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A methodological approach to risk management in industrial companies

Liliya Damyanova*, Elitsa Tasseva

University of Chemical Technology and Metallurgy, 8 Kl. Ohridski, 1756 Sofia, Bulgaria

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ABSTRACT

Risk management is one of the most important aspects of company's management in a market economy. The anticipation of the potential risks and their approximate estimation, as well as the development of an adequate security program minimizes the potential damage to the company.

The article offers a methodological approach to risk management in industrial companies discussing the nature, functions and methods of risk management in the company, presenting a risk management model, developing scales for measuring the likelihood of hazards, consequences and risk level, and proposing an approach based on a method for risk mapping which is applied to the company's personnel and property, as well as to the environment. Recommendations are made to enable a successful risk management process at the industrial company.

Keywords: risk, risk management, methods for risk assessment, methods for risk management, security program.

INTRODUCTION

The risk is a constant companion of any business activity in today's dynamic economic, political and social environment. The market economy, the globalization, the competition ramp-up, the financial and economic crises create risks for businesses every single day and hour putting the risk management at the heart of modern management.

EXPLANATION

1. NATURE AND FEATURES OF RISK MANAGEMENT. A RISK MANAGEMENT MODEL

Risk management is a set of methods, approaches and activities that enable us to forecast risky situations and take measures to neutralize or minimize the adverse impact of such events. Finding a course of action that ensures an optimal

** Correspondence to: Liliya Damyanova , University of Chemical Technology and Metallurgy, 8 Kl. Ohridski, 1756 Sofia, Bulgaria, E-mail: lilia_damianova@abv.bg*

ratio of losses to gains for a company resulting from the occurrence of a risk event is a major risk management concern for every manager.

Risk management is a process that involves several steps. Currently, there is no consensus among researchers and they advance different structural models [1 - 7]. We suggest the one comprising four steps connected to each other by forward and reverse links (Fig. 1).

This model is sufficiently versatile and invariant regardless of the nature of the system investigated. The first step includes risk identification and analysis. Identifying risk is associated with identifying specific sources of hazards. It includes the study of risk circumstances that adversely affect the normal operation of the company. As extremely large number and diverse types of risks are established during the risk identification step, these risks should be analyzed to see which one have a distinct impact on the business and have the largest negative effects, and hence to focus on them. This is the purpose of a risk assessment – to assess the frequency of occurrence of each risk event and forecast the damage. Multiplying

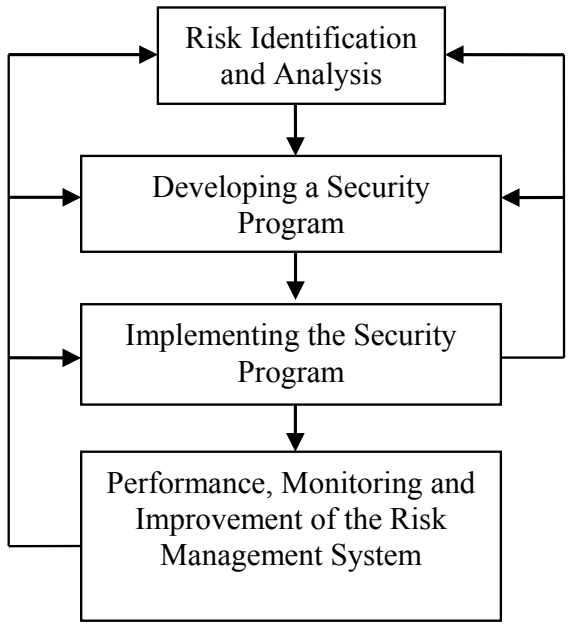

Fig. 1. Model of the risk management process at the company.

the amount of damage by the probability (or frequency) of risk event occurrence provides the basis for determining the risk level. Various quantitative and qualitative methods are used for risk assessment – brainstorming, Delphi, HAZOP (HAZard and OPerability studies), LOPA (Level of Protection Analysis), FMEA (Failure Modes, Effects Analysis), graphical methods (Fault Tree Analysis, Event Tree Analysis, Failure Tree Analysis), statistical methods, Risk Assessment Checklists, imitative modeling, etc. [8-19]. Risks are ranked based on the risk level ratings and a security program is developed for the most important risks.

