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METHODOLOGY FOR ASSESSMENT AND MANAGEMENT OF INDUSTRIAL RISKS

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Abstract: The article is devoted to the risk assessment methodology analysis in the field of safety and hygiene of the production processes (SHPP). This issue is relevant in view of the risk-oriented approach implementation in this area at the level of Ukrainian legislation. Relying on considerable foreign experience, primarily of the European Union countries, experts in the field of production processes safety try to create favorable conditions for this area implementation not only in the legislation, but also in the productive environment. The analysis of legislation points a very strong foundation for construction of the occupational safety management system in Ukraine based on a risk-based strategy. Therefore, the issue of risk management methodology examining is the basis for the formation of some approach to this problem both by society and all interested parties. The decisive aspect of the adoption of mentioned strategy of the COUNTER-FACTOR impact on the existing dangers is the social and economic positive impact on the occupational injuries level and the number of occupational diseases. And the methodological foundations of this strategy contribute to a better understanding of safety issues and the expansion of the range of measures that can be implemented to address them. Moreover, the goals in the labor protection field are constantly being improved and promising is not merely the reduction of negative safety indicators, but efforts to achieve a zero level of occupational injuries. With maximum efficiency this is possible to achieve by applying a scientific approach to developing safety measures and a reasonable attitude to a certain risk level based on the best practices in the world.

Keywords: occupational risks, risk management, safety of production processes; zero injuries strategy, labor safety, hygiene of production processes

1. INTRODUCTION

Industrial facilities are a permanent source of danger both for employees and for outsiders indirectly involved, or may be within the direct or secondary influence. The existing hazards of productive processes have an impact on health, working capacity, psycho-emotional state and life of participants and on the economic indicators of the enterprise and the industry as a whole. The presence of economic and social damage leads to the search for solutions that contribute to reducing such impact. Construction of the most safe labor conditions and favorable rest conditions after the working hours end is a strategic goal of every employer who acts in accordance with Ukrainian legislation and focuses on making a profit. Achieving this goal is possible through the use of the best safe practice that is appropriate in the relevant field of economic activity. Ukraine's legislation in the production

processes safety field is increasingly integrated with the European Union legislation and introduces the progressive experience that is now oriented towards the zero injuries strategy. The world experience in safety managing and production processes hygiene has proved the economic and social feasibility of using a risk-based strategy to achieve the main goals in this direction.

2. RESEARCH OF THE LEGISLATION REQUIREMENTS IN THE FIELD OF SAFETY AND HYGIENE OF PRODUCTION PROCESSES (SHPP)

In the EU, a number of regulatory documents have been created to regulate the safety and life of an employee, usually by setting minimum safety requirements to locate the most significant risks in a particular professional activity area that are relevant both to the employer and the worker. Such requirements have already appeared in the current Ukraine legislation:

- The ILO Social Security (Minimum Standards) Convention, 1952 (No. 102);
- Council Directive 89/391/EEC of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work;
- Council Directive 89/655/EEC of 30 November 1989 concerning the minimum safety and health requirements for the use of work equipment by workers at work;
- Council Directive 89/656/EEC, of 30 November 1989 on the minimum health and safety requirements for the use by workers of personal protective equipment at the workplace;
- Council Directive 90/269/EEC of 29 May 1990 on the minimum health and safety requirements for the manual handling of loads where there is a risk particularly of back injury to workers;
- Council Directive 90/270/EEC of 29 May 1990 on the minimum safety and health requirements for work with display screen equipment (The norm of the state legislation - normative legal act on labor protection 0.00-7.15-18 Requirements of safety and health protection of workers in working with screen devices);
- Council Directive 92/57/EEC of 24 June 1992 on the implementation of minimum safety and health requirements at temporary or mobile construction sites (The norm of the state legislation - normative legal act on labor protection 45.2-7.03-17 Minimum Requirements for Occupational Safety on Temporary or Mobile Construction Plots);
- Council Directive 92/91/EEC of 3 November 1992 concerning the minimum requirements for improving the safety and health protection of workers in the mineral-extracting industries through drilling;
- Council Directive 99/92/EEC of 16 December 1999 on the minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres;
- Council Directive 2002/44/EEC of 25 June 2002 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (vibration);
- Council Directive 2003/10/EEC of 6 February 2003 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (noise);
- Council Directive 2006/25/EEC of 5 April 2006 on the minimum health and safety requirements regarding the exposure of the workers to risks arising from physical agents (artificial optical radiation);

- Council Directive 2013/35/EEC of 26 June 2013 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields).

