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IMPROVING THE ALGORITHM FOR DETERMINING THE COMPETENCE OF EMPLOYEES IN TERMS OF LABOR SAFETY

Purpose. To develop an algorithm for identifying the number of employees with a high level of self-confidence and low competence in occupational safety, who pose a threat to the occupational safety and health management system.

Methodology. To determine the risk level of the "incompetent employee" hazard in occupational safety and health management systems, a qualitative approach based on a 5 × 5 matrix was used. The horizontal axis represented the employee's level of self-confidence, while the vertical axis represented their level of competence, both ranging from 0 to 100 %. A systems approach was used to develop the algorithm for determining employee competence, which examines the model of the relationship between a hazard (an incompetent employee) and a dangerous event (their injury).

Findings. An algorithm was developed to identify the number of employees with a high level of self-confidence and low competence in occupational safety. It consists of five steps and involves training to develop risk-oriented thinking in employees, as well as special diagnostics with the involvement of experts. It is proposed that employee self-confidence be determined by comparing the results of assessments for theoretical and practical tasks, given by experts and the trainees themselves, after the risk-oriented thinking training. A risk matrix for unsafe employee actions was developed for occupational safety and health management systems, which accounts for the Dunning–Kruger effect. The competence analysis allowed employees to be divided into five groups: low, medium, significant, high, and highest, which correspond to the developmental stages of a beginner, learner, specialist, professional, and expert. It was found that among the employees involved in the risk-oriented thinking training, 10 % are in the beginner competence stage, of which 1 % have a high level of self-confidence that is not supported by any theoretical or practical occupational safety skills. At the same time, the attitude towards safety among low-competence employees is 0.45, which is a low-level indicator. Overall, the study found that only 6 % of professional employees have an appropriate level of self-confidence, while 30 % of specialist employees are characterized by low self-esteem.

Originality. The relationship between an employee's level of self-confidence, their incompetence in occupational safety, and the level of additional risk in occupational safety and health management systems has been established.

Practical value. The practical significance lies in the implementation of a tool for the early identification of employees with a high risk of unsafe actions within occupational safety management systems.

Keywords: *risk, employees, competence, training, occupational safety*

Introduction. Today, according to the International Labor Organization, more than 2,774,000 workers die from accidents or occupational diseases every year [1]. One of the main risk factors for accidents or occupational diseases is the incompetence of workers, line, middle and top managers [2]. If is supplemented with the high self-confidence, a dangerous event is almost unavoidable [3]. This can be explained by the Dunning-Kruger effect, when employees find it difficult to recognize their inadequacies due to a lack of cognitive awareness, which leads to, at the very least, decisions they are not ready for. Unfortunately, incompetent employees are not only unaware of their shortcomings, but also overconfident in their skills [4]. Employees with the Dunning-Kruger effect neglect advice, make unfounded judgments, and often refuse constructive criticism [5]. This leads to inconsistencies and unsafe actions in occupational safety and health management systems, which increase the likelihood of a hazardous event. This raises several pressing issues that need to be addressed. In particular, the development of an effective algorithm for identifying employees with low occupational safety competence and determining the reasons that prevent the manifestation of the Dunning–Kruger effect. According to the theory of social relations, most employees form or adjust their behavior by interpreting the information they receive based on the organization of the production process [6]. This adjustment can be negative or positive and depends on the emotional and cognitive abilities of employees. There is another need to substantiate effective preventive measures to reduce the number of employees who take too many risks when performing tasks by searching for ways to present information according to their perceptual abilities.

