

Improving the Process of Managing Psychosocial Risks in Organizations

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Introduction: Psychosocial risks (PSRs) are identified as one of the main modern occupational safety issues, primarily related to occupational stress, and need to be reduced to safe levels in accordance with international requirements. The research purpose is to improve the process of managing the PSRs in the occupational safety and health management systems of employees, taking into account the impact of psychosocial dangers in accordance with the requirements of ISO 45001:2018 and ISO 45003:2021 standards.

Methods: To develop the process of managing the PSRs, a system analysis method is applied, which allows determining the structural relationships between the variable elements of dangerous psychosocial factors described in the ISO 45003:2021 standard.

Results: The bow-tie model has been improved to determine the relationship between psychosocial dangers and the dangerous event occurrence – experiencing stress by an employee, taking into account the influence of various dangerous psychosocial factors, which provides for an additional risk level assessment for restoring the health of an employee who has experienced stress. The process of psychosocial risk management consisting of ten steps is proposed, which involves identifying the relationship between psychosocial dangers and consequences for human health, taking into account the impact of various dangerous psychosocial factors based on questionnaires, followed by analysis and processing of the duration and intensity of experiencing stress. To reduce the impact of subjective assessments of the duration and intensity of experiencing stress on the psychosocial risk level, it is proposed to take into account the value of individual perception of experiencing stress (stress resistance) and the employees' health condition.

Discussion: The scientific novelty is to determine the psychosocial risk level as the sum of the risk values from the impact of each dangerous psychosocial factor, which are characteristic of aspects of work organization, social conditions at work, working environment, equipment, dangerous tasks and the level of employee health. The practical value is the development of scales for assessing the impact of dangerous psychosocial factors and a form for documenting the process of managing psychosocial risks with the indication of precautionary measures to control them.

Keywords: psychosocial risk, dangers, stress, psychosocial factor, managerial decisions

Introduction

Psychosocial risks (hereinafter referred to as PSRs) at work provoke diseases among employees.¹ Exposure to stress reduces employees' well-being and leads to significant economic and social losses, as well as is a dangerous factor of occupational risks.² According to the estimates of various scientific studies,^{3–6} 50–60% of all lost working days for the disease in the EU are associated with stress. This includes the development of occupational diseases (professional burnout, emotional exhaustion, symptoms of depression and musculoskeletal disorders, etc.⁷) and oncological diseases.⁸ This situation requires the top management of organizations to take appropriate precautionary measures to reduce psychosocial risks. For example, the development of the concept of a healthy and safe workplace,⁹ which includes not only a traditional safe physical environment, but also a healthy psychosocial environment, safe epidemic environment, safe infectious environment, and a healthy lifestyle of the employee. The development of such a concept is convenient based on the requirements of a number of international standards: ISO 45001, ISO 45002, ISO 45003, ISO 45004, ISO/PAS 45005 and ISO 45006 (Figure 1). It is based on the risk management process: that is, to identify dangers, dangerous

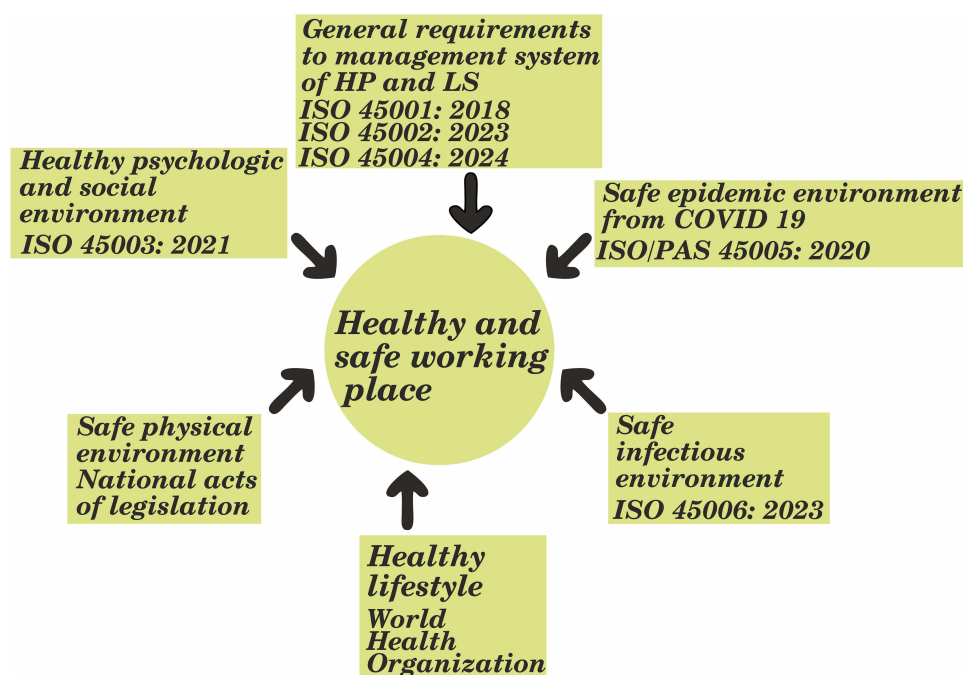


Figure 1 A contemporary vision of a healthy and safe workplace based on a number of international standards ISO 4500X.

external or internal factors that increase the probability of a dangerous event occurrence and the severity of consequences, as well as to justify precautionary/protective measures to avoid costs associated with work-related injuries, disabilities and diseases.^{10,11}

Of the components of the safe and healthy workplace concept listed, the most questions regarding the consistency of risk management procedures arise precisely in relation to the definition of psychosocial risks. Since they are characterized by “the interaction of the working environment, work organization”, etc. with the abilities, needs and concerns of employees, which affects the health condition through the influence of stress.¹² There is a difference between physical dangers and psychosocial dangers – stress. Physical dangers are characterized by specific circumstances that can lead to injury or deterioration of employees’ health. Psychosocial dangers (dangerous factors), as defined by the ISO 45003:2021 standard Occupational Health and Safety Management – Psychological Health and Safety at Work – Guidelines for Managing Psychosocial Risks, are specific events that are related to work organization, aspects of working environment and can cause psychological, social or physical harm to employees. In other words, the term “psychosocial danger” is defined as a dangerous factor in the interaction between psychological, physiological and working environment factors.¹³ In addition, their impact is related to the individual susceptibility of employees, which necessitates the assessment of psychosocial risks.¹⁴ It is also difficult to identify the severity of the consequences of psychosocial risks. For example, according to WHO (World Health Organization), a negative reaction in employees experiencing stress occurs when job demands and pressures do not correspond to the employees’ abilities.¹² Some people are known to be more susceptible to the effects of stress, depression and anxiety^{15,16} with long-term consequences on the quality of their professional life. At the same time, the impact of physical or chemical dangers is often characterized by a linear relationship between the values of harm and danger, rather than psychosocial danger – stress.¹⁷

Note that many organizations have legal obligations to conduct occupational risk assessments for all workplaces and activities to protect the health of employees and prevent accidents or other harmful effects of employees’ work.¹⁸ For this purpose, an occupational safety and health management system is often implemented in accordance with the requirements of ISO 45001:2018 «Occupational health and safety management systems – Requirements with guidance for use». Hence, there is an urgent task to develop a process for managing not only occupational risks, but also the PSRs, which can be easily integrated with other risk management processes (physical, chemical, infectious, and others).