Developing an adequate security program is the next step of the risk management process. The program should include various activities that have an impact on the different types of risks the company is exposed to. These activities can generally be divided into two main groups: 1) Preventive activities – these are aimed at preventing or reducing risks, such as providing safety training and induction to staff; fire safety activities and training for personal protection, and fire protection of buildings and facilities; enhanced security, anti-theft alarm systems, video surveillance systems, etc.; message control systems, etc.; Risk reduction can be achieved through a combination of approaches: by collecting more information and providing a more accurate estimate of the risk; by limiting – setting ceilings for expenses, credit, etc.; by redundancy (having more than one of a particular asset exposed to risks); by providing guarantees of transactions; and especially through diversification – allocating investments among various assets and activities that are not related to each other; 2) Risk financing methods – these are compensatory measures to cover damages after damage occurrence. We can distinguish between two types of measures: a) Covering the damages with own resources, incl. from the current cash flows; by creating reserve funds; by taking a credit; by establish-

ing own insurance company (captive insurance); b) Transferring the risk – in this case the responsibility for risk impacts is transferred to a third party. This is usually done through insurance, which can be used to transfer the risk to an insurance company [4,20]. Mutual insurance can also be used by establishing a mutual insurance fund (company) made up of legal entities that operate in the same sphere of activity. Risk hedging also belongs to this group of measures – it is a way of transferring the risk and may involve giving up potential profit. A basic requirement to follow when developing a security program is to observe the principle: the total cost of preventive measures and costs to cover damages should be less than losses that would be incurred if no security program were implemented.

The third step contemplates the implementation of the developed security program. The necessary financial resources must be provided to carry out the activities planned, to set due dates and persons responsible for the various activities, and to mobilize and coordinate the efforts of all staff members.

The last step refers to the control over the implementation of the security program, the introduction of any adjustments to it, as well as to drawing conclusions on how effective the company's risk management system is and making suggestions for its improvement.

The risk management in industrial companies should be consistent with the following principles set out in International Standard ISO 31000: 2009 [21, 22]:

1. Risk management should create a value;

2. Risk management should be an integral part of organizational processes;

3. Risk management should be a part of the decision-making process;

4. Risk management should explicitly address uncertainty;

5. Risk management should be a systematic and structured process;

6. Risk management should use the best available information;

7. Risk management should be tailored to the specific site;

8. Risk management should consider the human factor;

9. Risk management should be transparent and comprehensive;

10. Risk management should be a dynamic, iterative process (repeated many times), always ready for changes;

11. Risk management should be susceptible to continuous improvement and capacity enhancement.

These principles are universal – they can be used by any public, private or community enterprise, association, group or individual. ISO 31000: 2009 is not specific to any industry or sector and can be applied throughout the life of an organization, and to a wide range of activities, including strategies and decisions, operations, processes, functions, projects, products, services and assets. It can be applied to any type of risk, whatever its nature or consequences.

2. RISK MANAGEMENT APPROACH IN INDUSTRIAL COMPANIES

General safety instructions based on industry standards need to be applied to ensure effective risk management in industrial companies. More specifically, their purpose is refers to:

- Prevention of accidents and occupational diseases;
- Prevention of a damage to the company property;
- Elimination or minimizaion of the risks in the company.
- Personal protective equipment should be used to reduce individual risk to each employee – hard hats, ear protection, safety glasses, gloves, etc. All incidents should be reported to the line supervisor.