Literature review. A significant number of different works are devoted to the study of the level of competence of employees for the successful fulfillment of production tasks [7–15]. The main idea is to create a symbiosis between humans and technology [7], to study the weaknesses of operators that can lead to failures of "machines" they control. The established dependencies

make it possible to ensure an appropriate level of labor productivity in changing production conditions and to determine the psychophysiological abilities to control "machinery" during emergencies. The disadvantages of the presented work include the lack of information on the impact of the Dunning–Kruger effect on the performance of operators and the number of errors made in human-machine systems, which requires further research. There is a need to develop new approaches to motivate employees to improve their own abilities and skills [8]. The authors describe the need for improvement as a vital necessity for the further prosperity of the organization. Constant changes, improvements, and enhancements create prerequisites for possible emergencies in the absence of relevant knowledge about predicting future developments. Employees need to have the skills to find out-of-the-box solutions to new challenges or threats. This requires the development of a system of continuous training. However, the authors did not propose a system for diagnosing learning outcomes to understand the number of people who are able to make appropriate and adequate decisions, depending on the situation. There is a problem of the lack of a clear algorithm for determining the growth of the level of competence of employees on the job [9]. The solution to the described problem is to use artificial intelligence both to train employees and to help them manage modern Industry 5.0 production technologies, which are characterized by constant environmental change. This will allow one to obtain a significant amount of information, quickly analyze it and develop appropriate predictive models to determine corrective and preventive actions. However, the authors do not describe the situation when there is a need to verify the actions of artificial intelligence in determining the corrections that are not considered in neural networks. For this purpose, it is necessary to have highly qualified employees capable of timely recognizing the relevant threats inherent in new technologies. The need to develop on-the-job training is an important element of organizational success [10]. The authors of the study note that, based on the analysis of various systems for ensuring the vital activity of Industry 4.0 organizations, there is a need to develop SMART technologies to adapt employees to new realities through the formation of competencies in terms of leadership, analytics, and social interaction.

The next area of research on the development of employee competencies in production is the application of the concept of human potential, a measure of embodied abilities, talent and qualifications to generate appropriate financial income. The concept provides for the creation of an appropriate system of human potential development at work to successfully fulfill all requirements [11, 12]. Any concept based on behavioral or attribute-based approaches to the formation of relevant competencies requires their definition, classification and assessment. This concept provides for the assessment of integral competence, which includes the ability to act systematically, identify inconsistencies in management systems, determine risk levels, justify or calculate engineering safety measures, etc. There is a need to determine the impact of cognitive biases on decisions [13]. This is an extremely important task for the successful organization of business processes, the solution of which is seen in the formation of "competency matrices" to eliminate the influence of cognitive biases [14].

In terms of research content, scientists have mainly studied the impact of three groups of employees' personal characteristics on the possible occurrence of a hazardous event (system failures or accidents, emergencies) in occupational safety and health management systems: incompetence, negligence, and self-interest [15]. It is noted that in order to avoid the occurrence of dangerous events, employees and managers need to develop the ability to manage uncertainty and use structured processes in the organization to respond to challenges and threats in a sustainable manner. The authors argue that already at the stage of planning production activities, it is necessary to foresee various scenarios, identify the necessary resources to prevent dangerous situations, and have trained employees who can make effective decisions [16].

The analysis of the papers shows that the topic of studying the relationship between competence and the risk of a dangerous event due to inadequate decisions is relevant and needs to be addressed accordingly. It is important to identify in time potentially dangerous actions of employees due to misunderstanding, inadequacy or risky behavior.

The idea of this study is to identify incompetent employees. They pose a danger to the occupational safety and health management system, as they can lead to an increase in the risk of a hazardous event due to overestimation of their own capabilities and lack of understanding of the technological process [17]. The lack of sufficient knowledge and practical skills, as well as the constant realization of the risk of a hazardous event, leads some employees to believe that they are right. Their further actions are described by the Dunning–Kruger effect: self-confident and incompetent people consider themselves professionals, while those with certain knowledge and skills tend to doubt themselves and their abilities. The lower the level of competence, the higher the self-confidence.

The purpose of the article is to develop an algorithm for determining the number of employees with a high level of self-confidence and low competence in occupational safety, which pose a threat to the system of occupational safety and health management.

To achieve this goal, the following tasks need to be addressed:

- development of a model for assessing the risk of an incompetent employee in occupational safety and health management systems;
- development of a training program for employees to develop risk-oriented thinking to determine the level of confidence in the safe performance of production tasks, which will allow determining the stage of competence development of an employee;
- development of an algorithm to determine the number of employees who are not aware of their own dangerous actions, which will allow department heads to receive relevant information to improve preventive measures;
- development of recommendations in the occupational safety and health management systems to reduce risk levels.