The analysis of studies has shown that the priority direction of research on this issue is aimed primarily at studying the PSR impact on the effectiveness of the organization's activities,¹⁸ since their presence increases the number of days of inability to work^{19,20} and accidents, medical care costs and staff turnover.²¹ The demand for such research is understandable, as there is a need for financial support of precautionary measures to reduce the level of occupational stress.²² At the same time, more interesting are studies on determining the relationship between long-term exposure to occupational stress and the emergence of distress, which depends, among other things, on the health condition, including, for example, mental disorders, cardiovascular diseases.²³ In addition, of interest are studies on counterproductive behavior, sabotage, interpersonal conflicts with colleagues, subordinates or managers due to the presence of stressful tension, which ultimately worsens the effectiveness and efficiency of the organization's activities,²⁴ the quality of products (services).^{3,25,26} Also important are studies on the negative impact of occupational stress on employee well-being due to the exhaustion of personal resources.²⁷ However, all of the above research papers do not describe the process of managing the PSRs. Some of them only indicate their importance.^{28,29} Unfortunately, the number of such studies is not significant. This may be due to the complexity of determining risk as the product of the probability of a dangerous event occurrence and the severity of the consequences, which in this case significantly depends on the individual characteristics of a person, his/her stress resistance, religious beliefs, and family circumstances.³⁰ There are studies^{31–34} on the development of questionnaires to identify psychosocial factors (stressors) in the workplace, and then a qualitative description of the impact on mental health of working conditions is conducted, which is difficult to compare in the conditions of one organization, not to mention the conditions at different enterprises. There is also a problem with the interpretation of conclusions by different experts: psychologists, psychotherapists, psychoanalysts and ordinary occupational safety engineers who are responsible for reducing the PSRs.³⁵ In addition, there is a significant difference between psychological and social dangers, which require the development of various measures to reduce the impact on the health of employees.³⁶

The conducted analysis of scientific research suggests the existence of certain gaps in the substantiation of PSR management process in the organization's occupational health and safety management system. This requires conducting appropriate research to find answers to questions about the consistency of the process of managing psychosocial risks in occupational safety and health management systems in specific settings, as well as to identify not only occupational risks but also psychosocial risks and assess their level, as well as develop appropriate precautionary measures to reduce them to an acceptable level.

The purpose of the research is to improve the process of managing the PSRs in the occupational health and safety management systems of employees in accordance with the requirements of ISO 45001:2018 and ISO 45003:2021 standards.

Materials and Methods

A system analysis method is used to develop the PSR management process.³⁷ It allows determining the structural relationships between the variable elements of dangerous psychosocial factors described in ISO 45003:2021 standard, and the probability of a dangerous event occurrence (experiencing stress by an employee) and the severity of consequences (development of occupational diseases).

To assess psychosocial risks, the bow-tie method is used, which is described in IEC 31010:2019 Risk Management – Risk Assessment Techniques (Figure 2). This method is quite common and is used in many industries.^{38–40} It is a composition of a fault tree and an event tree, taking into account the impact of a dangerous event occurrence on the root causes of various dangerous psychosocial factors. Its use allows for a good visualization of the chain between the root cause, a dangerous event and its consequences, thereby identifying not only protective barriers, but also dangerous factors that increase the probability or severity of consequences.³⁵

The choice of the bow-tie method for psychosocial risk assessment is related to the possibility of implementing all the steps: from identifying the dangers to monitoring the effectiveness of precautionary measures, as specified in the IEC 31010:2019 standard. The bow-tie method is based on a cause-and-effect relationship: psychosocial danger – stress that can lead to a dangerous event – experiencing stress by an employee under the influence of several groups of dangerous psychosocial factors (aspects of work organization, social factors at work, working environment, equipment, dangerous

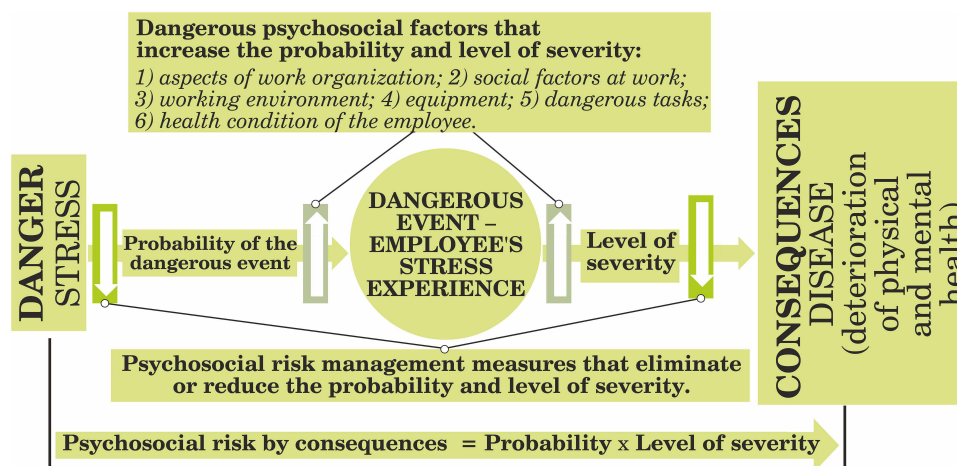


Figure 2 Model of psychosocial risk management based on the ISO 45003 standard requirements using the bow-tie method.

tasks, employee's health level, etc). Using a system analysis, it is supposed to identify the impact of potentially dangerous psychosocial factors, as well as to analyze the ability of available resources, such as support, feedback, dedication, and good physical and mental health, to reduce the severity of consequences. The selection of these groups of dangerous psychosocial factors is primarily due to the recommendations of ISO 45003:2021 standard. The identification of these groups of dangerous psychosocial factors has also been confirmed by various scientific studies. They indicate the existing relationship between the employee's experience of stress and the impact of work organization^{41,42} lack of support from management or coworkers,^{43,44} performing dangerous tasks.^{45,46} The impact of dangerous tasks on the employee's experience of stress is associated with high demands for performing such tasks, which lead to the need to take appropriate measures and strategies to actively respond to these demands.⁴⁷ It is believed that this disrupts a person's internal state of stability, which can lead to stress.⁴⁸

Questionnaires are used to determine the impact of psychosocial dangerous factors. Their analysis is supposed to identify not only dangerous psychosocial factors, but also indicators of the intensity and duration of experiencing stress. The practice of using questionnaires is quite widespread.^{49,50} There are a significant number of such developments.⁴⁹ Thus, to reduce the influence of subjectivity and increase the reliability of such approaches, it is recommended to use a combination of several different questionnaires,⁵¹ to use exploratory factor analysis (EFA),⁵² for example, through the use of the Gonzaga's School of Business online application (<https://analytics.gonzaga.edu/parallelengine/>).