The essence of the proposed risk management

approach refers to the preparation of risk maps for the company's personnel and property, as well as for the environment. Various risk maps can be applied using different scales (three-, four-, five-step scales, etc.). However, the general principle is as follows: expert assessments made on the ground of scales prepared beforehand are used to estimate the hazard likelihood and consequences, and then the risk level is defined as the product of these two indicators. Risk Likelihood/Consequences Scales are presented in Table 1.

Based on the above, all possible likelyhood-consequences combinations are made and a risk rating is assigned to each of them. Table 2 below shows thirty (30) possible combinations and their corresponding risk ratings measured using a five-step scale: very low, low, moderate, high, critical.

Qualitative risk assessments should be quantified in order to avoid differences in their application. For example, a qualitative scale for measuring likelihoood can be quantified as shown in Table 3.

The quality scales for the consequences (damage) should be quantified separately for the company's personnel, assets or the environment as their nature is different. The consequences for the personnel can be measured by the degree and duration of the disability resulting from the risk factors. For example, the qualitative scale for the consequences for the personnel can be quantified as shown in Table 4.

Table 1. Scales for Measuring Likelihood/Con-

Likelihood	Consequences
A-Very unlikely	**1-**Minor
B-Unlikely	**2-**Small
C-Possibly	**3-**Medium
D-Likely	**4-**Big
E-Very likely	**5-**Critical
	6-Catastrophic

Risk assessment checklists can be prepared for each job position using these scales. They should include all possible hazards, the adverse events that these hazards may trigger, the specific risk level, the ongoing control and residual risk level, the recommended risk mitigation measures with due dates and responsible persons, as well as the final risk level (Table 5).

Different types of risks are associated with different job positions. Risks are more likely to happen at lower hierarchical levels. Such risks have a greater probability of happening and more severe consequences. A higher priority is assigned to physical risks at these levels since they can lead to occupational accidents and diseases. The lower hierarchical levels are exposed to significant risks, and therefore require a periodic risk assessment. The latter frequency is regulated by Regulation No.5 dated 11.05.1999 [23].

Risk assessment checklists can be likewise drawn up for any type of company assets:

- Tangible fixed assets - buildings, plant and equipment, vehicles, tools and equipment;
- Current assets - raw materials, materials, tools, work in progress, inventories, etc.;
- Financial assets - shares, stocks, government securities, bonds, and other financial assets, receivables, investments, cash;
- Intangible assets - development products, know-how, software products, patents, corporate and trademarks, license rights, concession rights, etc.

Each of the above types of assets is exposed to specific risks. For example, buildings, plant and equipment are exposed to risks of industrial accidents, fire, earthquakes, floods, theft, and damage due to improper use. Inventories of finished goods, raw materials and materials are exposed to risks of theft, damage due to storage under inappropriate conditions, fire, flood, etc. Financial assets are exposed to financial risks – currency risks, liquidity risks, inflation risks, credit risks,

Table 2. Risk Level Determination.

Consequences	Likelihood	Combination	Risk Level
1-Minor	**A-**Very unlikely	**1A**	**Very low**
1-Minor	**B-**Unlikely	**1B**	**Low**
1-Minor	**C-**Possibly	**1C**	**Low**
1-Minor	**D-**Likely	**1D**	**Low**
1-Minor	**E-**Very likely	**1E**	**Low**
2-Small	**A-**Very unlikely	**2A**	**Very low**
2-Small	**B-**Unlikely	**2B**	**Low**
2-Small	**C-**Possibly	**2C**	**Low**
2-Small	**D-**Likely	**2D**	**Moderate**
2-Small	**E-**Very likely	**2E**	**Moderate**
3-Medium	**A-**Very unlikely	**3A**	**Low**
3-Medium	**B-**Unlikely	**3B**	**Low**
3-Medium	**C-**Possibly	**3C**	**Moderate**
3-Medium	**D-**Likely	**3D**	**Moderate**
3-Medium	**E-**Very likely	**3E**	**High**
4-Big	**A-**Very unlikely	**4A**	**Low**
4-Big	**B-**Unlikely	**4B**	**Moderate**
4-Big	**C-**Possibly	**4C**	**High**
4-Big	**D-**Likely	**4D**	**High**
4-Big	**E-**Very likely	**4E**	**Critical**
5-Critical	**A-**Very unlikely	**5A**	**Moderate**
5-Critical	**B-**Unlikely	**5B**	**Moderate**
5-Critical	**C-**Possibly	**5C**	**High**
5-Critical	**D-**Likely	**5D**	**Critical**
5-Critical	**E-**Very likely	**5E**	**Critical**
6-Catastrophic	**A-**Very unlikely	**6A**	**Low**
6-Catastrophic	**B-**Unlikely	**6B**	**Moderate**
6-Catastrophic	**C-**Possibly	**6C**	**High**
6-Catastrophic	**D-**Likely	**6D**	**Critical**
6-Catastrophic	**E-**Very likely	**6E**	**Critical**

