Improvement of processes of professional risk assessment and management in occupational health and safety system

E V Klimova, A Yu Semeykin, E A Nosatova
Department of Life Safety, Belgorod State Technological University named after V.G. Shukhov, 46, Kostyukova Str., Belgorod 308012, Russia

E-mail: klimova.ev@bstu.ru

Abstract. The paper analyzes the main problems of the occupational health and safety management system functioning and identifies the need to improve it in order to reduce industrial injuries. As a way to improve it, we propose the development and implementation of an automated system for forecasting and managing professional risks, which implements the algorithm for a multifactor analysis of the causes of occupational injuries. The automated system should be a part of the automated system of labor safety management of the enterprise. The main function of the proposed system is assessment and forecasting the level of occupational risk at specific workplaces, taking into account the changes in the qualification indicators, the psychophysiological state of personnel and factors of working conditions.

1. Introduction
Any of the modern occupational safety and health (OSH) management systems is built on the principle of hazard prevention. The risk category is one of the currently used hazard characteristics [1,2].

The most promising and effective approach to the implementation of “prevention of danger” in practice is the process of identifying, assessing and managing professional risks. In foreign countries, this tool allows to achieve exceptionally high results and the desired goal – workplaces without injuries and occupational diseases [3-5].

At present, labor protection in the Russian Federation is on the verge of significant changes. Along with the already widespread methods and forms of management, there is a need to introduce new models of safety management in the workplace. New methods of OSH management, such as occupational health and safety management (analogue of the currently used OSH), based on international standards and recommendations, will soon replace standard forms of management of labor protection [6,7].

The starting material for the formation of new models of industrial safety management is the international standards that are an integral part of the company’s general management: the SA 8000 series (social responsibility), OHSAS 18000 (occupational health and safety management), ISO 9000 (quality management), ISO 14000 (environmental management), ILO OSH 2001 (safety and health management) [1-7].

2. Relevance, scientific significance of the issue
For today, there is an objective need to modernize the traditional OSH management system taking into account:
• use as a basis standards of management standards, recognized in world practice;
• application of the system approach in the solution of labor protection issues;
• transition from responding to insurance accidents to managing occupational risks in the workplace, taking into account micro-injuries and incidents;
• close interaction of managerial and production activities;
• transition from local control systems to integrated ones.

According to the international standards of occupational safety in order to protect the health and safety of employees, following preventive measures are used [4]:
• development of a strategy for managing the safety of the enterprise, which includes safe working conditions, social relations, prevention of the impact of factors of the industrial environment on work safety;
• determination of the root causes of risks;
• assessment of risks that can not be avoided;
• minimization of risks in the workplace and, if possible, reducing them to zero;
• replacement of hazardous production factors by less dangerous ones;
• taking into account the specifics of the work of a particular specialist, taking into account the reduction in production risk;
• training and instruction of employees of the enterprise;
• preferential use of collective protection measures.

Statistics of occupational injuries show that these measures are not sufficiently effective, since, despite the annual decrease in injury rates, its level remains high (Figure 1) [8,9].

An analysis of the annual data on the level of industrial injuries shows that in Russia, on average, there is one fatal accident for every 20 – 22 injuries in the workplace. At the same time, in the countries of the European Union a similar ratio averages from 1:600 to 1:1900 [10]. This is due to the shortcomings in the approaches to managing professional risks and occupational safety in Russia.

At present, the transition to the professional risk management system in Russia is only advisory. At the same time, the definition of professional risk management in the Labor Code of the Russian Federation [11] indicates that the introduction of this system entails the need to change the OSH management system in general.
Assessment of occupational risks, health and safety at work are an important part of the entire enterprise management, development and implementation of which can be provided on the basis of the international standard OHSAS 18001: 2007 Occupational health and safety management systems and a number of domestic legislative acts, taking into account the economic aspects associated with compensation for the costs of improving the conditions and protection of workers in the enterprise.

