



FORMATION OF OCCUPATIONAL SAFETY COMPETENCE IN THE PROCESS OF PROFESSIONAL TRAINING OF MECHANICAL ENGINEERING SPECIALISTS

Oleksandr Kobylanskyi¹, Sofia Dembitska²

¹ DSc in Education, Professor, Head of the Department of Life Safety and Safety Pedagogy of the Faculty Information Technologies and Computer Engineering, Vinnytsia National Technical University.
<http://orcid.org/0000-0002-9724-1470> ; e-mail: akobilanskiy@gmail.com.

² DSc in Education, Professor, Professor of the Department of Life Safety and Safety Pedagogy of the Faculty Information Technologies and Computer Engineering, Vinnytsia National Technical University.
<http://orcid.org/0000-0002-2005-6744> ; e-mail: sofiyadem13@gmail.com.

Abstract

Relevance: the formation of the employees' motivation regarding safety requirements observation during the performance of work directly affects the decrease of industrial injuries and the increase of the company profits. Therefore, training of mechanical engineering specialists for occupational health and safety professional activity, to ensure its effectiveness, should begin at the stage of students' training in higher education institutions.

Objective: determine the content of labor protection competence of mechanical engineering specialists as an integral component of professional training and to outline the effective ways of its formation.

Methods: theoretical (analysis of higher education standards, publications on the subject the research problem, critical analysis of the available theoretical and methodical means of solving the studied problem in Ukraine and abroad); empirical (questionnaires, surveys, etc. to find out the level of motivation of students in acquiring labor protection knowledge, abilities, skills and competences; observation of the educational process; survey of experts).

Results: modern approaches to risk management at the enterprise were analyzed, the content of risk-oriented thinking was elaborated; on the basis of risk-oriented approach, the content of the concept of "labor safety competence" has been defined; the ways of forming occupational health and safety competence of future mechanical engineering specialists have been defined and characterized.

Conclusions: the establishment of the semantic content of occupational health and safety competence of future mechanical engineering specialists was preceded by the analysis of theoretical studies, devoted to the characteristic features of the professional training of specialists in machine-building industry and characteristic aspects of their risk-oriented thinking formation (in accordance with DSTU(State Standard of Ukraine) ISO 9001:2015). Peculiarities of the occupational health and safety professional activities of machine-building industry workers at all production stages were analyzed and the expert assessment was conducted. In accordance with the obtained results, the author's approach to the solution of the initiated problem has been proposed.

Keywords: *occupational health and safety competence, mechanical engineering specialists, institutions of higher education, professional training, risk-oriented thinking process, risk-oriented approach, specialists of technical specialties*

Introduction. Currently, in connection with the introduction of the risk management concept at enterprises, their management is carried out taking into account the principles of sustainable development. At the stage of globalization of the economic and financial systems, when new sources of risks appear, the issue of risk management is one of the determining factors for the economic development not only of the enterprises, but also the state as a whole. The significance and expediency of this approach is emphasized in a number of publications by both domestic and foreign scientists (Selleck, Hassall, & Cattani, 2022; Platania, Morando, Caruso, & Scuderi, 2022; Dhalmahapatra, Das, & Maiti, 2022, etc.).

One of the key aspects of risk management is the minimization of industrial hazards and the creation of favorable working conditions for the company staff. However, it is impossible to eliminate the impact of dangerous and harmful factors on the staff on a unilateral basis. This issue should be resolved in the process of interaction and dialogue between all the parties involved, both employers and employees.

Against this background, the creation of the safe working conditions and the formation of motivation to preserve the health of the employees during the work is a priority area of professional development of the individual. As the creation of safe working conditions and decrease of production risks not only increases the overall productivity of the employees, but also positively affects the dynamics of the company economic and social development. Accordingly, there is a need to prepare future mechanical engineering specialists for labor protection professional activities.

The European integration course initiated by Ukraine poses extremely difficult economic, political, social and other challenges. Key issue among them is the formation of relations with the employees based on social responsibility, which provides the involvement of professionals who are aware of the difference between the old and new requirements and know how to comply with them.

This emphasizes the usefulness of knowledge for employees of machine-building enterprises of the EU requirements concerning occupational safety and the ability to include them in the occupational safety competence of future mechanical specialists in educational programs. Domestic enterprises must learn how to build the system of labor protection effectively, democratically and legally, as well as ensure the formation of respect for rights and freedoms, raise a decent standard of living and create conditions for the comprehensive development of the employee's personality.