Table 3. Quantification of the qualitative scale of likelihood.

Likelihood Qualitative scale	Likelihood Quantitative scale
A-Very unlikely	Up to 5%
B-Unlikely	5 to 15%
C-Possibly	15 to 55%
D-Likely	55 to 80%
E-Very likely	80 to 100%

Table 4. Quantification of the qualitative scale for the consequences for the personnel.

Consequences Qualitative scale	Consequences Qualitative-quantitative scale
1-Minor	An accident without physical injury or an injury without absence from work
2-Small	Temporary incapacity to work of one person
3-Medium	Permanent slightly reduced capacity to work of one person or temporary incapacity to work affecting more people
4-Big	Permanent total incapacity to work of one person or significantly reduced capacity to work affecting more people
5-Critical	Death of one person or total incapacity to work affecting more people
6-Catastrophic	Death of more than one person

exchange risks, bankruptcy risks, etc.

A risk map should be prepared for each type of assets identifying the specific risks in order to assess the original risk level, to envisage the mitigation measures, to assess the residual risk level, and if the latter is not low enough – to provide for additional mitigation measures (Table 6). Since 'minor' and 'major' consequences (damage) means different things for different companies, depending primarily on the company size, the turnover and profits, the value of the assets, it will be appropriate to consider the consequences as a percentage of the company's profit, of the assets value or of the turnover when quantifying the qualitative scale for the consequences in respect to the company's assets (Table 7).

Then the final risk has to be assessed, while the compensatory measures have to be envisaged if the potential damage is unacceptable for the company. Whether losses will be covered with own funds or through insurance depends on the final risk level and the company's financial capabilities. This has to be decided by the company management.

The following insurance policies are often used to cover losses and mitigate risk consequences:

- Fire or other hazard insurance policy;
- Accident policy for persons in motor vehicles;
- Life insurance policy;
- Third party car insurance policy;
- Casco Plus insurance policy.

Insurance is not applicable to financial assets – specific risk mitigation methods are used instead. Hedging is used most often – it is a risk-transfer method which provides risk mitigation at the cost of forgoing profits. The goal of the hedging party is to lower the existing risk posed by the market uncertainty. This is accomplished through fixed-term contracts. The risk does not disappear, but is transferred instead to other persons – most often to stock speculators.

Derivatives (derivative financial instruments) occupy a central place in hedging. They are financial instruments whose value is payable at a future date. Their value may change in response to changes of a specified interest rate, an exchange rate, a commodity price, a security price or a rating index, a credit rating or a credit index, or any

Table 5. Exemplary risk assessment checklist for a manager's job position at an industrial company (Continued).