The current standards in Russia on OSH management target all organizations to quantify the available occupational risks and to reduce or eliminate it. However, specific methods for preparing the relevant programs or plans are under development. The applied methods give contradictory results and in the majority are quite subjective. This fact puts employers in a difficult position, restrains the improvement of OSH management systems in full. The process of transition to the assessment of occupational risk is quite complex and can take many years.

For effective risk management, a more adequate and comprehensive risk assessment is needed, taking into account the professional and personal qualities of the personnel, its psychophysiological state, real-time labor conditions factors [12]. At the same time, the management of the enterprise should optimally assess the production risk of employees' safety and health, taking into account the nature of their work at the enterprise and all kinds of impacts in the performance of their duties, and for this an ongoing process of risk management must be introduced [13].

At the same time, it is necessary to take into account a significant degree of uncertainty in the factors that determine the level of occupational risk and the limited capabilities of specialists in enterprises responsible for occupational safety. In this regard, the use of modern information technology and automation systems for assessment, forecasting and management of professional risks (AS AFMPR) will significantly accelerate this process [14-16].

3. Results and discussion
This work suggests improving the processes of assessment and management of professional risks using algorithms of multifactor risk analysis by analyzing and processing the following data:

- factors of labor conditions factors;
- occupational injuries;
- data on occupational diseases;
- costs of labor protection measures.

Assessment, forecasting and management of occupational risk using this technology is based on the following methods [17-21]:

- Fault Tree Analysis (FTA) analysis methods;
- Analysis of staff errors and their consequences (Failure Mode and Effects Analysis (FMEA));
- Analysis of processes based on fuzzy approaches (Fuzzy Analytic Network Process);
- Event prediction based on Bayesian Networks;
- Analysis of events and processes using GERT networks (Graphical Evaluation and Review Technique);
- Prediction of events using neural network technologies (Neural Networks).

Its use allows for a multifactor analysis of occupational injuries and occupational risk factors and the identification of groups and categories of workers for whom the level of occupational risk exceeds the permissible values.

The results of the multifactor analysis of occupational risk are used by the automated system of accounting for forecasting and management of occupational risks, which allows to optimize the system of labor protection management in the enterprise, to study the data on injuries, both to labor safety specialists, and to managers and employees of the enterprise at various levels.

Figure 2 shows the operation scheme of the automated control system.

The user interface of the program consists of 5 blocks (modules).

The first block is called “Registration”. It serves to register users, which can act as ordinary users and representatives of the enterprise in the program.
The second block is called “Addition”. It serves to enter into the system information about the factors of working conditions, occupational injuries, occupational diseases, the costs of activities for labor protection. It consists of the introduction of the name of the enterprise, indicating the branch of economic activity and the municipal entity to which it refers. Further, the values of labor conditions factors, health damage indicators, occupational diseases and the costs of labor protection measures affecting the risks of damage to workers' health are introduced.

The third block performs the functions of viewing the entered information. It selects the enterprise of interest, industry, profession, using a filter, opening access to all available data for this query.

The fourth block regulates the functions of professional risk analysis. To obtain an analysis of occupational risk, it is necessary to indicate the enterprise of interest, industry, and data on factors of interest.

After performing the analysis of occupational risk all forecast values will move to the viewing window.

The fifth block allows you to display the actual and projected values of professional risks, draw conclusions on the level of occupational risk and develop measures to manage professional risks.

4. Conclusion
Forecasting and management of occupational risks will positively affect the overall safety of the enterprise and the level of industrial injuries of the enterprise, will allow employers to significantly improve the efficiency of the processes of assessment, forecasting and management of occupational risks in enterprises or specific workplaces.

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The developed automated system that implements the technology of multifactor analysis of occupational risk makes it possible to identify groups and categories of workers for whom the level of occupational risk exceeds the permissible values.

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**Acknowledgments**

The reported research was funded by Russian Foundation for Basic Research and the government of the Belgorod region of the Russian Federation, grant no. 18-47-310002.