Taking into account the necessity of the minimum safety requirements creation, it is possible to achieve the maximum protected production environment by focusing on the preventive measures of the COUNTER-FACTOR strategy for production processes safety management.

According to the international standard ISO 31000:2018 [1], the purpose of risk management is to provide a sustainable value creation and protection process that helps to achieve the goals of the organization and to improve its activities, for example, ensuring the people health and safety, environmental protection, product quality, etc.

Occupational risks are associated with a degree of uncertainty that arises in the internal and external organization environment and can be caused by:

- the consequences of sociological, psychological and cultural factors associated with human behavior;
- the natural processes influence;
- result of distorted, incomplete or inaccurate information;
- changes in the underlying factors (competitive advantages, trends, information);
- different perceptions of the impact of the uncertainty in different departments of the organization and various stakeholders.

The process of risk management is carried out with continuous monitoring and inspections, provides for the information exchange and counseling and is carried out according to the following algorithm:

1. Determination of application scope, environment and risk assessment criteria.
2. Risk assessment:
 - identification;
 - analysis;
 - evaluation.
3. Impact on the risk.
4. Documentation and reporting.

At the risk assessment stage, there is a common process of identifying, analyzing and evaluating risk. The overall risk assessment according to the current edition of DSTU IEC / ISO 31010: 2013 [2] can be carried out at the organizational level, individual units, in relation to projects, individual activities or specific risks. Different tools and techniques can be used for different directions, which can provide a risks understanding, causes of their formation, the consequences of their uncontrollable influence and the likelihood of their manifestation.

The risk assessment as a management stage creates an input base for decision making regarding to:

- the need of the certain activity start;
- the ways of opportunities maximizing to achieve the goals of the organization;
- the need for influence on risks;
- the choice among variants with different risks;
- the prioritization of variants of influence on risks;
- choosing the most appropriate strategies to influence the risks, which will reduce them from unacceptable level to acceptable or insignificant levels.

3. METHODOLOGY OF THE RISKS ASSESSMENT

A general risk assessment can be carried out using one or more methods with varying degrees of depth and detail of the study. A condition for the coherence of the risk assessment form with the evaluation criteria chosen at the start of the management process of them and conditioned by the application scope and environment is required.

The methods of general risk assessment according to DSTU IEC / ISO 31010: 2013 are divided into the following main groups:

- search methods (control questions lists, preliminary analysis of hazardous factors);
- auxiliary methods (structured interview and "brain attack", Delphi method, SWIFT analysis, general assessment of human HRA);
- analysis of the scenario (analysis of the root cause, analysis of the activity, analysis of the events tree, analysis of causes and consequences, etc.);
- functional analysis (FMEA and FMECA - analysis of the type and consequences of failures, HAZOP - study of hazardous factors and disability, HACCP);
- assessment of control means (LOPA - protection levels assessment, analysis according to the scheme "butterfly tie");
- statistical methods (Markov analysis, simulation modeling by the Monte Carlo method, Bayesian analysis).

Signs for choosing general risk assessment methods are resources and opportunities, the nature and extent of uncertainty, the complexity and the possibility of obtaining quantitative outcomes.

It should be noted that the individual risk conditions contribute to the comprehensive application of these methods and do not deny the appearance of others.

Risk assessment is conducted to justify the adoption of management decisions and is performed on the basis of results comparison obtained during the risk analysis with the accepted criteria for determining the need for additional corrective action on the impact of the risk. As a result of risk assessment, one of the following management strategies may be selected:

- the risk does not require influence on it;
- it is necessary to consider variants of impact on risk;
- further deep analysis is needed for better understanding of the risk;
- it is necessary to maintain and improve the existing means of control over the risk level;
- it is necessary to review the objectives of the risk assessment.