Research sources. The research carried out is based on the consideration of new thinking strategies in education and the analysis of professional education standards, which are highlighted in the works of S. Honcharenko, R. Gurevich, A. Gurzhii, M. Zgurovsky, V. Kremen, S. Lisova, N. Nychkalo, Yu. Pelekh, V. Rudenko, V. Sergienko, P. Tadeeva and others.

The characteristic features of future specialists training to perform labor protection professional activities were studied by O. Avramenko (formation of labor protection competence as a necessary condition for the professional development of a specialist), S. Hrynyov (formation of labor protection culture of enterprise managers), V. Zhdanova (features of formation of labor protection skills and skills of students), N. Yefimova (formation of readiness for safe professional activity of future chemical engineers), Y. Korsun (substantiation of pedagogical conditions for the formation of professional self-awareness in future engineers), O. Kosaruk (determination of the features of professional training of future specialists in engineering specialties on the basis of integration of education with production).

At the same time, despite the expressed interest of the scientists to the issue of professional training of graduates of technical higher education institutions, which is confirmed by the discussion in scientific publications, the problem of the formation of labor protection competence among specialists in technical specialties, in particular, specialists in mechanical engineering, has not been finally resolved to date.

Objective of the article is to determine the content of labor protection competence of mechanical engineering specialists as an integral component of professional training and outline effective ways of its formation.

Research methods: theoretical (analysis of higher education standards, publications reflecting the research problem, critical analysis of available theoretical and methodical ways of solving the initiated problem in Ukraine and abroad regarding the training of specialists in technical specialties for labor protection professional activity); empirical (questionnaires, surveys to find out the level of students' motivation in acquiring labor protection knowledge, skills and abilities; observation of the educational process; expert surveys).

Results and discussion. Based on the theoretical analysis of the problem of training future specialists in technical specialties for labor protection professional activity, the results of which are re-

flected in a number of publications (Dembitskaya, Kobylianskyi, & Pugach, 2020; Dembitskaya, Kobylianskyi, Gorokhivska, & Pugach, 2022; Dembitskaya, Kobylianskyi, & Pugach, 2022), we interpret labor protection competence as "a combination of knowledge, skills, and practical skills in labor protection, as well as risk-oriented thinking, which determines a person's ability to successfully carry out labor protection professional activities and is the result of professional training in vocational training" (Dembitska, 2020, p. 15).

For further determination of the conditions for the formation of labor protection competence of future mechanical engineering specialists, it is necessary to establish the content and structure of the formed concept. The analysis of regulatory sources which determine the principles of risk-oriented approach at industrial enterprises gives grounds for asserting that the occupational health and safety competence of the future specialist involves:

1) formation of a stable and interdependent system of labor protection knowledge and skills that enable the safe realization of the work;

2) formation and continuous development of risk-oriented thinking, as a basis for the further

professional activity in conditions of uncertainty and ambiguity.

The content of the concept of "risk-oriented thinking" is reflected in DSTU (State Standard of Ukraine) ISO 9001:2015, indicating the key goal of the quality management system to "act as a preventive tool". This requires from the specialist with risk-oriented thinking to be able to choose the method of risk assessment, guided by current regulatory documents and guidelines, predict possible consequences and develop ways to eliminate or reduce the risk before its onset. In addition, risk-oriented thinking makes it possible to determine the factors of deviation of the production process and the quality management system from the planned results in the plane of establishing preventive control measures to reduce negative impacts and to use opportunities as much as possible as they arise (DSTU ISO 9001:2015, c. 6).

With this in mind, a set of agreed methods and tools for the management and control of risks that may arise in the course of activity should be defined on the base of the enterprises that are guided by DSTU ISO 9001:2015 in their work. The application of this approach in practice is realized by implementing a continuous PDCA cycle (Fig. 1).