Company name Address (principal place of business)		EMPLOYEE RISK ASSESSMENT CHECKLIST No.		Prepared by:									
Job Position	Manager			Approved by:									
Date		NCO Code -											
RISK REDUCTION PLAN													
Assessment of initial risk					Specific Risk			Residual Risk			Final Risk		
Hazard	Adverse Event	Existing Controls	Responsible Person	Due Date	Consequences (1)	Likelihood (1)	Initial risk level (1)	Consequences (2)	Likelihood (2)	Residual risk level (2)	Recommended measures (Improving existing controls/ Implementing new measures	Responsible Person	Due Date	Consequences (3)	Likelihood (3)	Final risk level (3)
1.Occupational stress	Damage to the central nervous system, autonomic nervous system, cardiovascular system, digestive system, high neurological morbidity	1. Identify and control stress factors; 2. Set priorities; 3. Set sub-targets; 4. Delegate authorities; 5. Avoid conflicting situations by involving subordinated personnel in the decision-making process and management by objectives; 6. Rotation of activities; 7. Avoid deadlines that are difficult to meet;			4-Big	E-Very likely	Critical	3-Medium	C-Possibly	Medium				3-Medium	B-Unlikely	Low
2. Activities demanding attention (Working with a computer)	Overexertion; decreased alertness; errors, omissions, stress.	1. Provide suitable lighting fixtures; 2. Provide computer glasses; 3. Rest breaks; 4. Clear presentation of information			3-Medium	D-Likely	Medium	3-Medium	C-Possibly	Medium				2-Small	C-Possibly	Low

Table 5. Exemplary risk assessment checklist for a manager's job position at an industrial company (Continued).

3. Injury from moving machines, transport vehicles or parts thereof	Mechanical injuries	4-Big	C-Possibly	High	1. Company transport provided. 2. Testing for alcohol upon entering the Company site – every work shift; 3. Speed restriction barriers installed in traffic areas on the company site; 4. Placing speed restriction signs; 5. Providing wide enough roads for vehicle, and separating pedestrian from vehicle traffic 6. First aid and self help training for the personnel;	Low	B-Unlikely	3-Medium			Low
4. Falling or flying objects, materials, parts, components, etc. */When supervising processing operations/*	Mechanical injuries	3-Medium	C-Possibly	Medium	1. Protective covers and guards to protect all rotating parts; 2. PPEs – safety glasses, hard hat, steel-capped boots, workwear; 3. Safe Work Instructions (Mill Plant); 4. Available crane operation safety rules.	M	Unlimited	2--Small	Control on the use of PPEs	M	Low	B-Unlikely	Very Low
5. Collision, impact, slipping and falls from one level to another	Mechanical injuries	3-Medium	C-Possibly	Medium	1. Suitable steel lattice platforms free from accumulation of waste material; 2. Use of signal colors to warn against collisions and falls; 3. PPE – hard hat;			2-Small			Low	B-Unlikely	A-Very unlikely
6. Electric shock caused by indirect contact	Electric shock injury or death	3-Medium	C-Possibly	Medium	1. Protective grounding; 2. Zeroing; 3. First aid equipment; 4. First aid induction training; 5. Annual electrical safety training; 6. Annual measurements of the external earth fault loop impedence, and resistance of grounding and lightning protection systems;	E; M	Unlimited	2-Small	1. Annual review of measurement results; 2. Control on the compliance with the Safe Work Induction;	E; M	Low	B-Unlikely	Very low

Table 5. Exemplary risk assessment checklist for a manager's job position at an industrial company.