Research Results

Based on the bow-tie method model, an improved model has been developed for managing the PSRs in accordance with ISO 45003:2021 standard, which provides for consideration of additional psychosocial risk, taking into account the employee's health recovery (Figure 3). Its development arises from the need to create appropriate safe working conditions for employees who restore their mental health after experiencing occupational stress and their adaptation when returning to work.

This will allow, at least, the organization's managers to develop measures for psychological support (recovery) of employees upon returning to work, as well as to ensure the level of occupational physical and psychological load in accordance with the individual capabilities of such an employee.

Hence, there is a need to identify dangerous psychosocial factors that negatively affect the recovery of mental health and adaptation of an employee when returning to work. In particular, protection of violated rights of employees, especially in moments of greatest vulnerability, avoidance of forced execution of dangerous tasks, bullying, lack of support, etc.⁵³

The difference of the proposed bow-tie method model for managing PSRs is also the consideration of physical and mental individual characteristics of a person as an additional factor influencing psychosocial risk.

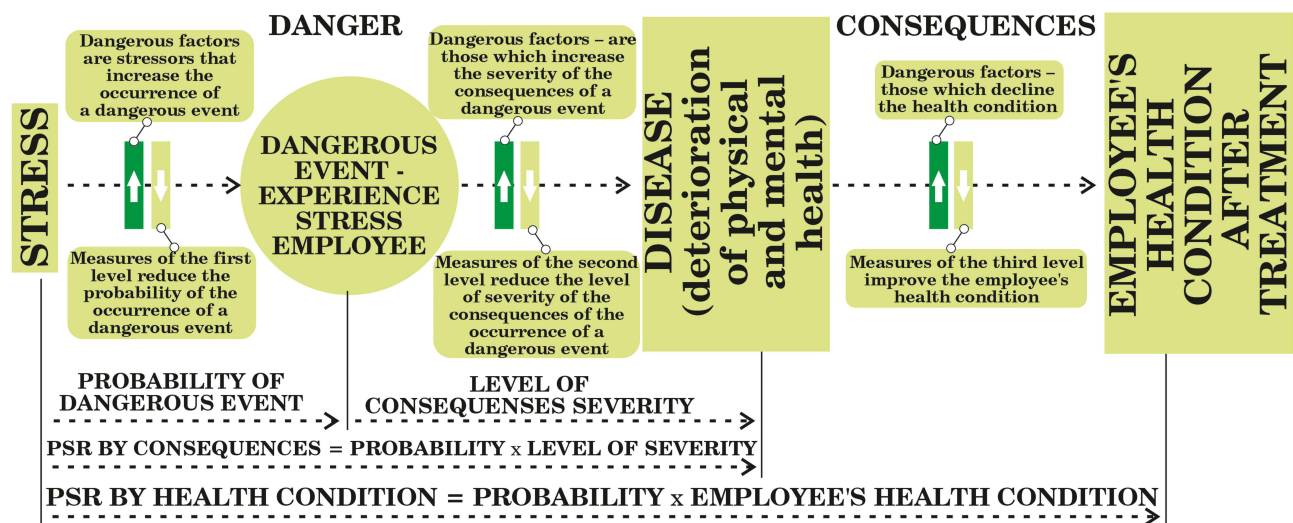


Figure 3 Proposed model for managing psychosocial risk of stress.

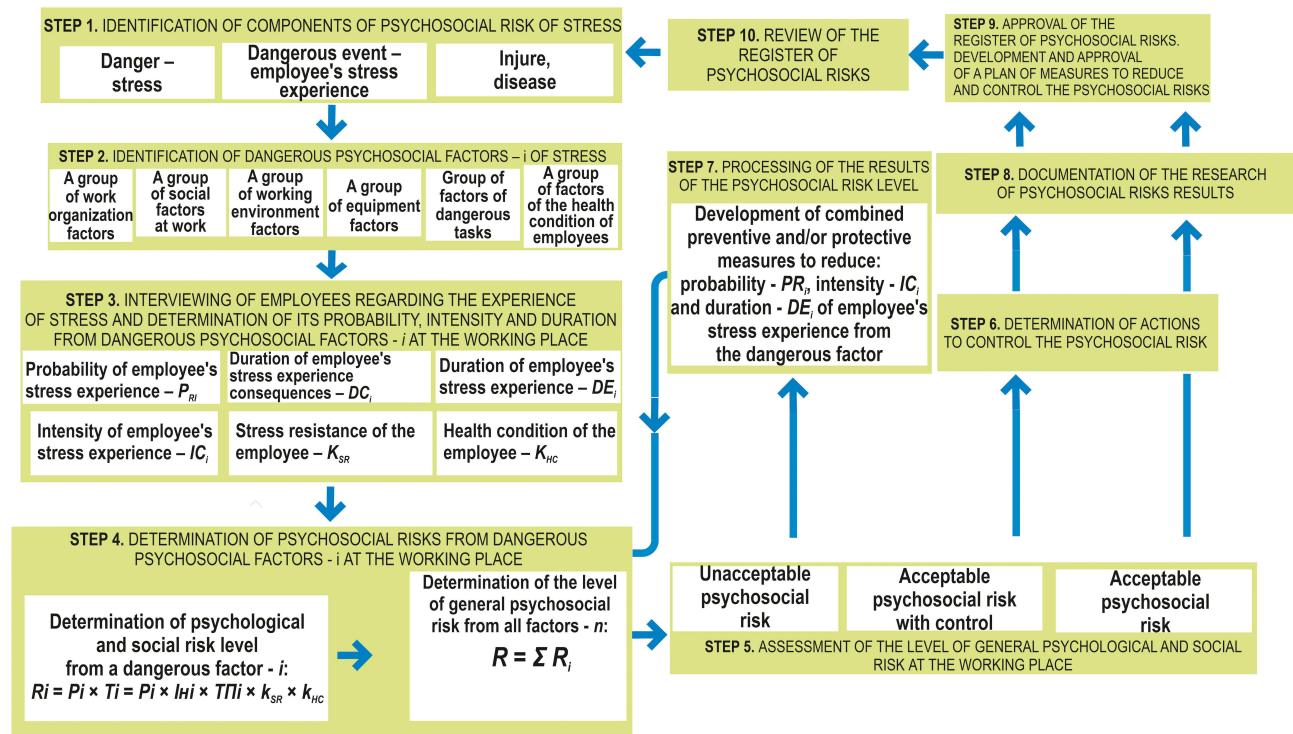


Figure 4 Process of psychosocial risk management.

Based on the proposed bow-tie method model (Figure 4), a PSR management process has been developed that includes eleven steps aimed at identifying the relationship between psychosocial danger – stress and human health consequences, taking into account the influence of various dangerous psychosocial factors on the level of psychosocial risk of stress.

The *first step* is to identify the psychosocial danger – stress, the dangerous event – experiencing stress and possible consequences, based on a study of the production environment with its characteristic dangerous factors. It is convenient to use different models for this step.⁵⁴ For example, the JD-R model, linking the demands to employees with their available capabilities, which makes it possible to identify psychosocial dangers that lead to experiencing stress.⁵⁵

It is also convenient to apply the Job Demands – Control – Support model, illustrating how job demands can cause stress for employees, such as heavy workload, role ambiguity, and work-related stress.⁵⁶ Using these models, determine the relationships between psychosocial dangers and dangerous events, the probability of which is increased by dangerous psychosocial factors and the severity of consequences – injuries or the development of occupational diseases. We document all the information, and, as an example, you can see Table 1.