Methods. It is proposed to develop an algorithm for determining the number of employees with a high level

of self-confidence and low competence in occupational safety based on a model for assessing the risk of an incompetent employee. This model is based on the cause-and-effect relationship between the hazard, hazardous factors, hazardous event and losses (economic, environmental, life and health) from the occurrence of a hazardous event (Fig. 1).

The model allows determining the risk matrix of dangerous actions of employees in occupational safety and health management systems, which considers the presence of the Dunning–Kruger effect by determining the self-confidence and competence of employees. It is believed that the impact of hazardous factors on the level of risk will increase due to the growth of employee self-confidence [18, 19]. Self-confidence will be interpreted as an overestimation of employees' own capabilities to perform difficult tasks when the probability of failure is high and the awareness of its occurrence is low [20]. Or when a person is not sufficiently aware of the problem that has arisen in the performance of a production task and does not have sufficient qualifications to solve it independently and is not aware of his or her actions [21].

Based on the proposed model, it is proposed to use the matrix 5 × 5 (Fig. 2) to determine the risk of an "incompetent worker" hazard.

The horizontal axis of the matrix represents the distribution of self-confidence, and the vertical axis represents the level of competence, which varies from 0 to 100 %. A difficult point in building the matrix is determining the number of cells with unacceptable risk [22]. To do this, we used a method based on the iso-risk contour [23]. Low-risk cells are located below and to the left of the iso-risk line 30, and the highest-risk cells are located above and to the right of the iso-risk line 60.

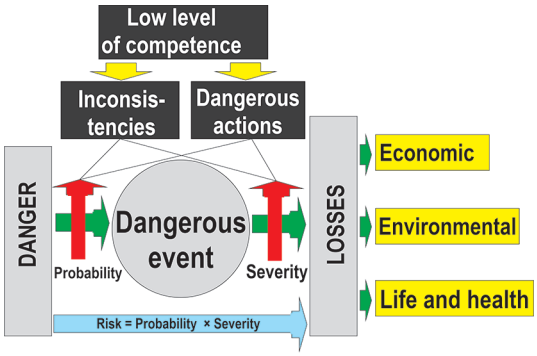

Fig. 1. Model of employee hazard risk and exposure to hazardous factors – stages of competence

	The zone of complete uncertainty 0-5%	Zone of partial uncertainty 5-25%	Zone of partial uncertainty 25-75%	Zone of partial confidence 75-95%	Zone of partial confidence 95-100%
The zone of complete incompetence 0-5%					
The zone of partial incompetence 5-25%					
The zone of average incompetence 25-75%					
The zone of partial competence 75-95%					
The zone of full competence95-100%					

Acceptable risk; Acceptable risk with verification; Unacceptable risk

Fig. 2. Risk matrix of dangerous actions and inactions of employees depending on the respective levels of competence and confidence in their competence

Employees' self-confidence is measured by comparing the results of their grades for completing theoretical and practical tasks after completing the risk-oriented thinking training, which are given by experts and the students themselves according to the formula

$$P_{ki} = (O_{(ei)} - O_{(ci)}/O_{(ei)}) \cdot 100,$$

where $O_{(ei)}$ is the expert's assessment of the students' answers, points; $O_{(ci)}$ is the students' self-assessment of their own answers, points.

To determine competence, it was assumed that all employees go through five stages of development: beginner, student, specialist, professional, and expert (Table 1). The level of competence in the analytical format was defined as a three-dimensional surface of a truncated cone [24]. It was assumed that the level of competence of a specialist is at 75 on a 100 % scale, if he or she is guaranteed to fulfill the tasks and fully realize his or her potential. In this case, the level of a professional is 75–95 %, since he or she has specialized knowledge that allows him or her to perform the task efficiently. The expert level of 95–100 % means that he or she can provide a qualified opinion on the subject matter of his or her activity.