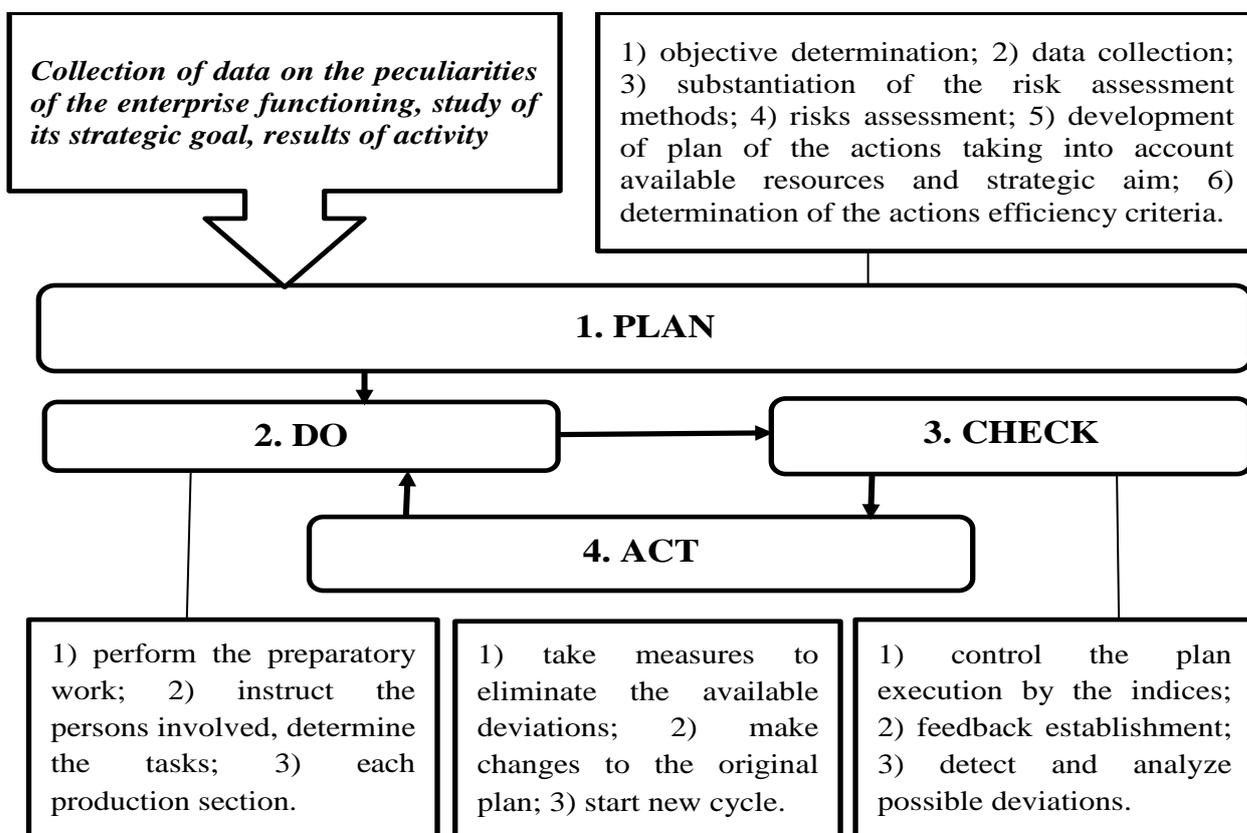


Fig.1 Realization of the risk-oriented approach at the enterprise

In addition, under Article 56 of the Association Agreement between Ukraine and the European Union (2014), Ukraine undertook to develop and implement

measures that would ensure compliance with EU technical regulations and EU standardization, metrology, accreditation, conformity assess-

ment and market surveillance systems, and to adhere to the principles and practices set forth in EU decisions and regulations.

That is, the purpose of the risk-oriented approach to the management of the company production processes is the continuous identification, analysis and control of risks in order to minimize their impact on its further work. An important feature of the risk-oriented approach to ensuring the safety of employees in the process of their work is not to separate it from all other processes of the company, but on the contrary, to maximize the involvement of all employees, from the lowest level to the highest level, for the achievement of the common goal.

ISO series standards have been developed for the implementation of the risk management system at the enterprises (DSTU ISO 31000:2018 "Risk management. Principles and guidelines", DSTU IEC/ISO 31010:2013 "Risk management. Methods of general risk assessment", ISO/TR 31004:2013 "Risk management. Guidance on the implementation of ISO 31000"). We consider the basis for the formation and further development of risk-oriented thinking to be the analysis of the individual articles specified in the regulatory documents and examples of their practical implementation at real, effective enterprises.

The analysis of the pedagogical experience and the results of the conducted pedagogical experiment proved that for the effective formation of labor protection competence, it is necessary to consider the following issues:

- a detailed analysis of the content and features of the risk-oriented approach at enterprises of the machine-building industry;

- definition and characterization of risks in the machine-building industry, tools and mechanisms of their analysis;

- analysis of the existing sources of risks at machine-building enterprises, their possible consequences, in particular in retrospective, as well as determination of ways to minimize their consequences;

- general principles of organizing the risk-oriented approach at a machine-building enterprise.

Improving the professional training of future mechanical engineering specialists in the context of the formation of their labor protection competence it should be taken into account that the algorithm according to which machine-building companies manufacture products usually consists of the following steps:

- development of an idea of a new product, which ends with its design;

- detailed modeling of the product, its detailing and implementation of the necessary engineering calculations;

- creation and publication of project documentation;

- development of management, production and product quality control programs;

- organization of the production process.