The *second step* is to identify the dangerous psychosocial factors that affect the psychosocial risk level based on the use of a questionnaire. Various well-known questionnaires, such as Copenhagen Psychosocial Questionnaire (COPSOQ; COPSOQ II, COPSOQ III), can be used.⁵⁷ However, there is a need to process and revise them to assess dangerous psychosocial factors in accordance with the working environment and the mentality of employees. An example of a fragment of such a questionnaire, developed in accordance with the groups of dangerous factors specified in the ISO 45003:2021 standard for one of the mining enterprises, is given in Table 2. To form it, a combination of various existing approaches was used to determine the level of perceived PSS-10⁵⁸ or to measure GAD-7 anxiety symptoms.⁵⁹ The peculiarities of the proposed questionnaire include determining the duration and intensity of experiencing stress from the

Table 1 Form of the Register of Dangerous Psychosocial Factors

Name of Dangerous Factor Group	Dangerous Factors (aspects) of Work Organization (DF _{0i}) (quantity - j)	Dangerous Social Factors at work (DsF _i) (quantity – k	Dangerous Factors of Working Environment (DF _{WEi}) (quantity - l)	Dangerous Factors of Equipment (DF _{e_{qu}i} p _i) (quantity – m)	Dangerous Factors of Dangerous Task (DF _{d_ti}) (quantity – n)
Stress	Intensity	From 1 to 10 scores			
	Duration	From 1 to 10 scores			
	Consequence	From 1 to 10 scores			
Employee's health condition	From 0.1 to 1 score				
Stress resistance	From 0.1 to 1 score				

Table 2 Questionnaire to Identify Dangerous Psychosocial Factors (Fragment)

Indication DF _{j-i}	A Dangerous Factor (Question)	Psychosocial Risk Components		
		Frequency of Occurrence	Intensity	Duration
1. Organizational factors				
DF ₁₋₁	Is there any uncertainty before performing the work?	Fr ₁₋₁	In ₁₋₁	D ₁₋₁
DF ₁₋₂	Are there any production tasks that are difficult to combine?	Fr ₁₋₂	In ₁₋₂	D ₁₋₂
DF ₁₋₃	Do you have to neglect production tasks because of their large number?	Fr ₁₋₃	In ₁₋₃	D ₁₋₃
DF ₁₋₄	Do you refuse to take breaks due to workload?	Fr ₁₋₄	In ₁₋₄	D ₁₋₄
DF ₁₋₅	Do you feel a lack of time to do your work?	Fr ₁₋₅	In ₁₋₅	D ₁₋₅
2. Social factors				
DF ₂₋₁	Is there support from colleagues or management?	Fr ₂₋₁	In ₂₋₁	D ₂₋₁
DF ₂₋₂	Is there a sufficient level of interaction between colleagues?	Fr ₂₋₂	In ₂₋₂	D ₂₋₂
DF ₂₋₃	Do you feel that your well-being is taken care of?	Fr ₂₋₃	In ₂₋₃	D ₂₋₃

(Continued)

Table 2 (Continued).

Indication DF _{j-i}	A Dangerous Factor (Question)	Psychosocial Risk Components		
		Frequency of Occurrence	Intensity	Duration
DF ₂₋₄	Is there a management style applied that does not match the nature of the work?	Fr ₂₋₄	In ₂₋₄	D ₂₋₄
DF ₂₋₅	Does the management make unfair decisions?	Fr ₂₋₅	In ₂₋₅	D ₂₋₅
3. Working environment factors				
DF ₃₋₁	Is there an appropriate level of safety in the workplace?	Fr ₃₋₁	In ₃₋₁	D ₃₋₁
DF ₃₋₂	Are there any physical dangers (noise, insufficient lighting, high humidity or temperature, etc.) in the workplace?	Fr ₃₋₂	In ₃₋₂	D ₃₋₂
DF ₃₋₃	Are there all the necessary tools for safety in the workplace?	Fr ₃₋₃	In ₃₋₃	D ₃₋₃
DF ₃₋₄	Are comfortable working conditions ensured?	Fr ₃₋₄	In ₃₋₄	D ₃₋₄
DF ₃₋₅	Is the working environment adequately monitored?	Fr ₃₋₅	In ₃₋₅	D ₃₋₅
4. Infrastructure factors (equipment, tools, etc.)				
DF ₄₋₁	Does the spatial layout of the workplace meet the needs of employees and the work performed?	Fr ₄₋₁	In ₄₋₁	D ₄₋₁
DF ₄₋₂	Is there appropriate technical maintenance?	Fr ₄₋₂	In ₄₋₂	D ₄₋₂
DF ₄₋₃	Is the equipment you use outdated?	Fr ₄₋₃	In ₄₋₃	D ₄₋₃
DF ₄₋₄	Are you satisfied with the ergonomics of the equipment work panel?	Fr ₄₋₄	In ₄₋₄	D ₄₋₄
DF ₄₋₅	Are there any cases of unstable equipment operation?	Fr ₄₋₅	In ₄₋₅	D ₄₋₅
5. Factors of dangerous tasks				
DF ₅₋₁	Is there a fear of losing a job?	Fr ₅₋₁	In ₅₋₁	D ₅₋₁
DF ₅₋₂	Does the work involve a significant risk to life?	Fr ₅₋₂	In ₅₋₂	D ₅₋₂
DF ₅₋₃	Do you perform high-risk work/in extreme conditions or situations?	Fr ₅₋₃	In ₅₋₃	D ₅₋₃
DF ₅₋₄	Do you perform work in unstable environments, such as war zones?	Fr ₅₋₄	In ₅₋₄	D ₅₋₄
DF ₅₋₅	Do you work in unfavorable conditions in the workplace?	Fr ₅₋₅	In ₅₋₅	D ₅₋₅
6. Employee health factors				
DF ₈₋₁	Do you often have to stop working due to fatigue?	Fr ₈₋₁	In ₈₋₁	D ₈₋₁
DF ₈₋₂	Do you take medication on a regular basis?	Fr ₈₋₂	In ₈₋₂	D ₈₋₂
DF ₈₋₃	Is there a significant increase in blood pressure when performing work?	Fr ₈₋₃	In ₈₋₃	D ₈₋₃
DF ₈₋₄	Do you often get colds throughout the year?	Fr ₈₋₄	In ₈₋₄	D ₈₋₄
DF ₈₋₅	Can you hold your breath for more than 30 seconds?	Fr ₈₋₅	In ₈₋₅	D ₈₋₅

specified dangerous psychosocial factor using the Sten scale, where 1 means no stress, and 10 means significant intensity and duration of stress.⁶⁰ It is believed that the severity of health consequences can be determined based on the intensity and duration of experiencing stress.^{61–63}

The *third step* involves surveying employees about the intensity and duration of experiencing stress and the frequency of experiencing stress from various dangerous psychosocial factors. In this case, statistical analysis reveals significant dangerous

psychosocial factors. For example, with the help of STATISTICA (Dell Technologies, Round-Rock, Texas, USA) software, which conveniently uses the Mann–Whitney U -test to assess differences in stress experience and its perception.⁶⁴ Based on the identified significant dangerous psychosocial factors, it is necessary to form their register. This will make it possible to clarify the impact of dangerous psychosocial factors at specific time intervals. Having a register of dangerous psychosocial factors will help identify the effectiveness of precautionary measures to reduce the experience of stress.