The level of competence of employees was determined by experts with at least 8 years of work experience and a relevant certificate of occupational safety knowledge, including risk assessment and international law requirements.

The process of training employees to develop risk-oriented thinking involves the transfer of practical experience from the coach to the trainee [25]. During the training, an active learner gains certain abilities: anticipation of traumatic situations; conscious fulfillment of occupational safety requirements; ability to assess risks based on the established relationships between the hazard and the hazardous event.

The risk-oriented thinking program included 14 classes of one and a half hours each, divided into 7 theoretical and 7 practical classes. The theoretical block is divided into two sections: legislative requirements for workplace safety; workplace hazards with justification of preventive measures. The practical block included classes on acquiring skills in risk management in occupational safety and health systems, including: analysis of working conditions; determination of the hierarchy of hazardous tasks; assessment of occupational risks; justification of preventive measures; establishing the level of integrity of risk management; change management. The tasks in the evaluation sheets consisted of background information, theoretical questions, practical tasks, and a questionnaire (Table 2). The background information included the name and surname of the trainee, company name, position, and experience in the current position.

Theoretical questions were formed from: general requirements for organizing safe work based on the requirements of the ISO 45001 standard; risk assessment; effectiveness of the proposed preventive measures; communication; monitoring of the state of safety; and opportunities for improvement. Practical tasks consisted of: a set of photos of workplaces, from which it was necessary to identify situations where work should be stopped; situations in which the risk level can be reduced to an acceptable level through organizational measures

Table 1

Stages of competence development [26]

No.	Stage name	The essence of the stage
1.	"THE BEGINNER"	This is the stage when an employee lacks skills or knowledge, but does not even realize it yet. For example, an employee who is convinced that he or she is simply "unlucky" with the team and management, who requires him or her to fulfill the relevant job requirements. And he or she "knows" everything, better than anyone else, knows how to do the job. As a result, the work is performed poorly and dangerously
2.	"PUPIL"	At some point, an employee begins to realize that he or she does not know certain things. For example, an employee learns that there are a lot of dangers and begins to realize that they lack knowledge and skills. At this stage, a decision is made whether to develop (learn) or leave it at that
3.	"SPECIALIST"	This is the stage when the acquired knowledge and skills are not fixed. Their application requires concentration, attention and further improvement. For example: a worker has studied, consulted with experienced workers, started to work out new knowledge and is getting the first results – experience
4.	"PROFESSIONAL"	This is the stage when the professional skills acquired and consolidated in practice are embedded and performed on the basis of additional specialized knowledge acquired by the employee independently, he or she realizes how to improve the work in terms of quality and safety. Makes suggestions for improving the quality and safety of work. Becomes a mentor to newcomers
5	"EXPERT"	This is the stage when the professional skills acquired and consolidated in practice are embedded and performed automatically by the employee. He or she begins to conduct examinations and advise others. He or she makes suggestions for improving the quality and safety of work. They become a mentor for beginners and professionals

Table 2

Description of the components of the scorecard

Section	Description of tasks	Answers
Background information	Socio-demographic characteristics, work characteristics (work experience, scope of work)	Description
Theoretical issues	Legal requirements for occupational safety in the workplace; leadership in the field of occupational safety (based on the requirements for the formation of leadership traits); risk assessment (risk assessment methods and features of qualitative assessment); common hazards in the workplace and the hierarchy of control; methods for justifying occupational safety measures	1 – True 2 – Incorrect 3 – I do not know
Practical tasks	A set of photos of workplaces from which to identify situations where work should be stopped, situations where the risk level can be reduced to an acceptable level, and situations where significant re-equipment is required	
Survey	Cognitive: beliefs; affective: emotions/feelings; past experience, ability to provide professional expertise	A variant of the Likert scale: Strongly disagree; Disagree; Not sure; Agree; I definitely agree

and situations where significant re-equipment of the workplace is required to reduce the risk. The questionnaire consisted of three questions that characterize the employee's attitude to safety.

