, on the characteristics of the areas of location and other possible specific circumstances.

The classification of labor hazard multipliers into sanitary-hygienic, psychophysiological, social-psychological and aesthetic ones is based on the research of the Research Institute of Labor. This classification does not contradict the classification of hazardous and harmful production factors, provided for by GOST 12.0.003-74 SSBT.

Sanitary and hygienic labor hazard multipliers characterize the environment in the workplace with which the employee interacts in the performance of official duties. This group of elements is the result of the impact of the applied technological equipment and technical systems, raw materials and materials, fuel and energy and can be quantified: temperature, humidity and air mobility; noise; illumination; non-ionizing electromagnetic radiation (ultraviolet, visible, infrared, laser, microwave, radio frequency, low frequency); static, electric and magnetic fields; ionizing radiation; toxic liquids and gases, chemical reagents, some biological substances (antibiotics, enzymes, etc.), bacterial environmental pollutants and other elements. This group characterizes working conditions from the standpoint of their harmfulness and danger.

Psychophysiological multipliers of labor hazard are determined by the very processes of the employee's performance of job duties from the standpoint of their severity and tension. This group of elements includes: static and dynamic physical activity, the mass of the load being lifted and moved, stereotypical working movements, working posture, body tilts, shifts, the duration of continuous work during the day, monotony, work and rest mode, intellectual and emotional stress, and others. For a number of elements of this group, generally accepted standard units of measurement have been developed, for the majority, such a search is being conducted. Elements of this group characterize working conditions by indicators of its severity and tension. As for the socio-psychological and
aesthetic elements of working conditions, which primarily affect the efficiency of workers’ work, there are currently no norms, standards, units of measurement for the quantitative assessment of these elements, but a systematic study of these elements, the accumulation of data through expert assessments, questionnaires, oral questioning, etc. are essential for improving working conditions.

There is also a higher level of generalization of information on the state of labor safety. It is represented directly by indicators of injury and occupational morbidity. Such indicators (frequency of injuries, severity of injuries, etc.) act as indicators that fully characterize the degree of hazard to work and are comparable for organizations of various types of activity. Depending on the tasks to be solved, the researcher may be interested in the labor safety parameters of one or another information level - factors, multipliers, indicators, or several levels simultaneously. So the tasks of an aggregated, generalized assessment of labor safety can be solved using only indicators of labor safety, while the tasks of analyzing and managing working conditions will require, in addition to this, the involvement of multipliers, and, if necessary, primary labor factors.

An occupational safety management system, like any control system, can be characterized by input and output parameters, as well as control and disturbing effects on the system.

In this case, the input parameters should be considered factors of working conditions (socio-economic, organizational and technical, natural), as well as the corresponding standard values of multipliers (standards for noise, vibration, radiation, etc.). The organizational level of the organization should be considered as a controlling influence, which, given the input parameters, primarily determines the actual level of multipliers and indicators of military service security. The latter act as output parameters of the labor safety system. The disturbing influence in the labor safety system is the abnormal behavior of employees in the process of performing their professional duties, which spontaneously and, as a rule, negatively affects the level of injuries and morbidity. As in any control system, in this case it is necessary to distinguish between controlled, uncontrolled and poorly controlled parameters.

Natural conditions, as well as some of the technical and technological parameters, which cannot be influenced for one reason or another, should be considered unregulated in the labor safety management system.

One of such reasons, in particular, may be the imperfection of technical means and technologies, as a result of which it may be practically impossible to replace technical means and technologies that pose a danger to the health of workers with safer ones.

2. Materials and methods

Another insurmountable obstacle to changing technical and technological parameters towards their greater safety may be the economic side of the matter: the exorbitant costs of replacing the used technical means and technologies can force the existing professional risks to be regarded as an unpleasant but inevitable phenomenon.

Adjustable parameters, respectively, can be considered those parameters of the occupational safety management system that are amenable to direct or indirect impact and can be changed at the discretion of the subject of management.