At the *fourth step*, determine the level of total PSR at the employee's workplace by the sum of all identified psychosocial risks from the impact of each dangerous psychosocial factor - i

$$R = \sum R_i \quad (1)$$

where R – is the psychosocial risk value; R_i – is the psychosocial risk value from the impact of each dangerous psychosocial factor – i .

For example, two approaches are proposed for determining the PSR value depending on the influence of each psychosocial factor. The *first approach* is based on the understanding that the PSR level from exposure to i – a dangerous psychosocial factor is determined by the formula as a combination of the probability (frequency) of occurrence of a work-related psychosocial danger and the severity of consequences in terms of health deterioration, as specified in ISO 45003:2021 standard:

$$R_i = Fr_i \times S_i, \quad (2)$$

where, Fr_i – is the frequency of stress experience; S_i – is the severity of stress experience consequences.

In this case, the probability of experiencing stress by an employee is convenient to determine by the frequency of occurrence of a stressful situation. The ten-score scale for determining the frequency of stress experience occurrence is shown in Table 3. It was formed based on the relationship between the frequency of experiencing stress by employees and the possible development of mental disorders (depression, anxiety, sleep disturbances, deterioration of the immune and cardiovascular systems, etc).^{65–67}

Table 2 is based on the assumption that the more often a person is exposed to stress, the more the psychosocial risk level increases.^{68–70} However, there is a significant number of publications indicating that the deterioration of mental health from the frequency of stress experience is ambiguous, the dependence is quite complex⁷¹ and requires taking into account individual characteristics of a person (for example, stress resistance).⁷² At the same time, the proposed scale allows for a qualitative comparison of the number of stressful situations experienced by an employee in the production environment. At least, this approach makes it possible to identify psychosocial dangerous factors. Of course, it needs to

Table 3 Frequency Scale of the Stress Experience Occurrence (Fr)

No	The Level of Frequency of Dangerous Event Occurrence	Indication	Criteria	Score
1.	High	A	At least once a day	10
2.		B	At least once a week	9
3.		C	At least once a month	8
4.	Medium	D	At least once a quarter of a year	7
5.		E	At least once a half of a year	6
6.		F	At least once a year	5
7.	Low	G	At least once in 2 years	4
8.		H	At least once in 5 years	3
9.		O	At least once in 10 years	2
10.	Absent	P	A dangerous event does not occur	1

be improved based on the analysis of a significant amount of accumulated research. At the same time, the method for determining psychosocial risk should not be too complicated. Otherwise, it will be impossible to involve employees in enterprises for its implementation, which is required by ISO 45001 standard. It should be noted that the involvement of employees in the process of managing the PSRs is one of the important aspects of the successful management system operation in organizations, which is confirmed by scientific evidence.^{73,74}

To create the scale of severity of stress experience consequences (Table 3), we use the recommendations from.^{75,76} More details about the development of frequency scales (or probability) of a dangerous event occurrence and the scale of severity of consequences are disclosed in the paper.⁷⁷ By combining the scales of frequency of stress experience occurrence (Table 2) and severity of consequences of experiencing it (Table 3), a simple matrix can be constructed to determine the PSR level (Table 4). It is a two-dimensional grid. On one axis, there are categories of severity of consequences, and on the other, there are categories of frequency of stress experience occurrence. The cells within the grid determine the psychosocial risk level. A difficult point in constructing such risk assessment matrices is determining the number of cells with an unacceptable risk.^{76,78} For this purpose, it is recommended to use the method based on the iso-risk contour.⁷ Low-risk cells are located below and to the right of the 30 iso-risk line, and highest-risk cells are located above and to the left of the 60 iso-risk line.

Thus, the unacceptable psychosocial risk level is in the range of 60 to 100 scores, and the acceptable psychosocial risk level is from 1 to 27. The range from 27 to 60 scores refers to acceptable risk level with control. However, the proposed risk assessment matrix is an example (Table 5) and needs improvement, based on the conditions of use in a particular organization.

Given that the relationship between the frequency of stress experience and the psychosocial risk level is complex and often depends on the individual level of physical health of the employee, as well as his/her stress resistance, a *second approach* is proposed. Determination of the PSR level takes into account the employee's stress resistance, intensity and duration of stress experience, the employee's health condition through the use of appropriate coefficients. Then, formula (1) will be transformed into:

$$R_i = Fr_i \times S_i = Pr_i \times IC_i \times DE_i \times I_{SR} \times I_{HC}, \quad (3)$$

where IC_i - is the intensity of stress experience; I_{SR} - is index of stress resistance, from 0 to 1, in this case 0 – absolutely stress-resistant employee, 1 – absolutely stress-susceptible employee; DE_i - is duration of stress experience; I_{HC} - is index of employee's health condition, from 0 to 1, in this case 0 – absolutely healthy, 1 – severely ill.

Table 4 Severity of Stress Experience Consequences (S_i)

No	Level of Severity of the Consequences	Indication	Criteria	Score
1.	High	I	Death from injury or disease	10
2.		II	Severe disease with loss of working capacity (disability of the 1 st group)	9
3.		III	Severe disease with partial loss of working capacity (disability of the 2 nd group)	8
4.	Medium	IV	Average disease with partial loss of working capacity (disability of the 3 rd group)	7
5.		V	Average disease without loss of working capacity, but with long treatment of more than three months and less than a year.	6
6.		VI	Average disease without loss of working capacity, but with not long hospital treatment of more than two weeks, but less than three months.	5
7.	Low	VII	A minor disease without loss of working capacity, but with outpatient treatment for more than a week, but less than two weeks.	4
8.		VII	A minor disease without loss of working capacity, but with treatment for more than three days, but less than 7 days.	3
9.		IX	Average disease without loss of working capacity, but with long treatment	2
10.	Absent	X	No diseases	1

Table 5 PSR Assessment Matrix

Indication		Scale of Severity Because of Dangerous Event Occurrence									
		I	II	III	IV	V	VI	VII	VIII	XI	X
Scale of dangerous event occurrence	A	100	90	80	70	60	50	40	30	20	10
	B	90	81	72	63	56	45	36	27	18	9
	C	80	72	64	56	48	40	32	24	16	8
	D	70	63	56	49	42	35	28	21	14	7
	E	60	54	48	42	36	30	24	18	12	6
	F	50	45	40	35	30	25	20	15	10	5
	G	40	36	32	28	24	20	16	12	8	4
	H	30	27	24	21	18	15	12	9	6	3
	O	20	18	16	14	12	10	8	6	4	2
	P	10	9	8	7	6	5	4	3	2	1

To determine the intensity and duration of stress experience, the following scales are proposed, given in [Tables 6](#) and [7](#). For their construction, similar approaches are used, described in,^{60,65,66} as well as in.⁷

There is a difficulty, both in constructing three-dimensional matrices for determining risk based on three criteria, and in its use in organizations. In this approach, the following indicators are used to determine the psychosocial risk level: frequency of occurrence, intensity and duration of stress experience.^{54,79} To avoid creating such a three-dimensional matrix, we develop a matrix for determining the severity of consequences based on a grid between intensity and duration. The possibility of its development stems from the revealed dependence of the deterioration of a person's physical and mental health on the intensity and duration of stress experience.^{28,32,80,81}

Using the stress intensity ([Table 6](#)) and duration ([Table 7](#)) scales, we construct a matrix for assessing the severity of the consequences, which is shown in [Table 8](#). These values of the severity of consequences have been reduced by a factor of ten so that they can be compared with the data for the PSR matrix assessment ([Table 5](#)).