To establish the validity of the knowledge assessment, the Item Response Theory (IRT) and Exploratory Factor Analysis (EFA) were used [27]. An IRT item difficulty range of ±3 was considered acceptable, while discrimination values between 0.35 and 2.5 were considered acceptable. Item Characteristic Curves (ICC) were constructed to assess the correlation between an employee's ability to complete a task and their likelihood of answering a question. Item fit was determined by conducting a chi-square fit test for each item.

The determined evaluation indicators of the trainees and experts were transferred to Microsoft Excel format and then exported to the Statistical Package for the Social Sciences (SPSS) version 26. For this purpose, the collected data was analyzed to assess the distribution of numerical variables. Numerical data was presented as standard deviations (SD) or medians (IQR) based on a normal distribution. Knowledge scores were converted to percentage scores by dividing participants' scores by the maximum score and multiplying by 100. Two categories were used to record knowledge, attitudes, and practices: 1) knowledge (good or poor); 2) attitude (positive or negative); 3) practice (safe or unsafe). The level of attitude to safety among the students was determined on a five-point Likert scale, where 1 means "I do not follow safety rules" and 5 means "I fully comply with all safety rules". The scores for the established stages of employee competence development were summed and averaged.

Representatives of industrial enterprises in Dnipro region who agreed to undergo appropriate training (within five days) on occupational safety at the Department of Occupational Health and Civil Safety of the National Technical University "Dnipro University of Technology" were voluntarily involved in the study. The sample size of the study consisted of 149 people with an average age of 36.3 ± 4.2 years, of whom 82 (54.7 %) were women and 67 (54.3 %) were men. In terms of education, according to the NQF, 113 (22.2 %) had a bachelor's degree, and 82 (30.6 %) had a master's degree.

To establish the reliability of the data, the chi-square criteria (χ^2) was calculated to analyze the relationship between the two samples of variables (self-reported ratings and expert ratings). Logistic regression analysis was used to determine the associated factors affecting the outcome variables (good knowledge, positive attitude, and safe practice) among participants. Variables with $p < 0.25$ were selected for inclusion in multivariate analysis. A significant level was set at $p < 0.05$.

The algorithm for determining the number of employees with a high level of self-confidence and low competence consists of five steps (Fig. 3):

- all employees of one of the company's divisions undergo training in risk-oriented thinking, which includes a theoretical and practical module;
- the level of their knowledge and practical skills is assessed by experts who give the relevant scores on a scale from 0 to 100 points;
- the level of knowledge and practical skills is assessed by the employees themselves, who give the appropriate marks on a scale from 0 to 100 points;
- the level of employee self-confidence is calculated based on a comparison of the ratings given by employees and experts, and the matrix determines the employee's risk level for the occupational safety and health management system;
- recommendations for preventive actions in the occupational safety and health management systems are developed for the level of production tasks performed by a particular employee and for further training of employees to increase safety awareness.

Results of the study. Table 3 shows the results of the calculated coefficients of task difficulty and students' abilities, which were obtained based on the analysis of students' testing according to the principles of the IRT model.

The task difficulty coefficient was calculated using the formula [27].

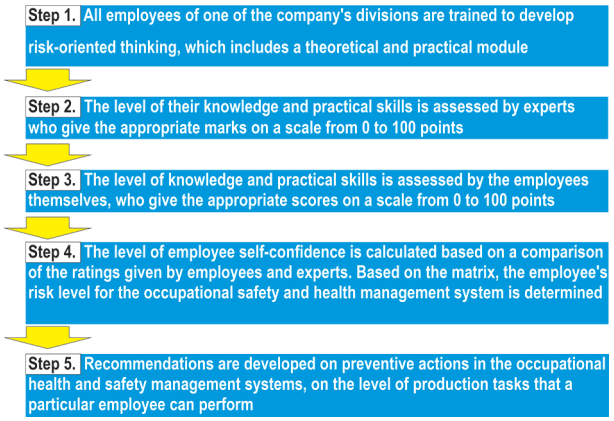

Fig. 3. Algorithm for determining the number of employees with a high level of self-confidence and low competence

$$b = \ln\frac{R}{N-R},$$

and the ability coefficient of listeners, respectively

$$a = \ln\frac{Q}{M-Q},$$

where R is the number of correct answers to the test tasks of all students; M is the total number of answers provided by one student; Q is the number of correct answers provided by one student; N is the total number of answers to a given test.