The impact on risk can occur in the next safety improvement scenario:

- avoidance of risk, that is, do not start activities that are associated with the formation of this type of risk;
- acceptance or even increase of risk in order to achieve the highest level of profit and the use of favorable opportunities and circumstances;
- elimination of the source of risk;
- change in the likelihood of risk implementation;
- change of the risk effects;
- distribution of risk with the other party;
- conscious risk preservation and refusal to influence it.

When choosing strategies for the risk, organizations should consider the interests of all stakeholders and their commitment. However, even a carefully developed risk and impact measures on it may not be effective and may not always form the residual rate of risk at an acceptable or insignificant level. Also, as a result of the impact on risk, new types of risks may also appear, which also need to be evaluated, analyzed and influenced, which may not lead to the desired effect on the impact on the initial type of risk. Therefore, all actions for analysis, assessment and impact on risks should be documented and provide the opportunity to formulate reports with a specific set of tools for a more detailed study of risk and strategies for influencing it.

The following indicators can be used as criteria for assessment of the risk analysis effectiveness and the measures taken to influence on it:

- the number of incidents, accidents, errors in the work of personnel, failures in the equipment;
- actual costs and financial performance of the organization (level of profit, debts, etc.);
- the presence of inconsistencies;
- level of occupational injuries and occupational diseases;
- production quality;
- complaints of unauthorized persons;
- degree of achievement of the organization goals;
- degree of achievement of the risk management objectives.

3.1. ORGANIZATION OF RISK ASSESSMENT

The risk assessment of the safety and hygiene of the production processes (RAS) is the responsibility of the employer. Based on the analysis of risks, the employer takes the appropriate decision on accepting or not taking this risk and plan for further action to reduce the risk level if necessary. But the very procedure for risk assessment requires some regulation and coherence.

Elements of the organization of the RAS realization depicted in Figure 1 indicate the need to attract not only specialists at the experts level and leading specialists in the industry, but also the constant participation of employees involved in the implementation of professional tasks on certain equipment. It is also necessary to take into account the relevant characteristics of the production environment and external factors.