Table 6 Scale of Stress Experience Intensity (IC)

No	Stress Experience Intensity	Indication	Criteria	Score
1.	High	«a»	100%	10
2.		«b»	90%	9
3.		«c»	80%	8
4.	Medium	«d»	70%	7
5.		«e»	60%	6
6.		«f»	50%	5
7.	Low	«g»	40%	4
8.		«h»	30%	3
9.		«o»	20%	2
10.	Absent	«p»	10%	1

Table 7 Scale of the Stress Experience Duration (DE)

No	Stress Experience Duration	Indication	Criteria	Score
1.	High	«1»	More than a year	10
2.		«2»	Less than a year, but more than 9 months	9
3.		«3»	Less than 9 months, but more than 6 months	8
4.	Medium	«4»	Less than 6 months, but more than 3 months	7
5.		«5»	Less than 3 months, but more than 1 month	6
6.		«6»	Less than 1 month, but more than 3 weeks	5
7.	Low	«7»	Less than 3 weeks but more than 2 weeks	4
8.		«8»	Less than 2 weeks but more than 1 week	3
9.		«9»	Less than 1 week, but more than 3 days	2
10.	Absent	«10»	Less than 3 days	1

Table 8 Matrix for Assessing the Severity of Stress Intensity and Duration Consequences

Indication		Scale of Stress Duration									
		1	2	3	4	5	6	7	8	9	10
Scale of stress intensity	«a»	10.0	9.0	8.0	7.0	6.0	5.0	4.0	3.0	2.0	1.0
	«b»	9.0	8.1	7.2	6.3	5.6	4.5	3.6	2.7	1.8	0.9
	«c»	8.0	7.2	6.4	5.6	4.8	4.0	3.2	2.4	1.6	0.8
	«d»	7.0	6.3	5.6	4.9	4.2	3.5	2.8	2.1	1.4	0.7
	«e»	6.0	5.4	4.8	4.2	3.6	3.0	2.4	1.8	1.2	0.6
	«f»	5.0	4.5	4.0	3.5	3.0	2.5	2.0	1.5	1.0	0.5
	«g»	4.0	3.6	3.2	2.8	2.4	2.0	1.6	1.2	0.8	0.4
	«h»	3.0	2.7	2.4	2.1	1.8	1.5	1.2	0.9	0.6	0.3
	«o»	2.0	1.8	1.6	1.4	1.2	1.0	0.8	0.6	0.4	0.2
	«p»	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1

To do this, we use the recommendations given in,^{76,82} which provide a specific peculiarity of scaling discrete categories of stress intensity and duration.

The well-known Connor-Davidson Resilience Scale (CD-RISC),⁸³ Resilience Scale for Adults (RSA),⁸⁴ or Resilience Scale for Mexicans (RESI-M) can also be used to determine the employee's stress resistance coefficient.⁸⁵ These scales are based on assessing employees' ability to cope with stress/change, self-esteem/confidence level, social problem-solving skills, sense of humor, etc. At the same time, their direct use to determine the psychosocial risk level, in particular the severity of stress consequences, is impossible, due to the difference in the estimated indicators in the above scales. Using their principles of construction, which are based on a quantitative indicator that determines a person's resistance to stress based on a physiological response, a scale is proposed (Table 9) that is compatible with the proposed

Table 9 Employee's Stress Resistance Coefficient (I_{SR})

No	Index of Employee's Stress Resistance	Indication	Description	Score
1.	High stress resistance	I_{SR1}	The employee can quickly adapt himself/herself and get out of the stress condition	0.1
2.		I_{SR2}		0.2
3.		I_{SR3}		0.3
4.	Medium stress resistance	I_{SR4}	The employee does not adapt himself/herself quickly and comes out of the stress condition with some effort	0.4
5.		I_{SR5}		0.5
6.		I_{SR6}		0.6
7.	Low stress resistance	I_{SR7}	The employee does not adapt himself/herself and comes out of the stress condition with some difficulties	0.7
8.		I_{SR8}		0.8
9.		I_{SR9}		0.9
10.	Absent stress resistance	I_{SR10}	The employee does not adapt himself/herself and does not get out of stress condition	1.0

approach to assessing PSR. Description of stress resistance coefficients is made in accordance with the data described in the studies of physiological recovery after experienced stressful situation based on the analysis of electrocardiography, electromyography, electrocutaneous activity and respiration to assess the physiological characteristics of stress resistance.^{86–88} It is proposed to set a scale for determining the coefficient of the employee's physical health condition from the medical history of employees or from determining their physical activity.⁸⁹ In this case, the scale is based on the assessment of a person's cardio fitness from 0.1 to 1, where 0.1 characterizes poor health, and 1 – good physical condition (Table 10). The approach described in⁹⁰ can also be used.

In the *fifth step*, assess the PSRs in accordance with the risk matrix (Table 5) as *acceptable*, *acceptable with control*, or *not acceptable*. Risk acceptance criteria for each organization are determined based on the well-known ALARP approach (that is, as low as is practicable).⁹¹

Table 10 Employee's Physical Health Condition Coefficient (I_{HC})

No	Employee's Health Condition	Indication	Description	Score
1.	High	I_{HC1}	The employee does not have significant health problems	1.0
2.		I_{HC2}		0.9
3.		I_{HC3}		0.8
4.	Medium	I_{HC4}	The employee has significant health problems	0.7
5.		I_{HC5}		0.6
6.		I_{HC6}		0.5
7.	Low	I_{HC7}	The employee has poor health, chronic diseases	0.4
8.		I_{HC8}		0.3
9.		I_{HC9}		0.2
10.	Absent	I_{HC10}	The employee is constantly ill and has significant health problems	0.1

In the *sixth step*, determine the actions to control the total PSR, if the risk is determined to be acceptable with control. To do this, additional and unscheduled conversations, surveys, etc. are conducted with employees to determine whether they experience stress, how often, and of what intensity and duration, and primarily with employees with low stress resistance and health condition.