7. Fire /Emergency situations	Burns and suffocation	4-Big	C-Possibly	High	1. Protection of electrical equipment; 2. Safety devices and emergency buttons; 3. Dry powder extinguishers available in each work area. 4. Available and designated emergency exits;	M	Unlimited	2-Small	B-Unlimited	Low	1.Annual emergency situation drill - fire.	M	Unlimited	2-Small	A-Very unlikely	Very low
8.Microclimate	Damage to health – respiratory diseases	2-Small	C-Possibly	Low	1. Flu immunization provided. 2. Special workwear for the cold period of the year;			2-Small	B-Unlikely	Low				2-Small	A-Very	Very low
9. Noise (dB) /During visits in production areas/	Noise-induced hearing damage	3-Medium	B-Unlikely	Low	1. PPE - earmuffs; 2. Noise proof cabs of mining plant; 3. Noise proof rooms for the employees	M	Unlimited	2-Small	B-Unlikely	Low	1. Control on the use of PPEs	M	Unlimited	2-Small	A-Very unlikely	Very low
10.Illumination: (lx)	Increased risk of incidents due to inadequate lighting, visual fatigue due to the surrounding illumination, non-compliance with the sanitary and hygienic standards	2-Small	C-Possibly	Low	1. Lighting levels comply with the standards;			2-Small	B-Unlikely	Low				2-Small	B-Unlikely	Low
11. PPEs (Lack or ineffective PPEs)	Mechanical injuries and occupational diseases	3-Medium	C-Possibly	Medium	1. PPEs provided; 2. Internal rules for the procurement of PPEs;	M	Unlimited	2-Small	B-Unlikely	Low	1. Control on the use of PPEs	M	Unlimited	2-Small	A-Very unlikely	Very low

Table 6. Exemplary risk assessment checklist for assessing risks posed to company property (Continued).

Company name Address (principal place of business)	*RISK ASSESSMENT CHECKLIST FOR ASSESSING RISKS POSED TO COMPANY PROPERTY*	Prepared by:						
Date		Approved by:						
Type of assets	Tangible fixed assets							
Assessment of initial risk		RISK REDUCTION PLAN						
	Specific Risk				Residual Risk		Final Risk	
Hazard	Adverse Event	Existing Controls	Responsible Person	Due Date	Recommended measures (Improving existing controls/ Implementing new measures	Responsible Person	Due Date	
1. Industrial accident	Damage or destruction of property	1. Observance of technological discipline 2. Providing mandatory breaks for the personnel 3. Periodic monitoring of the technical condition of the plant and equipment 4. Performance of scheduled and unscheduled repairs						
	Consequences (1)	4-Big			Consequences (2)	3-Medium	Consequences (3)	2-Small
	Likelihood (1)	C-Possibly			Likelihood (2)	B-Unlikely	Likelihood (3)	B-Unlikely
	Initial risk level (1)	High			Residual risk level (2)	Low	Final risk level (3)	Low

Table 6. Exemplary risk assessment checklist for assessing risks posed to company property.

2. Fire	Damage or destruction of property	4-Big	C-Possibly	High	1. Induction of personnel to fire protection requirements 2. Control on the compliance with the fire protection requirements 3. Taking emergency measures to limit fire spread and development	M	Unlimited	2-Small	B-Unlikely	Low		M	Unlimited	2-Small	A-Very unlikely	Very low
3. Theft	Loss of property	4-Big	C-Possibly	High	1. Provision of security services and installation of security systems. 2. Checking upon exiting the company site. 3.Protection of intellectual property by patents and licences.			2-Small	B-Unlikely	Low				2-Small	A-Very unlikely	Very low
4. Flood	Damage or destruction of property	4-Big	C-Possibly	High	1. Cleaning riverbeds 2. Building protective dikes	M	Unlimited	2-Small	B-Unlikely	Low		M	Unlimited	2-Small	A-Very unlikely	Very low
5. Earthquake	Damage or destruction of property	**6-**Catastrophic	C-Possibly	High	1.Additional strengthening of building structures 2. Anti-earthquake construction 3. Stable installation of plant and equipment 4. Inducting personnel on how to respond to emergency situations	M	Unlimited	3-Medium	B-Unlikely	Low		M	Unlimited	2-Small	B-Unlikely	Low

other base variable, i.e. their value is derived from an asset value. Derivative financial instruments give one party the right to exchange financial assets or financial liabilities with another party under conditions set in the derivative instrument. These conditions may become either favorable or unfavorable in the future with price changes of the financial markets. The most common financial instruments of this kind are futures/ forwards, swaps and options.