In the process of training of specialists for the machine-building industry, both general issues of labor protection and the detailing of safety requirements at individual technical stages of manufacturing the finished products are important. Modern specialist must not only know occupational health and safety legislation, industry requirements for ensuring safety and the process of professional activity, but also be able to find the information necessary to perform production tasks.

The professional activity of a mechanical engineer is related to the design, construction and operation of equipment, machines, mechanisms, devices, etc. in various spheres of the country's economy. Accordingly, the activity of a mechanical engineer is related to the operation of the equipment and technologies, as well as interaction with the staff and ensure personal and collective safety in the process of work. The specific job duties of a mechanical engineer depend significantly on the branch of the economy where he works, in particular, the majority of such specialists are employed at machine-building plants and the agro-industrial complex. Therefore, they are versatile and multifunctional and are related to the specialization of mechanical engineers in various areas of their professional activity: technologist, designer, test engineer and others.

The duties of the technologist consist of technical support and direct participation in the installation and adjustment of machines, mechanisms, equipment, devices, etc. His functions include the development, optimization, and organization of technological processes with the comprehensive introduction of modern automation tools.

The designer's responsibilities include the design and construction of equipment, machines, mechanisms, devices, etc., as well as technological processes and systems of complex production mechanization that implement them.

Functional responsibilities of the test engineer include both direct testing before commissioning,

- and maintenance of machines, mechanisms, equipment, devices, with constant or periodic monitoring and optimization of their operating modes.

The results of the analysis of the specific features of the activities of the machine-building enterprises employees, publications regarding the specific character of the organization of the production process, and the results of practical training of the students proved that in the field of occupational health and safety, in order to ensure personal safety at the workplace, a mechanical engineering specialist should:

- realize the existence of potentially dangerous and harmful production factors, be able to distinguish them and identify the existing sources of danger;
- know the ergonomics requirements for the workplace depending on its features;
- acquire the ability to assess the risk and determine ways to minimize it;
- know main characteristics of personal protective equipment, the method of determining their type and class depending on the existing situation, and to be able to use them as intended in the process of work in compliance with all safety requirements;
- be aware of the risk of the occupation diseases and know the ways of their prevention, comply with the requirements of physiology and occupational hygiene in the process of carrying out professional activities;
- learn to find the necessary information on labor protection in the legislative field, analyze it and use it in the process of work.

In the process of scientific research, an expert survey was conducted in order to determine the peculiarities of the professional activity of mechanical engineers at each stage of product manufacturing and the main professional tasks that must be taken into account in the process of the formation of occupational safety competence. According to S. Sysoeva and T. Krystopchuk (2013, p. 214), the attractiveness of expert evaluation is determined by the effectiveness of expert evaluation methods in the study of educational problems. It "combines indirect observation and survey with the involvement of competent experts to evaluate the phenomena." The organization of expert evaluation took place in the following stages:

- 1) preparation of documents for recording expert assessment;
- 2) formation of a representative expert group;
- 3) conducting a survey of experts;
- 4) generalization of the obtained expert evaluations.

Taking into account the theoretical research on the outlined issue, the peculiarities of the profes-

sional activity of mechanical engineers at each stage of product production, own educational experience and obtained expert evaluations, the content of occupational safety disciplines and occupational safety competence of specialists, ensuring the technological process at each stage of product manufacturing in mechanical engineering sphere has been specified.

For example, the content of occupational health and safety competence for the specialists who design a machine-building industry product and technical calculation of details includes:

- knowledge of the ergonomics requirements for the designer's workplace and the ability to ensure the compliance of the work area with the specified parameters;
- the ability to identify industrial hazards present at the workplace and the ability to eliminate or minimize their impact;
- knowledge of the existing occupational diseases of workers engaged in product design and engineering calculations and methods of their prevention;
- the ability to ensure compliance of the devices and parts being developed with labor protection standards and requirements;
- knowledge of safety requirements in the process of setting up, testing and putting into operation the experimental samples of products, units, systems and parts;
- the ability to assess the conformity of project standards, innovative proposals and inventions to the requirements and norms of labor protection;
- the ability to take into account labor protection requirements and ergonomic requirements when designing special equipment, tools and devices provided by the production technology of non-standard equipment, means of automation and mechanization.

Full description of labor protection competence in accordance with the specifics of professional activity is given in the Concept of training of future mechanical engineering specialists for labor protection professional activity (Dembitska, & Kobylanskyi, 2020).