Slightly adjustable parameters should be distinguished into a special group of parameters. The very existence of such a group is a consequence of a rather blurred border between regulated and unregulated parameters. Along with unconditionally regulated and unconditionally unregulated parameters, there is a set of parameters that admit the possibility of a certain, limited control of them, but require very large management efforts for this.

Certainly regulated, in particular, can be considered a number of organizational factors of labor activity - the organizational structure of the organization, the level of specialization of divisions and services, the organization of servicing workplaces, etc.

Certainly unregulated are largely natural conditions, for example, average annual air temperature, air humidity, average precipitation, maximum wind strength, etc.

An example of a poorly regulated parameter is the psychology of an employee who is prone to
abnormal behavior, due to which dangerous situations often arise with a threat to their health and the health of others. It is obvious that changing human behavior takes time, significant management efforts and the use of special mechanisms of influence.

The problem of classification of occupational safety parameters, clarification and quantitative description of causal relationships between various characteristics of the occupational safety management system is of interest for many reasons. In addition to the practical significance for the operational management of labor safety in an organization, its solution can, in particular, contribute to a rethinking of a number of problems of organizing compulsory insurance against accidents and morbidity, which is at the stage of formation in the country and is faced in practice with certain methodological and methodological difficulties.

It is quite obvious that, due to their different significance, not all the numerous parameters of occupational safety may be of interest. In this case, of course, the concept of significance or non-significance of a factor or indicator (multiplier, indicator) should be considered in relation to the specific task of analyzing labor safety in organizations. It is obvious that one and the same indicator (factor) can be significant in relation to one studied phenomenon and not significant in relation to another.

In addition, the range of factors and, as a consequence, multipliers that determine occupational safety depends on the nature of the activity and can differ significantly in organizations of different types of activity.

At the same time, indicators - the resulting indicators of labor safety are comparable for organizations of different types of activities. Due to this circumstance, it seems possible to recommend a certain unified list of indicators-indicators of the state of labor safety in organizations. Below in Table 1 is an indicative list of such indicators, on the basis of which, as we see it, through targeted selection, a compact and sufficiently informative system of labor safety characteristics in organizations can be formed.

Table 1. Indicators.

|   | Description                                                                 |
|---|-----------------------------------------------------------------------------|
| 1 | The number of victims during the analyzed period                             |
| 2 | Frequency rate of injury                                                     |
| 3 | Number of fatal accidents                                                    |
| 4 | Frequency rate of fatal injury                                               |
| 5 | Injury severity rate                                                         |
| 6 | Number of person-days of incapacity for work per 1000 employees (loss rate) |
| 7 | Number of workers with a known disease                                       |
| 8 | Incidence rate                                                               |
| 9 | The number of victims per year with the establishment of the percentage of disability |
| 10| Average size of temporary disability benefit                                |
| 11| General expenses for temporary incapacity for work                          |
| 12| Average percentage of disability per year                                    |
| 13| Average amount of one payment per month to the recipient of compensation for harm |
| 14| Total expenses for payments to recipients of compensation for harm for the analyzed period |
| 15| Expenses for the rehabilitation of victims (medical, social and               |
3. Analysis of Simulation Results and Experimental Data

It can be assumed that in order to select an informative and, at the same time, compact system of indicators—indicators of injuries and morbidity from the above list, it is sufficient to perform an analysis for a group of homogeneous organizations belonging to the same species. The findings, it seems, can be extended to other organizations with other types of economic activity.

This hypothesis is based on the fact that, despite the difference in the causes of injury and occupational morbidity in organizations with different specifics of activities, the level of harm caused to employees manifests itself in a similar way. In other words, no matter what the differences between organizations by the nature of their activities, the level of injuries and morbidity in all cases can be characterized by the same system of indicators, and there is some very compact system of indicators that is quite informative in relation to all organizations, regardless of their species and other accessories.

4. Conclusion

This assumption certainly needs verification. If it is not confirmed, it is obviously necessary to expand the scope of analysis with the involvement of data on the activities of organizations of different types of activity. However, it can be argued with full confidence that such a study is necessary, since the choice of a system of indicators is a key issue in solving many problems in the field of labor safety and insurance of professional risks.

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