The *seventh step* is the processing of psychosocial risk, where precautionary and protective measures are determined to reduce the probability, intensity and duration of stress experience. For this purpose, a plan is developed to reduce dangerous psychosocial factors (Table 11), which includes the following:

1) precautionary and protective measures to prevent or reduce the frequency, intensity, and duration of stress experience through additional breaks, changes in technology, equipment, workplace, use of fitness trackers, etc.^{92,93} (first level);

2) training employees to cope with the stress experience (meditation, mindfulness, cognitive-behavioral therapy^{94,95}), to increase stress resistance (mobile applications are used to implement this approach⁹⁶) (second level);

3) measures to restore the health level of employees affected by stress experience and their adaptation to work, as well as providing the necessary services and resources to support them at the initial stage of returning to the workplace^{97,98} (third level).

To provide support to employees at the initial stage of returning to the workplace, it is necessary to determine the risk of their health recovery. This is due to the continued experience of negative effects of the disease (including pain, fatigue, and bad mood) after the main treatment.^{53,97–99}

Taking into account changes in the psychosocial risk level from the initial level to an unacceptable level, which caused the employee's disease and partial recovery of his/her health, it is necessary to take into account changes in the stress resistance coefficient – I_{SR} and the employee's health condition – I_{HC} , which are not fully restored after stress-related diseases. This means that such employees will have a relatively high initial psychosocial risk level (Figure 5). When such employees experience a stressful event, they are more likely to exceed the acceptable risk level. This leads to a relapse of the disease. Therefore, such employees need to be given more attention when returning to work and providing support during work.

To calculate the risk of health recovery, we propose to replace the health condition coefficient I_{HC} in formula 3 with the employee's health recovery rate (I_{RC}):

$$R_i = Pr_i \times IC_i \times DE_i \times I_{SR} \times I_{RC}.$$

To determine the health recovery rate, we suggest using the Self-Assessment Revised Version (RSA-R) recovery scale developed by the Yale School of Medicine.^{20,100} Its authors note that it will be useful for developing plans to improve care for people recovering from mental diseases. The questionnaire consists of 32 questions to which the person answers. Each answer is rated on a scale of 1 to 5.²⁰ A higher score means that the person's health is recovered.^{20,101}

The health recovery rate values are given in Table 12.

In the *eighth step*, document all the information received on the identification of psychosocial risks, for example, according to the proposed form (Table 13).

In the *ninth step*, the organization's management approves a register of psychosocial risks and precautionary measures to reduce their impact on employees. We also develop a plan to monitor the effectiveness of measures to reduce psychosocial risk level with appropriate deadlines and necessary resources. In the last step, it is planned to review the

Table 11 An Example of a Plan to Reduce Dangerous Psychosocial Factors

No	Dangerous Psychosocial Factor	Measure to Control, Reduce and Eliminate the Risk	Execution Period	Resources	Responsible Person
I	A dangerous psychosocial factor is identified	A measure of control is described	The information about execution period is stated	Main financial resources are described	The surname of the responsible person is stated

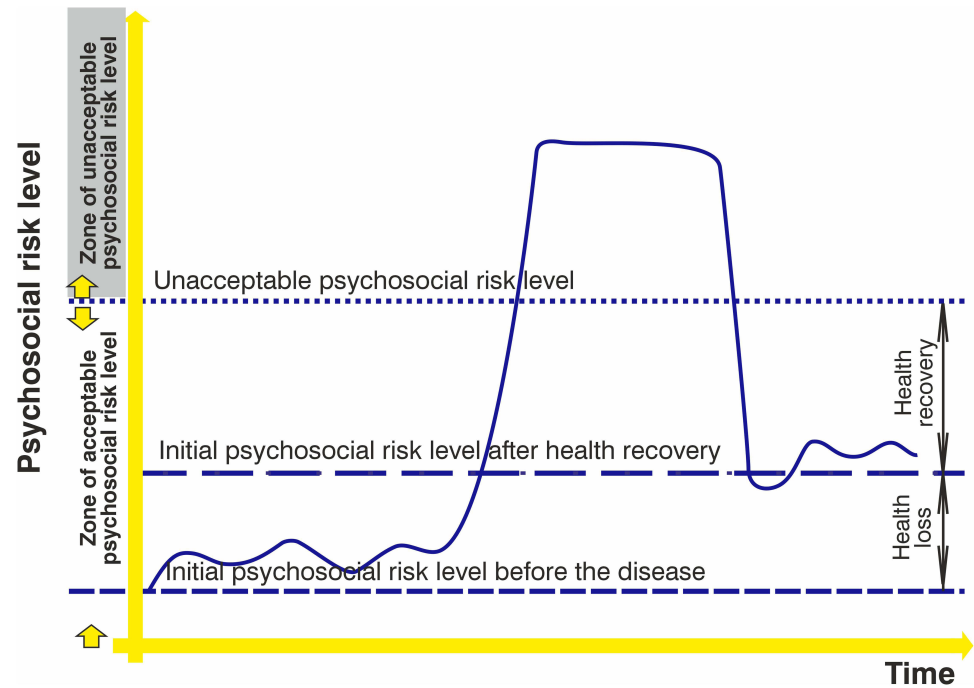


Figure 5 Diagram of the change in the psychosocial risk level that an employee may experience in a certain time period: from the initial PSR level to the occurrence of an unacceptable level, which led to the disease; in case of partial health recovery, with increase in the initial PSR level.

register of dangerous psychosocial factors and the effectiveness of measures to control them, or in case of changes in production activities at least once a year: new products or services; modernization, reconstruction, changes in equipment or processes; conditions of martial law, etc.

Table 12 Employee's Health Recovery Rate (I_{RC})

No	Level of Health Recovery after Experienced Stress	Number of Scores by the Recovery Self-Assessment Revised Version (RSA-R) test	Coefficient Characterizing Recovery Level
1.	Fully recovered	140–160	1
2.	Above average recovery rate	110–140	1.25
3.	Average recovery rate	80–110	1.5
4.	Low recovery rate	50–80	1.75
5.	Initial recovery rate	to 50	2

Table 13 Form for PSR Management Report

Identification of psychosocial risk components	Danger	Stress
	Dangerous event	Stressful situation occurrence
	Consequences	Psychological disease
	Dangerous factors	Identified according to the questionnaire

(Continued)

Table 13 (Continued).

Determining the risk level and its components	Probability of stress		Determined by the scale
	Severity of consequences	Duration of exposure	
		Intensity of exposure	
	Initial risk level		Calculated by the formula
Risk assessment			Acceptable/unacceptable
Measures to reduce the risk level	First level		Described in accordance with the prescribed level of compliance with justification of financial feasibility and appropriateness
	Second level		
	Third level		
Final risk assessment			Acceptable/unacceptable

Discussion

Management of PSRs is one of the main challenges in the field of occupational safety due to their potential impact on stress related to occupational safety, health protection and well-being of employees in the workplace.¹⁰² The need to create a process for managing PSRs will also allow managers of organizations to respond quickly to changes in technology, equipment or the organization of the production process.^{7,24,103} It is also important, in order to achieve effectiveness, that the process of managing the PSRs is integrated with other processes that already operate in organizations.¹⁰⁴ Therefore, the proposal to use a model for assessing the PSRs based on the bow-tie method will allow combining the procedures for assessing different types of risks in the occupational safety and health management system of employees, since it is most often used in organizations.^{13,16,105} It is clear that whatever the nature of precautionary and protective measures developed to reduce the risks of stress in the workplace, they should be evidence-based, adaptable to existing workplaces, comprehensive and timely. The implementation of measures should be well planned and resourced and involve those affected or potentially affected by stress.

