Reduction of occupational accidents at industrial enterprises

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Abstract. High rates of occupational injuries and diseases lead to significant financial losses for companies and the state. The article considers a systematic approach to solving this problem and proposes ways to reduce the level of occupational injuries at production enterprises.

1 Problem of occupational accidents

The basis for the development of a nation's economy consists of three necessary components: human capital, material capital, and natural resources. The ratio of the contributions of these capitals to the creation of GDP depends on the level of development of the national economy, the level of competence of the labour force, and the availability of natural resources. The preservation and development of human capital is very important for the development of a country's economy, because with the development of scientific and technological progress, high-tech industries are being created, which require highly qualified personnel.

The problem of preserving and developing human capital is the problem of designing measures to reduce occupational injury rates. A distinctive feature of today's reality is the high level of occupational injuries. It is noted that the more technologically complex the production, the higher the probability of accidents and the higher the probability of loss of highly qualified personnel.

According to the International Labour Organisation (ILO), 153 people are injured on the job every 15 seconds and one person dies as a result of a work-related injury or occupational disease. The annual loss to the global economy from these causes is about 2.8 trillion dollars or 4% of the global gross domestic product [http://www.ilo.org].

In Russia, 20.5 thousand people suffered from workplace accidents in 2020; over 27 million people worked in harmful and (or) dangerous working conditions. Due to occupational injuries, as well as reduced working hours and additional leave (provided to employees when harmful or hazardous production factors are identified on the workplace) 139.7 million man-days were lost, resulting in a lack of production of 586.34 trillion rubles, which is about 0.55% of GDP [1].

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2 Ways to reduce occupational injuries at manufacturing enterprises

Measures have been taken at state and organisational level to improve working conditions and protect the health of workers: requirements have been introduced for mandatory development of occupational health and safety management systems at enterprises, changes in the rules for training personnel and providing personal protective equipment, and it is recommended that records and analysis of micro-injuries should be kept. Despite the measures taken by the government, the number of serious and fatal occupational accidents continues to rise, increasing state losses.

The constant growth in the number of injuries at work calls for more effective occupational safety and occupational injury prevention measures at enterprises. Ways to improve efficiency could be recommended as follows:

- application of a systematic approach in identifying hazards operating in the workplace, which will allow identifying a greater number of hazards for subsequent development of measures to eliminate them;
- improving the motivation of company management to work effectively on health and safety at work;
- increased interest of employees in compliance with rules and requirements regarding labour protection and industrial safety, technological regulations, etc. [2];
- formation of safety culture at the enterprise [3];
- carrying out of internal audits of processes and behavioral audits;
- introduction of ISO 45001:2018 recommendations into the enterprise's work practice [4].

3 Systematic approach to identifying hazards in the workplace

Applying a systems approach to identify the list of workplace hazards and their elimination should consider the human-technical-environmental-materials system and analyse the hazards affecting the worker for each component, taking into account their mutual influence on each other. Accordingly, the following shall be analyzed

- the types of work performed in the workplace;
- the methods of work to be used
- the equipment used;
- presence of pressure vessels, equipment or containers with harmful and/or hazardous substances [5];
- traffic, including in the workshop and on the territory of the enterprise;
- routes of movement of employees within the territory of the works (hazards on the way of movement - slippery floors, stairs, drops in height etc)
- working conditions (temperature, illumination, etc.);
- the condition of the buildings and structures;
- condition of the workplace during the day;
- used raw materials, materials and tools [6];
- personal qualities of the employee (risk propensity, reaction rate, stress resistance)
- compliance of workers' qualifications with the requirements necessary for work performance.

In the process of hazard identification, the following should be considered:

- regular operation modes, possible emergency situations, maintenance and repair of equipment;
- risks of fire and fires;
- non-routine situations and accidents which have occurred before, and incidents which have not resulted in accidents;
- Micro-accidents recorded at the jobs being analysed and at similar workplaces;
- hazards occurring in the workplace as perceived by the employee;
- overtime and night shifts [7];
- holiday time [7];
- carrying out works on the territory of the enterprise by contractors;
- presence of hazardous production facilities (dams, power plants, main pipelines, power transmission lines, etc.) near the enterprise;
- availability of regulatory requirements and instructions for safe work performance;
- results of special assessment of working conditions;
- results of industrial control.

It should be noted that production enterprises are characterised by a significant variety of production processes and exposure of employees to a wide range of harmful and hazardous production factors. Identified hazards (realizable risks) are ranked according to the criteria of probability of occurrence and scale of negative consequences for employees' health and measures for their elimination are planned. The assessment of the extent of negative consequences can be estimated in working days [8], by the degree of damage to employee health, by the material losses of the enterprise [6]. The measures to eliminate the risks can be technical and organizational.