Fig. 4 shows the dependence of the probability P(b) of successful completion of the task on the complexity of the task b for all groups of tasks, which were built using the formula [27].

$$P(b) = \frac{e^{(a-b)}}{1+e^{(a-b)}}.$$

The data analysis shows that most participants were able to get 90–100 % of correct answers at the +2 difficulty level for the topics covered, while at the -2 difficulty level, only the probability of correct answers ranged from 40 to 85 %.

Table 4 shows the distribution of students' confidence in their answers, which shows that 20 % of them considered the tasks to be excellent, while 40 % considered them good, 20 % – satisfactory and 20 % – unsatisfactory.

Table 3

Results of determining the task complexity

No.	Topics from which the tasks were formed	Task difficulty factor *b* (SE)	Listener ability coefficient α (SE)	χ^2
1	Legal requirements for workplace safety	–1.95	0.84	2.39
2	Leadership in the field of labor safety (based on the requirements for the formation of leadership traits)	–2.42	–0.41	5.41
3	Risk assessment (risk assessment methods and features of qualitative assessment)	–2.82	0.84	1.34
4	Common workplace hazards and control hierarchy	–2.11	0.41	2.67
5	Methods for justifying labor safety measures	–1.72	0.84	3.26
6	Changes in management systems security	–2.13	0.41	5.60
7	Practical tasks	–2.31	–0.8,3	2.83

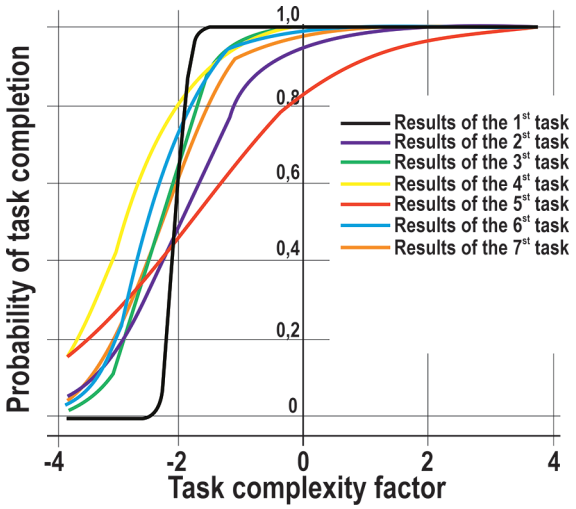

Fig. 4. Dependence of the probability of completing tasks from 1 to 7 (according to Table 3) on the task complexity coefficient

Table 4

Distribution of listeners by their levels of confidence

Confidence level criterion, %	very high	high	moderate	low	missing	Total participants
	100–90 %	90–70 %	70–50 %	50–25 %	25–0 %	
Number of listeners	31	25	35	30	28	149

Table 5

Distribution of attendees according to the experts' ratings on a 100-point scale

Criterion for the level of evaluation (points)	the highest	high	medium	low	inappropriate	Total participants
	100–90 %	90–80 %	80–70 %	70–60 %	60–0 %	
Number of listeners	18	27	43	20	39	149

At the same time, the experts who tested the level of knowledge of the students noted (Table 5) that only 12 % successfully completed the task, 47 % of the students did well, while 13 % received satisfactory results and 26 % unsatisfactory results.

A comparison of the students' scores with those of the experts revealed a group of students who had considerable confidence in their knowledge but demonstrated rather poor results (Table 6). The analysis of the data shows that 10 % of the students inadequately assess their abilities. Of these, five students have significant self-confidence, and 7 have a low level of competence. The incompetence was revealed by comparing the students' own assessments with the assessments given by the experts. The existence of the Dunning–Kruger effect among the students with low competence was confirmed by their negative attitude towards fulfilling the requirements for occupational safety. During the survey, they noted that there are inappropriate requirements that only hinder safety, which indicates a disregard for the opinion of the experts who developed these rules.