The environment is also exposed to risks posed by industrial activities. Many industrial production processes pollute the environment by releasing emissions of gases, heavy metals (Pb, Cd, Hg) content in suspended particulate matter, emissions from cement production, aerosols, wastewater, etc. Many of these substances are toxic, mutagenic and carcinogenic, affecting both human and animal health and degrading the overall quality of the natural environment. Among the most toxic substances are the compounds of mercury, lead, cadmium, chlorine, fluorine, cobalt, as well as hydrogen sulfide, phenols, nitrogen oxides, methane, carbon monoxide and carbon dioxide, ammonia, etc. These substances accumulate in considerable amounts in the vicinity of large industrial complexes and individual companies. For example, sulfur dioxide emissions from the production of sulfuric acid and metallurgical treatment of sulphide containing ores is discharged into the atmosphere; carbon dioxide is discharged mostly from power plants; heavy metals content in suspended particulate matter is released from metallurgical processes; wastewater is discharged by the pulp and paper industry, leather and fur industry, production of nitrogen fertilizers, surfactants, petrochemical industry energy sector, etc. Threshold values for these substances in the air, soil and water have been established and have to be complied with. The consequences of the environmental pollution are extremely severe. Therefore, any industrial enterprise has to control the environmental risks and take measures to mitigate these risks. An assessment checklist for the environmental pollution risks posed by industrial activities is mandatory (Table 8). Mitigation measures should be taken after the initial risk of pollution is assessed and if it is found to exceed the permissible limits. Then the residual risk should be assessed. If it is still high, additional measures have to be taken to mitigate it. The environmental risk should be mitigated until the threshold values for harmful substances in the atmosphere, soil and water are complied with.

Table 7. Quantifying the qualitative scale for the consequences on the company's assets.

Consequences Qualitative assessments	Consequences Quantitative assessments
1-Minor	Up to 5 % of the turnover
2-Small	5 to 20 % of the turnover
3-Medium	20 to 50 % of the turnover
4-Big	50 to 70 % of the turnover
5-Critical	70 to 100 % of the turnover
6-Catastrophic	More than 100 % of the turnover

CONCLUSIONS

The essence of the proposed approach to risk management in industrial companies is the development of three categories of risk assesment checklists:

- For the company's personnel – by job positions/types of activities;
- For the company's assets – by types of assets;
- For the environment.

The initial risk will be assessed using these checklists based on expert assessments and using pre-designed qualitative scales for likelyhoood,

Table 8. Exemplary risk assessment checklist for assessing the risk of environmental pollution (Continued).

Company name Address (principal place of business)	ENVIRONMENTAL RISK ASSESSMENT CHECKLIST	Prepared by:										
Date		Approved by:										
		RISK REDUCTION PLAN										
		Assessment of initial risk										
			Specific Risk					Residual Risk			Final Risk	
Hazard	Adverse Event		Initial risk level (1)	Existing Controls	Responsible Person	Due Date		Residual risk level (2)	Likelihood (2)	Consequences (2)	Final risk level (3)	Likelihood (3)	Consequences (3)
1. Release of carbon dioxide emissions	Air pollution, harm to human health and ecosystems		High	1. Construction of treatment facilities; 2. Introduction of low-carbon technologies			Recommended measures (Improving existing controls/ Implementing new measures	Low	B-Unlikely	2-Small	Low	A-Very	3-Medium
			Likelihood (1)				Responsible Person						
			Consequences (1)				Due Date						
2. Release of sulfur dioxide emissions	Air pollution, harm to human health and ecosystems		High	Capture with suitable absorbents or adsorbents	M	Unlimited	M	Low	B-Unlikely	2-Small	Very low	A-Very unlikely	2-Small
			D-Likely				Unlimited						
			4-Big										

Table 8. Exemplary risk assessment checklist for assessing the risk of environmental pollution.