The management of PSRs has certain peculiarities that are associated with an additional assessment of the risk level of an employee's health recovery. This will ensure a quick employee's health recovery, reducing the impact of various dangerous factors that are somehow present in the workplace.²³ At the same time, there is a need to improve the process of managing the PSRs by developing appropriate procedures: identifying dangerous psychosocial factors, assessing individual stress resistance, etc. In this case, it is important to use the existing theory of stress,¹⁰⁶ as well as tested empirical relationships between the development of diseases and the level of stress experience, to ensure the reliability of PSR assessment.

The proposed process of PSR management involves time control and type of dangerous psychosocial factors. This allows you to find out the level of stress impact on a person's health condition. It will also help to determine the effectiveness of the measures: whether the threat has actually been reduced. Time control involves long-term monitoring of exposure to dangerous psychosocial factors in order to record different variations and compare them with real health complaints,^{103,107} thereby minimizing subjective assessments, such as short-term biases in responses due to mood or recall of previous responses.

In addition, to increase the reliability of the described process of managing PSRs, it is necessary to constantly monitor the conditions of the working environment in which employees perform their duties in order to better understand the influence of certain types of dangerous psychosocial factors.

This research has identified and reviewed three main groups of precautionary measures that meet the specified criteria for reducing stress exposure. The research classified the measures into those that had an organizational, systemic and individual focus. Focusing on only one direction will not allow achieving the desired result.¹⁰⁸

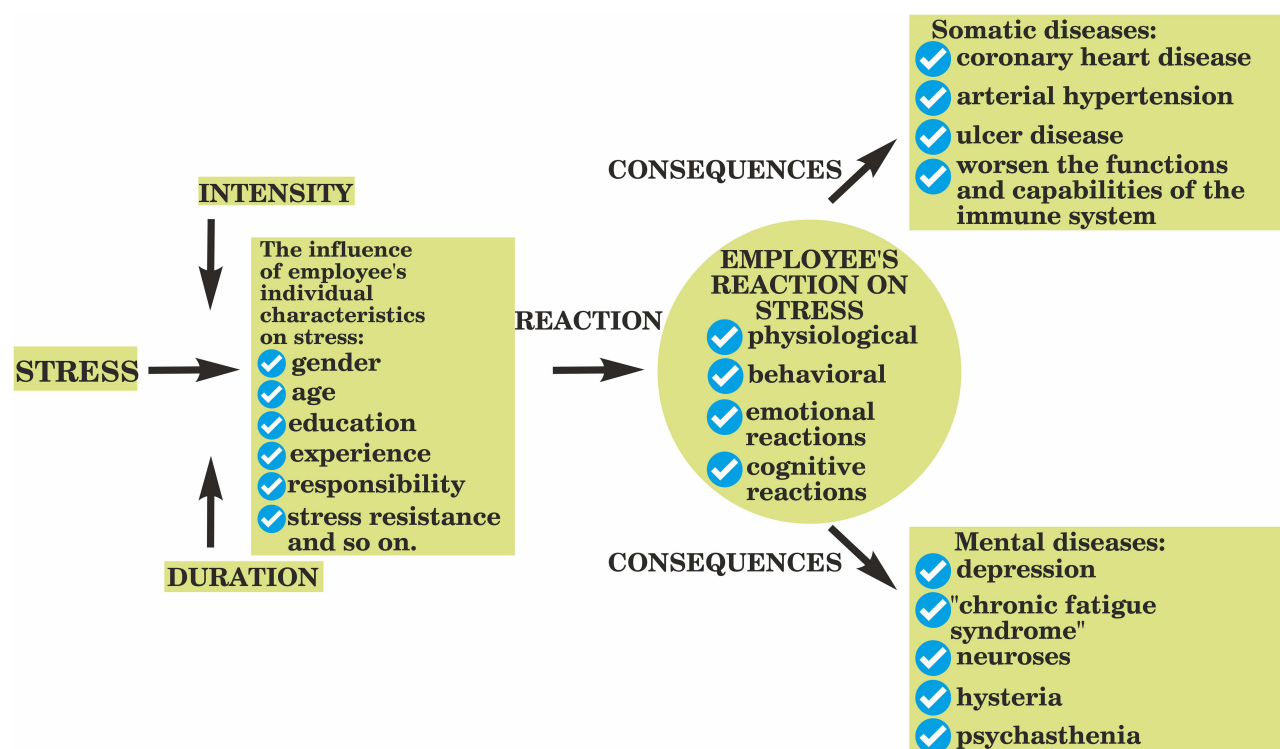


Figure 6 Model of the cause-and-effect chain “source of stress – stress – individual characteristics of the employee’s perception of stress – stress response – stress response consequences”.

Work-related stress is closely related to the way work is planned, managed and organized. In the literature, several sources of stress are often distinguished (often referred to as “psychosocial dangers”):² they include work-related stressors, organizational roles, work relationships, career development, organizational structure and team psychological climate. The stress process can be generalized through sources of stress, stress responses, long-term consequences of stress and individual characteristics of employees, as well as their interrelationships (Figure 6).

A growing body of evidence suggests that when stress responses last for a long period of time, it can lead to more persistent, less reversible health consequences: such as chronic fatigue, exhaustion, musculoskeletal problems, or cardiovascular diseases. Individual characteristics, such as personality, values, goals, age, gender, education level and family situation, can influence a person’s ability to cope. These characteristics can either enhance or mitigate the effects of risk factors in the workplace and, in turn, stress experience. In particular, an inadequate psychosocial working environment that influences productivity and, moreover, the health of the organization: namely, job satisfaction, morale, productivity, turnover, absence, presentability and organizational commitment.

Conclusions

The bow-tie method model has been improved to determine the relationship between psychosocial danger – stress and the dangerous event occurrence – experiencing stress by an employee, taking into account the influence of various dangerous psychosocial factors, which provides for an additional assessment of the psychosocial risk level for recovering the health of an employee who has experienced stress.

A psychosocial risk management process consisting of ten steps is proposed, which involves determining the relationship between psychosocial danger and human health consequences, taking into account the influence of various psychosocial dangerous factors using questionnaires, followed by analysis and study of the duration and intensity of stress experience.

It is proposed to determine the psychosocial risk level as the sum of the risk values from the influence of each dangerous psychosocial factor, which are characteristic of the following groups of dangerous factors: aspects of work organization, social conditions in the workplace, working environment, equipment, dangerous tasks and the employee's health level.

To reduce the impact of subjective assessments of the duration and intensity of stress experience on the psychosocial risk level, it is proposed to take into account the value of individual perception of stress experience (stress resistance) and the employees' health condition.

Scales for assessing the impact of dangerous psychosocial factors and a form for documenting the process of managing psychosocial risks with the indication of precautionary measures to control them are proposed.

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