The analysis made it possible to divide the students into four groups according to their level of competence: low, medium, significant and high, which corresponds to the stages of development of a beginner, a student, a specialist, a professional and an expert (Table 7).

It was found that 15 students belong to the beginner stage of competence, of whom 1 has a high level of

Table 6

Matrix of audience distribution

Level of competence, %	Distribution of deviations in students' confidence based on their knowledge, %					Total
	100–90	90–70	70–50	50–25	25–0	Number of listeners
0–60	1	2	5	6	9	23
60–70	2	3	8	9	8	30
70–80	2	7	11	13	5	38
80–90	3	11	9	5	4	32
90–100	5	4	8	4	5	26
Number of listeners	17	27	37	36	32	

Notes. Red is an unacceptable risk zone, orange is an acceptable risk zone with verification, and green is an acceptable risk zone

Table 7

Distribution of employees by stages of competence

No.	Name of the stages	Number of listeners	The level of their attitude to occupational safety	Level of ability to perform tasks
1	"Beginner"	15	0.45	2.87
2	"Apprentice" (added by the author)	28	0.71	4.6
3	"Specialist"	68	0.88	7.6
4	"Professional"	30	0.74	10.5
5	"Expert"	8	0.92	10.7

self-confidence not supported by any theoretical and practical skills in occupational safety. The level of attitude to safety of employees with low competence was 0.45. This characterizes a low awareness of the need to comply with occupational safety rules. In general, these calculations show that among the employees involved in risk-oriented thinking training, 10 % belong to the beginner stage of competence, of which 1 % have a high level of self-confidence with a low level of competence.

At the same time, a relatively low level of attitude to safety is characteristic of "professionals". However, it should be noted that the low level of attitude to safety among professionals can be explained by the accumulation of sufficient experience to improve or revise the proposed safety rules. Overall, the study found that only 6 % of professional workers have an appropriate level of self-confidence. It was found that about 30 % of professional employees are characterized by an underestimation of their knowledge level.

We identified 8 students with good knowledge of occupational safety and high self-confidence in their abilities. There were 18 trainees with an average level of competence and overestimated self-esteem.

Discussion. As a result of the study, an algorithm was developed to determine the number of employees with a high level of self-confidence and low competence in occupational safety and health management systems due to inconsistencies and dangerous actions. They can be manifested in a distorted self-perception of danger or an overestimation of their own capabilities, which affects the decisions made [28]. This example of identifying students with a low level of competence but high self-confidence after risk-oriented thinking training indicates the existence of a group of people who do not perceive the information presented to them. This requires finding other approaches to mitigate the impact of the Dunning–Kruger effect on employees [3]. The analysis of literary sources allows us to identify at least three recommendations: the introduction of a mentoring program that will unite employees based on shared cultural values, recognition of personal achievements, etc.; the introduction of special training courses and seminars that will teach employees to distinguish between internal and external attribution and help change perceptions of success, which is exclusively the result of joint teamwork and the influence of favorable external factors; introduction of structured feedback based on specific performance data, which will allow employees to adjust their self-assessment.

The difference between this study and the existing ones, which are mainly aimed at determining the level of competence of employees and identifying the relationship between the organization of work and the quality of fulfillment of labor obligations, is the determination of the impact of employees with the Dunning–Kruger effect [29]. The proposed algorithm for identifying employees with low competence and high self-confidence allows expanding theoretical knowledge on the formation of a conscious attitude to fulfilling occupational safety requirements.

Based on the above analysis, in order to improve the effectiveness of the safety management system, we offer three recommendations for reducing risk in safety management systems:

1. It is necessary to involve as many employees as possible in discussing ways to improve workplace safety, which will lead to improved professional competence and conscious safety behavior
2. SMART should introduce a system of continuous training with the possibility for employees to choose topics to improve their competence at a convenient time. This approach will lead to a positive attitude and a desire to improve the necessary skills.
3. It is necessary to build a strong corporate safety culture by involving all employees in addressing safety issues.