3. Release of nitrogen oxides emissions	Air pollution, harm to human health and ecosystems	4-Big	D-Likely	High	Capture with suitable absorbents or adsorbents		Low	B-Unlikely	2-Small		Very low	A-Very	2-Small			
4. Release of carbon oxide emissions	Air pollution, harm to human health and ecosystems	4-Big	D-Likely	High	Capture with suitable absorbents or adsorbents	M	Low	B-Unlikely	2-Small	Unlimited	Very low	A-Very unlikely	2-Small	Unlimited	M	
5. Release of heavy metal particulate matter emissions	Soil and air pollution, harm to human health and ecosystems	4-Big	D-Likely	High	Installing filters and capturing	M	Low	B-Unlikely	2-Small	Unlimited	Very low	A-Very	2-Small	Unlimited	M	
6. Release of particulate matter from cement production	Soil and air pollution, harm to human health and ecosystems	4-Big	D-Likely	High	Installing filters and capturing		Low	B-Unlikely	2-Small		Very low	A-Very	2-Small			
7. Release of fumes of harmful solvents	Air pollution, harm to human health and ecosystems	4-Big	D-Likely	High	Construction of treatment facilities	M	Low	B-Unlikely	2-Small	Unlimited	Very low	A-Very	2-Small	Unlimited	M	
8. Wastewater discharge	Water pollution, harm to human health and ecosystems	4-Big	D-Likely	High	Construction of water treatment plants		Low	B-Unlikely	2-Small		Very low	A-Very	2-Small			

consequences and risk level, which will be further quantified. A plan to reduce or eliminate the initial risk will be developed including a set of measures with assigned responsible persons, due dates and financial resources; the residual risk will be assessed and further mitigation measures taken if this risk is still not acceptable; the final risk will be assessed and measures taken in cases where the expected level is other than low or very low.

The following recommendations can be made for successful risk management in industrial companies:

• Conduction of continuous environmental monitoring, construction of additional treatment facilities, and implementation of low-carbon and non-waste technology;

• Creation of a new job position titled Risk Management Manager – he/she will coordinate the overall risk management process in the company, develop a security program and follow its implementation together with the supervisors at various levels throughout the organization;

• Introduction of a system for promoting all good achievements in the area of occupational health and safety, and imposition of penalties for serious violations of the safety rules;

• Holding regular meetings with the employees to discuss health and safety issues (working conditions, incidents and accidents), for discussing and recommending improvements of the workplace safety, and encouraging the employees to stay updated on current site safety issues. Maintaining and encouraging the employee participation in identification of the hazards and development of safety measures;

• Use of collective protective measures to reduce the need for personal protective equipment;

• Involving as many specialists and managers as possible in the risk management process.

• Agreement on the sources of information to be used and obtaining sufficient information. Ensuring the employees participation in the assessment of the work areas, diligent and accurate completion of surveys and questionnaires referring to the working conditions;

• Provision of complete records, including a risk assessment program with the corresponding manner, means, scope and level of its implementation, hazards identified, groups of employees and types of assets exposed to risk, assessment of risk elements, decisions based on the risk assessment, regulatory framework and information used, measurement data, observations, actions recommended and taken, and conditions for revision. Every aspect of the risk assessment needs to be recorded;

• Provision of a security program, which should be comprehensive, balanced, realistic and feasible.The leading criterion in determining risk management priorities in the company is to ensure employees health and safety. The risk reduction concept should not promote risk reduction at any cost, which sometimes may be too expensive, but rather reduce the risk to a reasonable, acceptable level that is also affordable for the company (price/benefit ratio). The program should include due dates and persons responsible, financial resources required. Regular monitoring of the program implementation, evaluation, opinions and additional recommendations during the program implementation, making any adjustments if necessary are also required.

Risk management in the industrial company should be consistent with the principles set out in International Standard ISO 31000:2009.

Risk management is part of the general management of the industrial company, therefore it should be closely linked to all other aspects of the company's management.

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