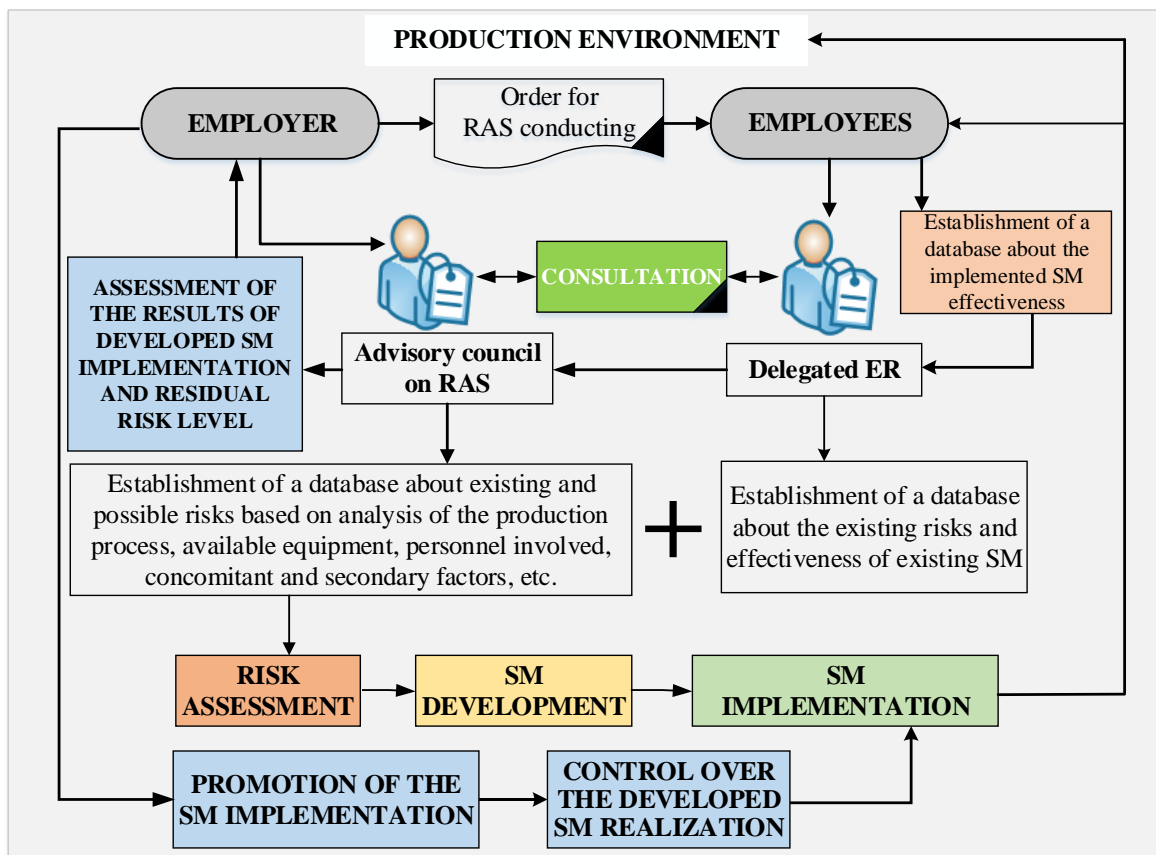


Figure. 1. Process of organization of RAS realization

A plan of measures for the organization of RAS conducting must be developed by the employer, the main elements of which must be provided:

- order for RAS conducting;
- ensuring organization and coordination of RAS conducting;
- consulting with the employees representatives (ER) regarding to the order of responsible executors (RE) appointment on the RAS conducting;
- providing RE with the necessary information, support and resources;
- definition of measures to be used to identify and conduct a RAS review;
- encouraging employee involvement in identifying and RAS reviewing;
- development of proactive, preventive and protective measures of the SHPP on the basis of the results obtained during the RAS conducting;
- implementation and control over the developed security measures (SM) realization in order to maintain their sufficient effectiveness;
- informing employees through the ER about the RAS results and the SM implementation and their effectiveness;
- an assessment of the implemented SM effectiveness in terms of employees and indicators of security and economic and social stability of the organization with the approved periodicity;
- adjustment of the attitude towards risk and implemented SM, taking into account the existing circumstances of the organization external and internal environment.

4. RISKS MANAGEMENT

Risk assessment is not an end in itself to the risk-based approach to the safety of production processes. But without security level assessing, it is not possible to develop effective and well-founded proactive, preventive and protective measures based on the best practices, economic priorities and organization capabilities. That is, the management of the organization is interested in conducting of the safety and production processes hygiene risks assessment, as it is a prerequisite for the development and implementation of changes in the production process to improve working conditions, increase the interest of the personnel in the results of work, increase profitability and competitiveness of the enterprise. RAS can also contribute to reducing the social and psychological factors impact on staff. Taking into account that the SM implementation sometimes requires significant financial expenses and implementation of this without qualitative risk assessment can be "doubtful" effective for the employer, the most important stage is their development and implementation. The RAS stages and the SM implementation in the risk management structure are inextricably linked to the goal of risks assessment and policies of the organization in the field of production processes safety and affect them and can change them, as well as external factors of influence, such as environmental, social, economic or legislative.

The risk management process is long-term and systematic and aims at preventing deterioration of working conditions and reducing the work capacity of workers, as well as contributing to the preservation of their lives and health. Also, this process contributes to the achievement of the goals of the organization and the values creation. Risk management combines all measures aimed at reducing, locating and avoiding risks while maintaining or increasing the profitability of an organization with the use of economically feasible practices. Another aspect of risk management is the reduction of losses from emergencies, occupational injuries and diseases, reduced work capacity, outflow of personnel with a high level of training, and so on.

The achievement of this goal is based on the risk management (RM) basic principles [1]:

- Principle 1. Integration.
- Principle 2: Structuring and Comprehensiveness.
- Principle 3. Adaptability.
- Principle 4. Inclusiveness.
- Principle 5. Dynamism.
- Principle 6. Informativity.
- Principle 7. Focusing on human and cultural needs.
- Principle 8. Perfection.