4 Developing management and personnel commitment to comply with occupational safety requirements

The effectiveness of occupational injury prevention depends on the level of interest of management in ensuring a favourable working environment for staff. International documents emphasise the need for management leadership in solving such problems, as it is the manager who determines the development strategy of the enterprise and allocates financial and human resources.

Unfortunately, some managers are of the opinion that health and safety is not important for the success of their businesses. This is explained by the fact that they do not see a logical relationship between working conditions, loss of working time, labour productivity, output and quality of products. At the same time, these are closely interrelated elements [9].

It is necessary to organize sectoral training for managers of enterprises in order to increase their interest in ensuring favourable working conditions for their staff. Also, during periodic training of managers it is necessary to emphasize the relationship between working conditions and profitability of the enterprise.

Analysis of occupational injuries shows that the causes of occupational accidents are most often caused by irregularities committed by employees of the enterprise [1]. Consequently, it is necessary to conduct systematic training and systematic work with the personnel, aimed at developing a responsible attitude to the observance of norms, rules and requirements of labour protection, instructions by labour protection and normative documents [10].

In order to create an interest of the company's personnel in compliance with occupational safety requirements and to create an awareness of the need to comply with occupational safety requirements, it is necessary to conduct systematic training of employees. Besides, a system of material incentives for the company's personnel can be developed, taking into account
- compliance (violation) of labour safety requirements, job descriptions, requirements of technological regulations by employees;
- number of proposals regarding improvement of working conditions
number and significance of hazards (hazardous work performance) detected by employees
- winning of competitions in labour protection sphere among subdivisions of the enterprise (with development of criteria for determination of winners);
- etc.

The system of moral incentives could include awards to employees with certificates of honour, free vouchers, certificates for injury-free work, etc.

Application of methods of moral and material stimulation will allow to increase interest of the personnel in observance of requirements to labour protection, to increase involvement of the personnel into labour protection work, which will finally promote reduction of a number of violations of rules and instructions by the enterprise personnel and reduction of occupational traumatism.

At the same time, it may be advisable to conduct a safety review of work instructions and procedures and, if necessary, to modify them to make them safer.

A culture of safety should be fostered amongst workers and responsibility for their actions raised to such an extent that workers not only avoid violations themselves, understanding the consequences they can cause, but also seek to eliminate violations by other workers.

Positive results aimed at the prevention of occupational injuries can be achieved by carrying out occupational safety audits in the company, which will identify the hazards at workplaces, analysis of the methods of carrying out hazardous jobs, violations committed by employees during work performance, analysis of the effectiveness of measures aimed at eliminating or reducing hazards and occupational risks.

5 A comprehensive approach to implementation of measures aimed at reducing occupational accidents

One of the ways to implement a systematic approach to solving the problem of occupational injuries is to introduce a health and safety management system developed in accordance with the requirements of ISO 45001:2018 [11]. Russian legislation requires industrial enterprises to develop occupational health and safety management systems. As a basis for the system development the recommendations contained in the Order of the Russian Ministry of Labour No.776n dated 29.10.2021 can be used, but as the results of inspections conducted at the enterprises show, the labour protection management systems are developed formally, the templates for the system development are often used documents, which were developed for other industries, at that the lists of dangerous factors, existing at the working places are not even actualized at the transfer of documentation to other enterprises. Naturally, the usefulness of such occupational health management systems (OHM) which have been developed only on paper is nil and the efficiency of the company's occupational health and safety performance is not increased.

In this situation, businesses can be advised to implement an occupational health and safety management system developed on the basis of the requirements of ISO 45001:2018 into their enterprise management system. Application of the standard has a number of advantages. When developing the standard, international experience of OHM implementation in the practice of the enterprise was taken into account, it allows to take into account the best practices for the development, implementation and operation of the system and to apply approaches to the formation of OHM aimed at maintaining its effective operation. It takes into account the external environment in which the organisation operates and factors in its internal environment. The standard provides guidance on how to improve staff proactivity and how to change the approach to the OHM action planning system and plan control system.

When the decision to develop OHM in accordance with the requirements of ISO 45001:2018 is made, a meeting shall be held to decide on the possibility of developing OHM
simultaneously in the entire enterprise or first a "pilot" project shall be implemented and the system shall be developed in one of the enterprise units. The next step is to train the action team that will be developing the system. When forming the team, it is a requirement that at least one person from each division of the enterprise must be trained. This step is necessary as it will ensure the further effectiveness of the system. The most effective approach is the one when the staff is involved in the development of the system, documents and instructions, necessary for the OHM functioning. Employees who have been trained should then be able to pass on their knowledge to other employees in the divisions in which they work. The knowledge gained should make it possible to increase the responsibility of the company's staff for meeting health and safety requirements.

Next, the business context - external and internal factors affecting the business to be taken into account when developing the OHM. These factors include legal requirements, the requirements of partners, trade associations, employees and others. A comprehensive brief assessment is made of the impact of factors and working conditions on the enterprise's personnel. Based on an analysis of the company's working environment, stakeholder requirements and an initial assessment of working conditions, an occupational health and safety policy is formed which defines the company's strategy for dealing with health and safety issues.