Conclusions.

1. An algorithm has been developed to determine the number of employees with a high level of self-confidence and low competence in occupational safety, which consists of five steps and involves training to develop risk-oriented thinking among employees and special diagnostics with the involvement of experts.
2. It is proposed to determine the level of self-confidence of employees by comparing the results of assessments. To consider the grades given by experts and students for theoretical and practical tasks after completion of training on the formation of risk-oriented thinking.
3. A risk matrix of dangerous actions of employees in occupational safety and health management systems has been developed, which considers the presence of the Dunning–Kruger effect in workers, which increases the likelihood of a dangerous event and the severity of the consequences.
4. The analysis of the employees' competence allowed us to divide them into five groups: low, medium, significant, high and the highest, which corresponds to the stages of development: beginner, student, specialist, professional and expert.
5. It was determined that among the employees involved in the training on the formation of risk-oriented thinking, 10 % belong to the stage of competence – beginner, of which 1 % have a high level of self-confidence, which is not supported by any theoretical and practical skills in occupational safety. The level of attitude to safety of employees with low competence is 0.45, which is classified as a low level. In general, the study found that only 6 % of professional employees have an appropriate level of self-confidence.

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Удосконалення алгоритму визначення компетентності працівників з питань безпеки праці

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Мета. Розробка алгоритму із визначення кількості працівників з високим рівнем самовпевненості й низькою компетентністю з безпеки праці, які становлять загрозу для системи управління безпекою праці та здоров'ям працівників.

Методика. Для визначення рівня ризику небезпеки «некомпетентного працівника» в системах управління безпекою праці та здоров'ям працівників використовувався якісний підхід на основі матриці 5 × 5, де по горизонталі знаходився розподіл рівня впевненості працівника, а по вертикалі – рівень його компетенції, що змінюються в діапазоні від 0 до 100 %. Для розробки алгоритму визначення компетентності працівників використовувався системний підхід, що досліджує модель взаємозв'язку між небезпекою (некомпетентний працівник) і небезпечною подією (їх травмуванням).

Результати. Розроблений алгоритм із визначення кількості працівників з високим рівнем самовпевненості й низькою компетентністю із безпеки праці, що складається із п'яти кроків і передбачає проведення навчання із формування ризик-орієнтованого мислення у працівників і спеціальної діагностики із залученням експертів. Запропоноване визначення самовпевненості працівників проводити через порівняння результатів оцінок, що отримані за виконання теоретичних і практичних завдань після закінчення навчання із формування ризик-орієнтованого мислення, що виставлені експертами й самими слухачами. Розроблена матриця ризику небезпечних дій працівників у системах управління безпекою праці та здоров'ям працівників, що враховує наявність ефекту Дан-

нінга–Крюгера. Проведений аналіз компетентності працівників дозволив розподілити їх на п'ять груп: низька, середня, значна, висока і найвища, що відповідає стадіям розвитку: початківець, учень, фахівець, професіонал та експерт. Визначено, що серед залучених працівників до навчання із формування ризик-орієнтованого мислення 10 % відносяться до стадії компетентності – початківець, із яких 1 % має високий рівень самовпевненості, що не підкріплений жодними теоретичними й практичними навичками з безпеки праці. При цьому рівень ставлення до безпеки працівників із низькою компетентністю складає 0,45, що відноситься до показнику – низький рівень. Загалом при дослідженні виявлено, що тільки 6 % працівників-професіоналів мають відповідний рівень самовпевненості. Встановлено, що 30 % працівників-фахівців характеризуються заниженою самооцінкою.

Наукова новизна. Встановлено взаємозв'язок між рівнем самовпевненості працівника та його некомпетентністю з безпеки праці й рівнем додаткового ризику в системах управління безпекою праці та здоров'ям працівників.

Практична значимість. Полягає у запровадженні інструменту для ранньої ідентифікації в системах управління безпекою праці працівників із високим ризиком небезпечних дій.

Ключові слова: *ризик, працівники, компетентність, підготовка, безпека праці*

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