4.1. IMPACT ON THE RISK

Simplified risk management model can be represented as a sequence that repeats the Deming cycle (Figure 2), namely:

- setting the goal of risk management, determining responsibilities and obligations of the parties interested in achieving this goal;
- risk assessment;
- planning and implementation of security measures;
- assessment of the residual risk level;

- adjustment or confirmation of the primary objectives of risk assessment and organization policies in the field of production processes safety.

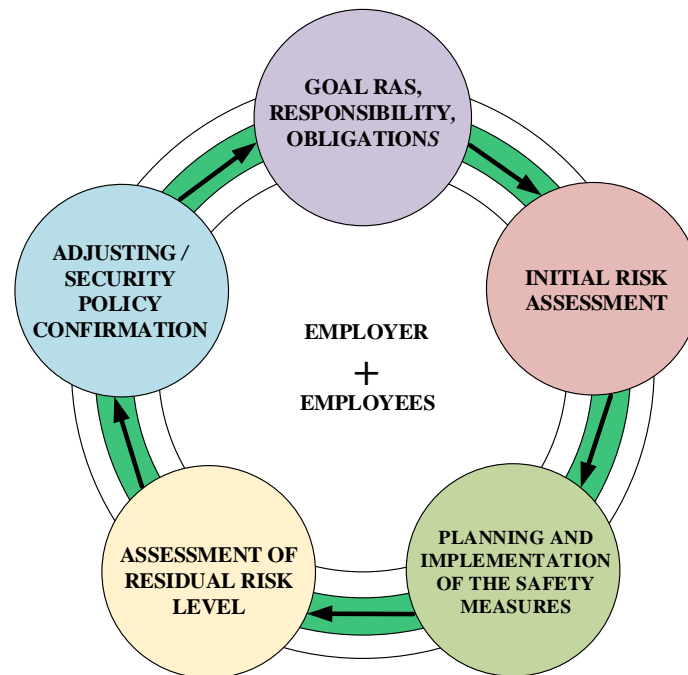


Figure. 2. Simplified risk assessment and risk management scheme

Implementation of this model involves all stakeholders and, above all, the employer and employees. And each stage is formed and implemented, taking into account not only internal conditions, but also external factors.

The risk assessment consists of four stages. The first stage is related to the risk profile. In the beginning, a comparative risk profile is presented to establish priorities and risk degrees.

The second step is to determine the acceptability of risk. The risk is compared with a number of socio-economic factors:

- benefits from one or another type of economic activity;
- losses caused by the use of a certain type of activity;
- the availability and possibilities for the regulatory measures introduction to reduce the negative impact on the natural environment and human health.

The comparison of "non-risk" factors with "risk" manifests the essence of the risk management process and specific decisions in relation to risk are provided.

There are three possible solutions:

- the risk is acceptable in full;
- the risk is acceptable in part;
- the risk is completely inappropriate.

In the latter two cases, it is necessary to establish the proportion of control, which is included in the tasks of the third stage of the risk management procedure.

The third stage is the definition of the control proportion, which is to choose one of the "typical" measures that contribute to reducing (in the first and second case) or elimination (in the third case) of the risk.

The fourth stage is the adoption of a regulatory decision, that is, the definition of normative acts (laws, regulations, instructions, policies of the organization in the field of labor safety) and their provisions, which correspond to the implementation of the selected "typical" measure, which was established in the previous stage. This element, completing the risk management process, simultaneously connects all its stages, as well as the stages of risk assessment into a single decision-making process, into a single risk management concept.

5. CONCLUSIONS

Thus, risk management is an integral part of an organization's management system that must cover all of the organization's interests and influence the security (technogenic, environmental, social, economic), the reasonableness of decision-making by senior management and at the unit level, the realization of the goals and policies of the organization. Risk management systems in separate areas should be integrated into a single risk management system that will allow for reasonable strategic and short-term management solutions based on maximizing the impact of using the best safety practices and modern strategies and risk assessment methods.

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