In addition, the following health and safety aspects are common to all mechanical specialists:

- presence of the skills and ability to analyze the existing technical condition of the means of production and tools for their safe operation;
- knowledge of the conditions of safe operation of machines and mechanisms;
- understanding the necessity and priority of compliance with the rules and requirements of la-

bor protection and industrial safety in the process of carrying out professional activities.

Conclusions. Therefore, according to the standards of higher education, the result of professional training is the formation of professional (integral) competence of specialists. The result of the process of future mechanical engineers training for labor protection professional activity is labor protection competence as an integral part of the professional competence. The results of the study show that occupational safety competence of future mechanical engineers is a combination of knowledge, skills and practical skills in occupational safety and risk-oriented thinking, which determines the competence of the specialist's personality as a whole.

Determination of the content of occupational health and safety competence of future specialists in mechanical engineering included the analysis of theoretical studies, regarding the specific features of professional training and the specific aspects of

the risk-oriented thinking of the specialists (according to DSTU ISO 9001:2015), as well as studies of the conditions of professional activity of workers of the mechanical engineering industry at various stages of creation and manufacturing of the products (design and modeling of products, implementation of engineering calculations, creation and publication of design documentation, technical planning, etc.). The content of the occupational health and safety competence was determined by means of the analysis of own pedagogical experience, generalization of the theoretical studies and interviewing experts who work in the engineering industry and have practical work experience in the field of the research.

We consider the refinement of the content of labor protection competence for the specialists in the related fields and the development of ways of its formation to be the prospects for further scientific research.

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ФОРМУВАННЯ ПРАЦЕОХОРОННОЇ КОМПЕТЕНТНОСТІ В ПРОЦЕСІ ПРОФЕСІЙНОЇ ПІДГОТОВКИ ФАХІВЦІВ МЕХАНІЧНОЇ ІНЖЕНЕРІЇ

Олександр Кобилянський¹, Софія Дембіцька²

¹ доктор педагогічних наук, професор, завідувач кафедри безпеки життєдіяльності та педагогіки безпеки факультету інформаційних технологій та комп'ютерної інженерії, ВНТУ. <http://orcid.org/0000-0002-9724-1470>, e-mail: akobilanskiy@gmail.com

² доктор педагогічних наук, професор, професор кафедри безпеки життєдіяльності та педагогіки безпеки факультету інформаційних технологій та комп'ютерної інженерії, ВНТУ. <http://orcid.org/0000-0002-2005-6744>, e-mail: sofiyadem13@gmail.com

Реферат

Актуальність: формування в працівників мотивації стосовно дотримання вимог безпеки під час виконання робіт безпосередньо впливає на зменшення виробничого травматизму та підвищення прибутків підприємства. Відтак, підготовка фахівців механічної інженерії до працезохоронної професійної діяльності, з метою забезпечення її ефективності, має розпочинатися ще на етапі навчання студентів у ЗВО.

Мета: полягає у визначенні змісту працезохоронної компетентності фахівців механічної інженерії як невід'ємної складової професійної підготовки та окресленні ефективних шляхів її формування.

Методи: теоретичні (аналіз стандартів вищої освіти, публікацій, що відображають проблему дослідження, критичний аналіз наявних теоретичних і методичних шляхів вирішення започаткованої проблеми в Україні та за кордоном); емпіричні (анкетування, опитування тощо для з'ясування рівня мотивації студентів у набутті працезохоронних знань, умінь, навичок і компетентностей; спостереження за освітнім процесом; опитування експертів).

Результати: проаналізовано сучасні підходи до управління ризиками підприємства, уточнено зміст ризик-орієнтованого мислення; на підставі ризик-орієнтованого підходу означено зміст поняття «працезохоронна компетентність»; визначено й охарактеризовано шляхи формування працезохоронної компетентності майбутніх фахівців механічної інженерії.

Висновки: встановленню змістового наповнення працезохоронної компетентності майбутніх фахівців механічної інженерії передувало проведення аналізу теоретичних напрацювань, що були присвячені особливостям професійної підготовки фахівців машинобудівної галузі та специфіці формування у них ризик-орієнтованого мислення (відповідно до ДСТУ ISO 9001:2015). Було проаналізовано особливості працезохоронної професійної діяльності працівників машинобудівної галузі на усіх етапах виготовлення продукції та проведено експертне оцінювання. У відповідності до отриманих результатів запропоновано авторський підхід до вирішення започаткованої проблеми.

Ключові слова: працезохоронна компетентність, фахівці механічної інженерії, заклади вищої освіти, професійна підготовка, ризик-орієнтоване мислення.

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