The effectiveness of OHM depends on staff understanding the importance of complying with the requirements set out in the system. Every employee must understand how his or her work will affect the effectiveness of the system; must understand that the OHM department cannot control all processes that influence the occurrence of workplace hazards. The operational control and timely elimination of such factors requires proactive personnel who can promptly report workplace problems and make suggestions for their resolution.

A systematic assessment of harmful and hazardous production factors at workplaces must be carried out in the course of OHM development; when identified, factors can be grouped by workshops, production areas, types of equipment. It is recommended to take into account the data of the special assessment of working conditions. The maximum possible number of factors in workplaces must be identified. Of course, it is not possible to eliminate all the identified factors at the same time, and the factors that lead to the greatest losses in the enterprise must be identified. To choose, criteria for evaluating occupational hazards must be developed. The factors selected from the general list are included in the annual work programme of the enterprise in the framework of OHM. The programme includes information on the divisions performing the tasks (necessary to eliminate the selected factors); terms of implementation; means required to implement the tasks and indicators of their implementation.

On the first stages of OHM and further (as required), the system documentation is developed, regulated by the requirements of ISO 45001:2018. The order of interaction between the divisions, ways and means of information transmission are defined.

The important stage of the system development is organization and conducting of the company's personnel training aiming at acquaintance with the ISO 45001:2018 standard requirements, studying of external and internal requirements, forming of the responsible attitude towards occupational safety problems.

Emergencies and accidents at the enterprise may influence the emergence of hazards (which may further result in damage to the health of personnel). Since a company must anticipate and keep under control all possible hazards operating in the workplace and the company's territory, it is necessary to prepare for emergencies.

To assess the effectiveness of OHM it is necessary to plan and carry out periodic monitoring of the system. It is necessary to check if the working conditions meet the legal requirements, the internal requirements set by the company, and to monitor the work programme and the achievement of planned targets. When monitoring, the enterprise should
take into account the results of a special assessment of working conditions, the results of industrial control, the prescriptions of external supervisory bodies. Another step in analysing the system's performance is to carry out an internal audit. Employees who have received prior training on the requirements of ISO 45001:2018 should be involved in the audit. The company shall develop an audit programme, taking into account that all units of the company shall be audited during the year. During the audit of subdivisions, the documentation of the subdivision regulating its work within the framework of OHM (orders, job descriptions, subdivision regulations, etc.), personnel awareness of harmful and hazardous factors operating at workplaces, personnel proposals for improvement of working conditions, etc. shall be checked.

In case the enterprise management is not interested in OHM effectiveness, the developers of the system will not achieve great success, as it is the management that determines the development strategy of the enterprise, allocates funds for OHM development. Therefore, the standard recommends that the enterprise actively work with the management of all levels of management and with the staff of the enterprise to create their involvement in the work.

This recommendation correlates with the requirement in ISO 45001:2018 that OHM should be reviewed by the management of the enterprise. The review considers the outcomes of all stages: establishing the enterprise policy; identifying stakeholder requirements; considering external and internal conditions affecting the enterprise; conducting staff training; identifying harmful and hazardous work factors and defining criteria for their assessment; considering staff suggestions for improving working conditions; preparing for emergencies by reducing their likelihood and preventing incidents from escalating into emergencies. OHM's management review also includes a review of the effectiveness of the monitoring and control environment and any observations made during the internal audit process. Management's analysis of OHM performance shows where the system can be improved.

It should be noted that taking into account the recommendations of ISO 45001:2018 allows the company to use the whole set of tools aimed at reduction of occupational injuries: when developing OHM, in accordance with the requirements of the standard, the company carries out training for managers and staff, tries to create conditions for their involvement in work (including the use of moral and material incentives), organizes accounting of the proposals coming from the employees, takes into account data of special assessment of working conditions, changes the approach to work planning. The integrated application of these approaches makes it possible to achieve a synergetic effect and increase the efficiency of the enterprise's work on occupational health and safety and reduce the occupational injury rate.

6 Conclusion

The financial sustainability of enterprises is important nowadays. Production losses due to unfavourable working conditions and high levels of occupational injury are detrimental to the economy of enterprises and the state.

Implementation of measures aimed at reducing the level of occupational injuries at enterprises: a systematic approach to identifying hazards, increasing the effectiveness of training, developing a system of material and moral incentives for employees, creating a culture of safety, internal audits will increase responsibility and staff, reduce workplace injuries, reduce working time losses, increase productivity and increase production output.

At the same time, the implementation of the requirements of ISO 45001:2018 into the company's work practice will allow to simultaneously implement the set of proposed methods. Furthermore, the implementation of the ISO 45001:2018 standard will allow the
company to certify its occupational health and safety management system, which will also contribute to demonstrating the reliability of the company and improving its reputation.

References